CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING
ENGINEERING AND CONSTRUCTION DIVISION

PROJECT MANUAL

KEEGAN'S BAYOU AND GREENRIDGE WASTEWATER TREATMENT PLANT IMPROVEMENTS

WBS NO. R-000265-0079-4

VOLUME NO. 1 OF 1

Divisions 00 through 16

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NOTE: Bold capitalized Specification Sections are included in the City of Houston Department of Public Works and Engineering Standard Construction Specifications for Wastewater Collection Systems, Water Lines, Storm Drainage, Street Paving, and Traffic located here: **http://documents.publicworks.houstontx.gov/document-center/cat_view/88-engineering-and-construction/92-specifications/208-division-02-16-standard-specifications.html**; and are incorporated in Project Manuals by reference as if copied verbatim. Documents listed "for filing" are to be provided by Bidder and are not included in this Project Manual unless indicated for example only. The Document numbers and titles hold places for actual documents to be submitted by Contractor during Bid, post-bid, or construction phase of the Project. Specification Sections marked with an asterisk (*) are amended by a supplemental specification, printed on blue paper and placed in front of the Specification it amends. Documents in the 200, 300 and 400 series of Division 00, except for Document 00410B – Bid Form, Part B, are not part of the Contract.

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Document 00015

Document 00042

DESIGNATED SUBCONTRACTORS AND SUPPLIERS

A. Subcontract work for the following Sections to firm(s) listed and for reason(s) stated below:

****
Edit following list. Ensure individual Sections include names of designated firms and the reason is stated here. Use the following sample format.
****

1. [Section 12610- Open Office Furniture; procurement and installation of Open Office Furniture. The City has an existing procurement/installation contract with the firm stated in Section 12610.]

END OF DOCUMENT

Document 00200

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Document 00200

INSTRUCTIONS TO BIDDERS

1.0 *RELATED DOCUMENTS*

A. Document 00210 – Supplementary Instructions to Bidders.

B. Document 00320 – Geotechnical Information.

C. Document 00330 – Existing Conditions.

D. Document 00410 – Bid Form, Parts A & B.

E. Document 00495 – Post-Bid Procedures.

F. Document 00520 – Agreement.

G. Document 00700 – General Conditions.

H. Document 00800 – Supplementary Conditions.

2.0 *DEFINITIONS*

A. Definitions set forth in Document 00700 – General Conditions and in other documents of Project Manual, are applicable to Bid Documents.

B. *Addendum:* Written or graphic instrument issued prior to Bid opening, which clarifies, modifies, corrects, or changes Bid Documents.

C. *Alternate:* The total amount bid for additions to work, as described in Section 01110 – Summary of Work. Each Alternate includes cost of effects on adjacent or related components, and Bidder's overhead and profit.

D. *Bid:* A complete and properly signed offer to perform the Work in accordance with this Document and Document 00210 – Supplementary Instructions to Bidders.

E. *Bid Date:* Date and time set for receipt of Bids as stated in Document 00210 – Supplementary Instructions to Bidders, or as modified by Addenda.

F. *Bid Documents:* Project Manual, Drawings, and Addenda.

G. *Bid Supplement: A* Bid submittal that is required in Document 00410 – Bid Form.

H. *Bidder:* Person or firm, identified in Document 00410B – Bid Form – Part B, including its successors, and its authorized representative.

I. *Code:* Code of Ordinances, Houston, Texas.

J. *Low Bidder:* Apparent successful Bidder that qualifies as a responsible Bidder and that submits Bid with lowest Total Bid Price.

K. *Project Manager:* Person designated in Document 00100 – Advertisement for Bids and Document 00220 – Request for Bid Information to represent the City during bidding and post-bid periods.

L. *Project Manual:* Volume assembled for the Work that includes the bidding requirements, sample forms, Conditions of the Contract, and Specifications.

M. *Security Deposit:* A certified check, cashier's check, or bid bond in the amount of 10 percent of the Total Bid Price.

N. *Total Bid Price:* Total amount bid for performing the Work as identified by Bidder in Document 00410B – Bid Form – Part B, which amount includes:

1. Stipulated Price;
2. Total Base Unit Prices;
3. Total Extra Unit Prices;
4. Total Cash Allowances; and
5. Total Alternates.

3.0 *NOTICE TO BIDDERS*

A. The City of Houston Fair Campaign Ordinance makes it unlawful for a Contractor to offer any contribution to a candidate for City elective office (including elected officers and officers-elect) during a certain period of time prior to and following the award of the Contract by the City Council. The term "Contractor" includes proprietors of proprietorships, all partners of partnerships, and all officers, directors, and holders of 10 percent or more of the outstanding shares of corporations. A statement disclosing the names and business addresses of each of those persons will be required to be submitted with each bid or proposal; for a City Contract. Bidder shall complete and submit Document 00452 – Form A, Contractor Submission List, City of Houston Fair Campaign Ordinance, with its Bid to comply with this requirement. See Chapter 18 of the Code for further information.

B. Chapter 15, Article VIII, of the City's Code provides that no contract shall be let, nor any other business transaction entered into, by the City with any person indebted to the City or a qualifying entity, if the contractor or transaction comes within the provisions of Section 15-1 (c) of the Code. Exceptions are provided in Section 15-126 of the Code. Bidder shall complete and submit Document 00455 – Affidavit of Ownership or Control, with its Bid to comply with this requirement.

C. Neither bidder(s) nor any person acting on bidder(s)'s behalf shall attempt to influence the outcome of the award by the offer, presentation or promise of gratuities, favors, or anything of value to any appointed or elected official or employee of the City of Houston, their families or staff members. All inquiries regarding the solicitation are to be directed to the designated City Representative identified on the first page of the solicitation. Upon issuance of the solicitation through the pre-award phase and up to the date the City Secretary publicly posts notice of any City Council agenda containing the applicable award, aside from bidder's formal response to the solicitation, through the pre-award phase, written requests for clarification during the period officially designated for such purpose by the City Representative, neither bidder(s) nor persons acting on their behalf shall communicate with any appointed or elected official or employee of the City of Houston, their families or staff through written or oral means in an attempt to persuade or influence the outcome of the award or to obtain or deliver information intended to or which could reasonably result in an advantage to any bidder. However, nothing in this paragraph shall prevent a bidder from making public statements to the City Council convened for a regularly scheduled session after the official selection has been made and placed on the City Council agenda for action, or to a City Council committee convened to discuss a recommendation regarding the solicitation.

4.0 *BID DOCUMENTS*

A. The Bid Documents may be obtained at location specified in Document 00210 – Supplementary Instructions to Bidders.

B. The Bid Documents are made available only for the purpose of bidding on the Work. Receipt of Bid Documents does not grant a license for other purposes.

C. On receipt of Bid Documents, Bidder shall verify that documents are legible and complete, compare contents of Project Manual with Document 00010 – Table of Contents, and compare Index of Drawings with Document 00015 – List of Drawings. Bidder shall notify Project Manager if Bid Documents are incomplete.

D. If City of Houston Standard Specifications or Standard Details are required by the Project Manual, Bidder shall refer to Document 00210 – Supplementary Instructions to Bidders for purchase information.

5.0 *EXAMINATION OF DOCUMENTS, SITE, AND LOCAL CONDITIONS*

A. Bidder shall examine Project site, become familiar with local conditions under which the Work shall be performed, conduct appropriate investigations, and correlate personal observations with requirements of the Bid Documents before submitting a Bid.

B. Bidder shall make site investigations to the extent Bidder deems necessary to ascertain extent of subsurface conditions.

C. Failure of Bidder to perform the investigations prior to submitting a Bid does not relieve Bidder of responsibility for investigations, interpretations and proper use of available information in the preparation of its Bid.

D. Bidder shall observe limitations of access to occupied or restricted site as stated in Document 00210 – Supplementary Instructions to Bidders.

6.0 *INTERPRETATIONS DURING BIDDING*

A. Bidder shall immediately submit Document 00220 – Request for Bid Information to Project Manager upon finding errors, discrepancies, or omissions in Bid Documents. Confirmation of receipt of questions by the City is the responsibility of Bidder. Verbal discussions and answers are not binding.

B. Document 00220 – Request for Bid Information must be received at least 10 days before the Bid Date to allow issuance of Addenda in accordance with Paragraph 7.O.D. Replies, if issued, are by Addenda.

7.0 *ADDENDA*

A. Addenda that affect bidding requirements are applicable only during applicable only through issuance of the Notice to Proceed. Addenda that affect the Contract are a part of the Contract.

B. BIDDERS WHO SUBMIT A BID ON THIS PROJECT SHALL BE PRESUMED TO HAVE RECEIVED ALL ADDENDA AND TO HAVE INCLUDED ANY COST THEREOF IN THEIR BIDS, REGARDLESS OF WHETHER THEY ACKNOWLEDGE THE ADDENDA OR NOT.

C. The City will make Addenda available at same location where the Bid Documents may be obtained. The City will notify plan holders of record when Addenda are available. Bidders are responsible for obtaining Addenda after notification.

D. No Addendum will be issued later than noon on Monday before Bid Date, except Addenda with minor clarifications, withdrawing request for Bids, or postponing Bid Date.

8.0 *SUBSTITUTION OF PRODUCTS*

A. No substitutions of Products will be considered during the bidding period.

9.0 *PREPARATION OF BIDS*

A. Bidder shall fill in applicable blanks in Document 00410A&B – Bid Form – Parts A & B and Bid Supplements. In addition, Bidder shall bid all Alternates. Bidder shall properly sign Document 00410B -Bid Form.

B. Bidder shall initial all pages, except signature page, of Document 00410B – Bid Form – Part B.

C. Bidder is responsible for all costs incurred by the Bidder, associated with preparation of its Bid and compliance with Post-bid Procedures.

D. Bidder may not adjust preprinted price on line items stating "Fixed Unit Price" in the description on the Bid Form.

E. Bidder may increase, but not decrease, preprinted price on line items stating "Minimum Bid Price" in the description on the Bid Form by crossing out the minimum and inserting revised price on the line above. Bidder **may not** decrease the preprinted price on line items stating "Minimum Bid Price".

F. Bidder may decrease, but not increase, preprinted price on line items stating "Maximum Bid Price" in the description on the Bid Form by crossing out the maximum and inserting revised price on the line above. Bidder **may not** increase the preprinted price on line items stating "Maximum Bid Price".

G. Bidder shall insert a price no greater than the maximum preprinted range and no less than the preprinted range for line items stating "Fixed Range Unit Price" in the description on the Bid Form by crossing out prices noted and inserting revised price on the line above.

H. Bidder may not adjust Cash Allowance amounts.

10.0 *BID SUBMISSION*

A. City Secretary will receive Bids on Bid Date at location specified in Document 00210 – Supplementary Instructions to Bidders.

B. Bids submitted after Bid Date will be returned to Bidder unopened.

C. Verbal, facsimile, or electronic Bids are invalid and will not be considered.

D. Bidder shall submit in person or by mail one copy of the signed Document 00410 – Bid Form, Parts A and B, along with required Security Deposit, and required Bid Supplements, in a sealed, opaque envelope. In addition, Bidder shall clearly identify Project, Bid Date and Bidder's name on outside of envelope. If forwarded by mail, the sealed envelope containing the Bid must be enclosed in another envelope addressed for postal delivery.

11.0 *BID SECURITY*

A. Bidder shall submit a Security Deposit with its Bid.

B. Certified Check or Cashier's Check

1. Bidder shall make check payable to the City of Houston.

2. A check is submitted on the condition that if Bidder is named Low Bidder and fails either to timely and properly submit documents required in Document 00495 – Post-Bid Procedures, the City will cash the check in accordance with Paragraph 11.0.E.

C. Bid Bond

1. The bid bond must be a valid and enforceable bond, signed by a surety that complies with other requirements set out by law.

2. The bid bond must name the City of Houston as obligee, and be signed by the Bidder as principal and signed and sealed by the surety.

3. The bid bond must be conditioned such that if Bidder is named Low Bidder and then fails to timely and properly submit documents required in Document 00495 – Post-Bid Procedures, surety will be obligated to pay to the City an amount in accordance with Paragraph 11.0.E.

D. Security Deposits will be retained until after the Contract is awarded or all Bids are rejected.

E. Low Bidder forfeits Security Deposit if it fails to timely and properly submit documents required in Document 00495 – Post-Bid Procedures. The City may claim an amount equal to the difference between the Total Bid Price of the defaulting Bidder and the Total Bid Price of the Bidder awarded the Contract. If Security Deposit is a check, the City will reimburse any remaining balance to the defaulting Bidder.

12.0 *SUBCONTRACTORS AND SUPPLIERS*

A. The City may reject proposed Subcontractors or Suppliers.

B. Refer to Document 00800 – Supplementary Conditions, for MWBEPDBE, DBE and SBE goals.

13.0 *MODIFICATION OR WITHDRAWAL OF BID*

A. A Bidder may modify or withdraw a Bid submitted before the Bid Date by written notice to the City Secretary. The notice may not reveal the amount of the original Bid and must be signed by the Bidder.

B. Bidder may not modify or withdraw its Bid by verbal, facsimile, or electronic means.

C. A withdrawn Bid may be resubmitted up to the time designated for receipt of Bids.

14.0 *BID DISQUALIFICATION*

A. The City may disqualify a Bid if the Bidder:

1. fails to provide required Security Deposit in the proper amount;

2. improperly or illegibly completes information required by the Bid Documents;

3. fails to sign Bid or improperly signs Bid;

4. qualifies its Bid; or

5. improperly submits its Bid.

B. When requested, Low Bidder shall present satisfactory evidence that Bidder has regularly engaged in performing construction work as proposed, and has the capital, labor, equipment, and material to perform the Work.

15.0 *PREBID MEETING*

A. A prebid meeting is scheduled to be held at the place, time, and date listed in Document 00210 – Supplementary Instructions to Bidders.

B. All Bidders, subcontractors, and suppliers are invited to attend.

C. Representatives of City Engineer will attend.

16.0 *OPENING OF BIDS*

A. Bids are opened by the City Secretary and publicly read in City Council Chambers on the Public Level in City Hall Annex at 11:00 a.m. on Bid Date.

B. Place and date of Bid opening may be changed in accordance with Sections 15-3(b)(5) and 15-3(b)(6) of the City Code.

17.0 *EVALUATION AND CONSIDERATION OF BIDS*

A. Project Manager will tabulate, record and evaluate Bids.

B. The City may reject all Bids or may reject any defective Bid.

18.0 *ACCEPTANCE OF THE BID*

A. The City will send to Low Bidder Document 00498 – Notice of Intent to Award. Acceptance by the City is conditioned upon Bidder's timely and proper submittal of documents required in Document 00495 – Post-Bid Procedures.

B. The Bid remains open to acceptance and is irrevocable for the period of time stated in Document 00410A – Bid Form – Part A.

END OF DOCUMENT

Document 00210

SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

The following Paragraphs modify Document 00200 - Instructions to Bidders. Where a portion of the Instructions to Bidders is modified or deleted by these Supplementary Instructions, the unaltered portions of the Instructions to Bidders remains in effect.

2.0 – DEFINITIONS: Add the following Paragraphs to this Section:

O. *Office of Business Opportunity (OBO):* All references to Affirmative Action Contract Compliance Division (AACC) set forth in Document 00700 – General Conditions and in other documents of the Project Manual, shall refer to, and include, the Office of Business Opportunity.

3.0 - NOTICE TO BIDDERS: Add the following Paragraph to this Section:

C. The City will award this contract to a "Local Business", as that term is defined in Section 15-176 of the City of Houston Code of Ordinances ("the Code"):

- If the bid of the Local Business is less than $100,000 and is the lowest responsible bid or is within 5% of the lowest bid received, or
- If the bid of the Local Business is more than $100,000 and is the lowest responsible bid or is within 3% of the lowest bid received, and
- Unless the Director determines that such an award would unduly interfere with contract needs, as provided in Section 15-181 of the Code.

If there is no bid of a Local Business that meets these criteria, the City will award the contract to the lowest responsible bidder.

4.0 – BID DOCUMENTS: Add the following Paragraphs to this Section:

A. Add the following Paragraph A.1:

1. Bid documents may only be obtained electronically at the City's website: http://bidsets.publicworks.houstontx.gov/.

D. Add the following Paragraph D.1:

1. Copies of the City Standard Specifications and Details may be acquired at no cost on the City's website

http://documents.publicworks.houstontx.gov/document-center/cat_view/88-engineering-and-construction/92-specifications/208-division-02-16-standard-specifications.html

E. The following plan rooms, whose names, addresses, phone and fax numbers were last updated on April 9, 2007, have been authorized by the City to display Bid Documents for examination:
(Note: The Bid Documents furnished to the plan rooms for examination can be in electronic format, in hard copies, or in any other formats pertaining to each City Contracting Division's discretion.)

1. AMTEK Information Services, Inc., 4001 Sherwood Lane, Houston, TX 77092, 713-956-0100, Fax 713-956-5340, Email: planroom@amtekusa.com

2. Associated Builders & Contractors, Inc., (ABC), 3910 Kirby, Suite 131, Houston, TX 77098-4151, 713-523-6222, Fax 713-874-0747. Email: lori@abchouston.org

3. Associated General Contractors (AGC-BB) Building Branch, 3825 Dacoma, Houston, TX 77092-8717, 713-843-3700, Fax 713-843-3701. Email: karla.s@agchouston.org

4. Associated General Contractors, (AGC-HHUI), Highway, Heavy Utilities and Industrial Branch, 2400 Augusta St., Suite 180, Houston, TX 77057, 713-334-7100, Fax 713-334-7130. Email: houston@agctx.org (Attention: Mel Keyser)

5. Construction Information Network, 1225 North Loop West, Suite 550, Houston, TX 77008, 713-868-2233 ext. 329, Fax 866-852-2713. Email: paul.tilford@cnsx.com

6. F. W. Dodge Corporation, 4101 Greenbriar, Suite 320, Houston, TX 77098, 713-529-4895, Fax 713-524-7639. Email: terrie_harris@mcgraw-hill.com

7. Hispanic Contractors Association of Houston (HCA-GHA), 11 Parker Road, Suite 7, Houston, TX 77241, 713-699-2732 or 832-754-3705, Fax 713-695-1556, Email: hispanicontractorsassociation@yahoo.com; or Randymagdaleno@yahoo.com

8. Houston Minority Business Development Center, 2900 Woodridge, Suite 124, Houston, TX 77087, 713-644-0821, Fax 713-644-3523. Email: gtamez@gacompanies.com

9. Reed Construction Data, 30 Technology Parkway South, Suite 100, Norcross, GA – 30092-8629. Tel. 1-800-424-3996 or 1-800-699-8640; Fax 1-800-317-0870 or 1-800-508-5370.

10. The Builders' Exchange of Texas, Inc., 3910 Kirby, Suite 131, Houston, TX 77098, 210-564-6900, Fax: 210-564-6921, Email: houston@bxtx.com

F. Add the following Paragraph F.1:

1. **Designation as a City Business or Local Business**

To be designated as a City or Local Business for the purpose of the Hire Houston First Program, as set out in Article XI of Chapter 15 of the Houston City Code, a bidder or proposer must submit the Hire Houston First Application and Affidavit to the Director of the Mayor's Office of Business Opportunity (OBO) and receive notice that the designation has been approved prior to submission of a bid or proposal. Submit with your bid a valid official letter from OBO with your designation as a City or Local Business.

5.0 - EXAMINATION OF DOCUMENTS, SITE, AND LOCAL CONDITIONS: Insert the following paragraph:

A. Add the following Paragraph D.1:

1. The site, or part of it, is currently occupied and access is limited. Premises will be made during the pre-bid meeting, under admission by Bintuan Zhu, P.E. at (832) 395-4987.

9.0 – PREPARATION OF BIDS: Add the following Paragraph I to this Paragraph:

I. For math errors the City encounters in analyzing Bids, the following guidance will be used:

In the event of a conflict between:	The Bid Price is:
1. Individual Unit Price and Extension of that Unit Price	Individual Unit Price times Estimated Quantity
2. A Unit Price extension and total of Unit Price Extensions	Sum of all Individual Unit Price Extensions
3. Individual Alternate and total of Alternates	Sum of all Individual Alternates
4. Individual subtotals for Stipulated Price, Base Unit Prices, Extra	Sum of Individual subtotals for Stipulated Price, Base Unit Prices,

Unit Prices, Contractor Bonus, Cash Allowances, and Alternates; and the Total Bid Price	Extra Unit Prices, Contractor Bonus, Cash Allowances and Alternates

10.0 – BID SUBMISSION: Add the following Paragraph A.1 to this Section:

A. Add the following Paragraph A.1:

1. City Secretary will receive Bids at 900 Bagby, Room P101, Houston, Texas until 10:30 a.m., local time on October 8, 2015.

15.0 – PREBID MEETING: Add the following Paragraph A.1 to this Section:

A. Add the following Paragraph A.1:

1. A Prebid Meeting will be held at 10:00 A.M. on Tuesday, September 22, 2015, in 15th Floor, Conference Room No. 1546 at 611 Walker Street, Houston, Texas 77002.

END OF DOCUMENT

Document 00220

REQUEST FOR BID INFORMATION

PROJECT: Keegans Bayou and Greenridge WWTP Improvements

PROJECT No.: WBS No. R-000265-0079-4

TO: Gauher Khan, P.E.
15th Floor
611 Walker, Houston, Texas 77002

Phone No. (832) 395-2295
Fax No. (832) 395-2344
Email Addr. Gauher.Khan@houstontx.gov

(Type or Print question legibly; use back if more space is needed)

_____
_____
_____
_____
_____
_____
_____
_____
_____

This request relates to _____ and/or _____
Drawing / Detail No. Specification Section No.

Attachments to this request: _____
_____
_____

_____ _____
Signature Date

_____
(Type or Print Name)

_____
(Type or Print Company Name)

END OF DOCUMENT

Document 00320

GEOTECHNICAL INFORMATION

1. DOCUMENT INCLUDES

   A. Soils investigation reports.
   B. Bidder's responsibilities.

2. RELATED DOCUMENTS

   A. Document 00340 – Environmental Information
   B. Section 02260 - Trench Safety Systems

3. SITE INVESTIGATION REPORTS

   A. In the design and preparation of Contract documents for this Project, the City and Design Consultant have used information in geotechnical reports for the investigation and analysis of soils and subsurface conditions at the Project site.

   B. An electronic copy of the report for this project is included in a CD-Rom affixed to the inside front cover of the project manual.

   C. Neither the City nor Design Consultant is responsible for accuracy or completeness of any information or data.

4. GEOTECHNICAL REPORTS

   A. Report No.: G132-13 Prepared by (Firm Name): Aviles Engineering, Corp.; Title: Geotechnical Investigation Greenridge WWTP Improvements ; Report Date: September 11, 2014 No. of Pages: 47

   B. Report No.: G131-13R1 Prepared by (Firm Name): Aviles Engineering, Corp.; Title: Geotechnical Investigation Keegans Bayou WWTP Improvements; Report Date: September 17, 2014 No. of Pages: 36

5. BIDDER RESPONSIBILITIES

   A. Bidder shall take full responsibility for interpretation and use of information contained in above listed reports for its bidding and construction purposes.

B. Bidder may perform additional soils investigations as Bidder deems appropriate.

END OF DOCUMENT

Document 00410A

BID FORM – PART A

To: **The Honorable Mayor and City Council of the City of Houston**
City Hall Annex
900 Bagby Street
Houston, Texas 77002

Project: Keegan's Bayou and Greenridge WWTP Improvements
Project No.: WBS No. R-000265-0079-4
Bidder: _____
(Print or type full name of business entity, such as corporation, LLC, etc)

1.0 OFFER

A. Total Bid Price: Having examined the Project location and all matters referred to in Bid Documents for the Project, we, the undersigned, offer to enter into a Contract to perform the Work for the Total Bid Price shown on the signature page of this Document

B. Security Deposit: Included with the Bid is a Security Deposit in the amount of 10 percent of the Total Bid Price subject to terms described in Document 00200 – Instructions to Bidders.

C. Period for Bid Acceptance: This offer is open to acceptance and is irrevocable for 90 days from Bid Date. That period may be extended by mutual written agreement of the City and Bidder.

D. Addenda: All Addenda have been received. Modifications to Bid Documents have been considered and all related costs are included in the Total Bid Price.

E. Bid Supplements: The following documents are attached:

[X] Security Deposit *(as defined in Document 00200 – Instructions to Bidders)*
[X] Document 00450 - Bidder's Statement of MWSBE Status
[X] Document 00452 - Contractor's Submission List - Fair Campaign Ordinance Form A
[X] Document 00453 – Bidder's Statement of Residency *(not required for AIP funded project)*
[X] Document 00454 - Affidavit of Non-interest
[X] Document 00455 - Affidavit of Ownership or Control
[ ] Document 00456 - Bidder's Certificate of Compliance with Buy American Program *(required for AIP funded project)*
[X] Document 00457 – Conflicts of Interest Questionnaire (CIQ)
[ ] Document 00458 - Bidder's Certificate Regarding Foreign Trade Restriction *(required for AIP funded project)*
[ ] Document 00459 - Contractor's Statement Regarding Previous Contracts Subject to EEO *(required for AIP funded project)*
[X] Document 00460 – Pay or Play Acknowledgement Form (POP 1-A)

[X] Document 00470 – Bidder's MWSBE Participation Plan *(required unless no MWSBE participation goal is provided in Document 00800* (the "Goal")*)*.

[X] Document 00471 – Bidder's Record of Good Faith Efforts *(required if the goal in Bidder's Participation Plan–Document 00470 is lower than the Goal).*

[X] Document 00472 – Bidder's Goal Deviation Request *(required if the goal in Bidder's Participation Plan–Document 00470 is lower than the Goal).*

[X] Others as listed: Valid official letter from OBO with your designation as a City or Local Business *(Bidder's Participation Hire Houston First)*

2.0 CONTRACT TIME

A. If offer is accepted, Contractor shall achieve Date of Substantial Completion within **800** days after Date of Commencement of the Work, subject to adjustments of Contract Time as provided in the Contract.

Document 00410B

BID FORM – PART B

1.0 TOTAL BID PRICE HAS BEEN CALCULATED BY BIDDER, USING THE FOLLOWING COMPONENT PRICES AND PROCESS (PRINT OR TYPE NUMERICAL AMOUNTS):

A. STIPULATED PRICE: $ N/A

(Total Bid Price; minus Base Unit Prices, Extra Unit Prices, Cash Allowances and All Alternates, if any)

B. BASE UNIT PRICE TABLE:

Item No.	Spec Ref.	Base Unit Short Title	Unit	Estimated Quantity	Unit Price (this column controls)	Total in Figures
Keegan's Bayou WWTP						
1	01502	Mobilization	LS	1	$145,000.00(1)	$145,000.00(1)
2	Div. 1 through Div. 16	Improvements to existing Grit Removal System Facilities, in compliance with requirement of contract documents, inclusive of start-up, commissioning and training of City personnel for a fully functional system. The items of work includes but not limited to the following: demolition, dewatering and bypass pumping, construction of a new grit chamber and new epoxy coated flow channels, modifications to existing flow channels, supply and installation of equipment, civil/site work, repair of cracks in the concrete walls/slabs of the existing facility, electrical work, and storm-water pollution prevention control.	LS	1		
3	Div. 1 through Div. 16	Supply and installation of fully functional electrically operated actuators at the existing Clarifiers Influent Gates, including all associated electrical work.	LS	1		

Item No.	Spec Ref.	Base Unit Short Title	Unit	Estimated Quantity	Unit Price (this column controls)	Total in Figures
4	02101	Removal and disposal of settled sludge and debris in the existing Grit Removal System Facility.	TON	300		
5	02260	Trench Safety System	LF	500		
6	Div. 13 Div. 16	Replacement, modifications, and expansion of PLC based control systems, including demolition and removal of replaced and decommissioned systems and system components. Provide PLC control systems, control panel components, field devices, wire & cabling, raceways, testing, commissioning, training, and documentation. Provide network upgrades and replacement user workstation monitors. Trace & identify existing control signal wiring and terminations, verify operation of existing field devices.	LS	1		

Item No.	Spec Ref.	Base Unit Short Title	Unit	Estimated Quantity	Unit Price (this column controls)	Total in Figures
7	Div. 13 13310	Provide SCADA Software Engineering and System Integration services. Verify existing control signals, PLC and manufacturer's equipment software programs, and HMI graphical user interface. Identify existing active control signals for reconnection and abandoned control signal for demolition. Implement plant-wide reassign control network IP address reassignments. Configure replacement PLC systems. Integrate manufacturer's equipment control installations into COH IFIX based remote monitoring and control system. Develop and install PLC software programming and update HMI graphical user interfaces. Debug, test, commission, calibrate, and demonstrate operation of replacement control systems. Train COH operations personnel.	LS	1		
8	Div. 16	Electrical, Power Panels, Conduit support Racks, wiring and conduits associated with Dewatering Building. Work includes replacement of electrical circuits, conduits to the existing pumps.	LS	1		

9	11375	Provide manufacturer's replacement control retrofits for six (6) existing digester blower systems, incl. new control panels, PLC control systems, touch screen monitors, replacement field devices, wiring, engineering, software programming, testing, start-up, training, and demonstration services	LS	1		
Total Keegan's Bayou WWTP				$_____		

Item No.	Spec Ref.	Base Unit Short Title	Unit	Estimated Quantity	Unit Price (this column controls)	Total in Figures
Greenridge WWTP						
10	01502	Mobilization	LS	1	$190,000.00(1)	$190,000.00(1)
11	Div. 1 through Div. 16,	Demolition and Improvements to various existing facilities at this plant, in compliance with requirement of contract documents, inclusive of start-up, commissioning and training of City personnel for a fully functional system. The items of work includes but not limited to the following: Aeration Basins, Blower Building, Digester System, Chlorination and de-chlorination System, Scum Removal System Upgrades, Civil/Site work, such as Dewatering and bypass pumping, Asphalt Concrete removal, and Concrete Roadway Paving, Clarifier Influent Gate Motors, Detention Mitigation, Drainage, Bollards, and Storm Water Pollution Prevention Control measures. Work also includes new electrical equipment, and new circuit/conduits to support new blower and aerator replacements.	LS	1		
12	02101	Removal and disposal of settled sludge and debris.	TON	1,500		
13	02260	Trench Safety System	LF	500		
14	02631	Storm Sewer Outfall, Replacement	LF	300		

Bidder's Initials [ ]

Item No.	Spec Ref.	Base Unit Short Title	Unit	Estimated Quantity	Unit Price (this column controls)	Total in Figures
15	Div. 13 Div. 16	Provision of new PLC based control system, including demolition and removal of replaced and decommissioned systems and system components. Provide PLC control systems, control panel, control panel components, field devices, wire & cabling, raceways, testing, commissioning, training, and documentation. Provide network upgrades. Provide modification of existing PLC control system for installation of replacement chlorine neutralizing system.	LS	1		
16	Div. 13 13310	Provide SCADA Software Engineering and System Integration services. Verify existing control signals, PLC and manufacturer's equipment software programs, and HMI graphical user interface. Assign control network IP addresses. Configure new PLC systems. Integrate manufacturer's equipment control installations into COH IFIX based remote monitoring and control system. Develop and install PLC software programming and update HMI graphical user interfaces. Debug, test, commission, calibrate, and demonstrate operation of replacement control systems. Train COH operations personnel.	LS	1		
		Total Greenridge WWTP			$_____	

C. EXTRA UNIT PRICE TABLE:

Item No.	Spec Ref.	Base Unit Short Title	Unit	Estimated Quantity	Unit Price (this column controls)	Total in Figures
17	02101	Removal of sludge/settled debris above the base bid amount	TON	500	[$100.00](2)	[$50,000.00](2)
18	02318	Hand Excavation	CY	50	[$100.00](2)	[$5,000.00](2)
19	02318	Machine Excavation	CY	250	[$25.00](2)	[$6,250.00](2)
20	02318	Furnish, Place and Compaction of Select Backfill Material	CY	250	[$10.00](2)	[$2,500.00](2)
21	02321	Cement Stabilized Sand Backfill, complete in place	CY	100	[$50.00](2)	$5,000.00](2)
22	02221	Asphalt Removal	LF	200	[$20.00](2)	[$4,000.00](2)
23	02751	Additional 7" thick Reinforced Concrete Pavement	SY	100	[$45.00](2)	[$4,500.00](2)
24	02775	Additional 4" thick concrete with/without form	SY	100	[$30.00](2)	[$3,000.00](2)
25	02820	Extra Bollards	EA	15	[$650.00](2)	[$9,750.00](2)
26	03211	Reinforcing Steel	LB	5,000	[$1.00](2)	[$5,000.00](2)
27	03310	Class A (4,000 psi) Concrete with or without forms	CY	100	[$200.00](2)	[$20,000.00](2)
28	03310	Crack repairs in concrete slab and walls	LF	100	[$200.00](2)	[$20,000.00](2)
29	16111	3/4" PVC coated Rigid Steel Conduit installed above ground	LF	5,000	[$5.40](2)	[$27,000.00](2)
30	16111	1-1/2" PVC coated Rigid Steel Conduit installed above ground	LF	5,000	[$12.80](2)	[$64,000.00](2)
31	16111	1" PVC coated Rigid Steel Conduit installed above ground	LF	6,000	[$9.40](2)	[$56,400.00](2)
32	16111	2" PVC coated Rigid Steel Conduit installed above ground	LF	6,000	[$14.40](2)	[$86,400.00](2)

Item No.	Spec Ref.	Base Unit Short Title	Unit	Estimated Quantity	Unit Price (this column controls)	Total in Figures
33	16111	1" Schedule 40 PVC Conduit installed in underground duct bank	LF	5,000	[$4.20](2)	[$21,000.00](2)
34	16111	2" Schedule 40 PVC Conduit installed in underground duct bank	LF	4,000	[$7.05](2)	[$28,200.00](2)
35	13600 16120	Copper No. 14 AWG Conductor with XHHW-2 insulation, installed in conduit	LF	500	[$0.69](2)	[$345.00](2)
36	16120	Copper No. 12 AWG Conductor with XHHW-2 insulation, installed in conduit	LF	30,000	[$0.85](2)	[$25,500.00](2)
37	16120	Copper No. 10 AWG Conductor with XHHW-2 insulation, installed in conduit	LF	30,000	[$1.18](2)	[$35,400.00](2)
38	16120	Copper No. 8 AWG Conductor with XHHW-2 insulation, installed in conduit	LF	15,000	[$1.78](2)	[$26,700.00](2)
39	16120	Copper No. 2 AWG Conductor with XHHW-2 insulation, installed in conduit	LF	2,000	[$3.50](2)	[$7,000.00](2)
40	16120	Copper No. 1/0 Conductor with XHHW-2 insulation, installed in conduit	LF	500	[$5.60](2)	[$2,800.00](2)
41	16120	Copper No. 3/0 Conductor with XHHW-2 insulation, installed in conduit	LF	500	[$9.90](2)	[$4,950.00](2)
42	16126	2/C or 3/C, #16 AWG twisted shielded instrument cable, installed in conduit	LF	1,000	[$1.40](2)	[$1,400.00](2)
43	16402	Duct bank Trenching, Rebar, concrete encasement, and backfill for a duct bank where the top of the conduit is 36" below grade. The cross sectional area of the concrete encasement shall be four square feet.	LF	300	[$27.00](2)	[$8,100.00](2)

Item No.	Spec Ref.	Base Unit Short Title	Unit	Estimated Quantity	Unit Price (this column controls)	Total in Figures
44	Div 13	Additional Programming for SCADA Integration as Requested by Owner	Man-Hours	40	[$120.00](2)	[$4,800.00](2)
45	13300 13315	Fiber Optic Cable: Multi-mode pair, including provisions for new liner, terminations and testing, installed in existing raceway.	LF	1,000	[$5.00](2)	[$5,000.00](2)
46	13300 13315	Fiber Optic Patch Cable Assemblies: Preassembled multi-mode fiber optic duplex patch cable, 10' nominal length, complete with MT-RJ and/or ST terminations as required.	EA	30	[$50.00](2)	[$1,500.00](2)
47	13300 13315	Control & Instrumentation Cable: 12 AWG stranded, 2 conductors, jacketed, installed, tested, tagged, and terminated.	LF	27,500	[$7.00](2)	[$192,500.00](2)
48	13300 13315	Control & Instrumentation Cable: 18 AWG stranded, 2 conductors, shielded and jacketed, installed, tested, tagged, and terminated.	LF	25,000	[$4.00](2)	[$100,000.00](2)
49	13300 13315	Ethernet Cable: 4 pair Category 6, installed including terminations & testing.	LF	5,500	[$3.50](2)	[$19,250.00](2)
50	13300 13315	Programmable Logic Controller: Siemens S7-300 Series Modular Type, including backplane and module rack, central processor module, memory, set-up and configuration.	EA	3	[$1,800.00](2)	[$5,400.00](2)
51	13300 13315	Power Supply: 120 VAC input, 24 VDC output, 5 amp nominal.	EA	7	[$250.00](2)	[$1,750.00](2)

Item No.	Spec Ref.	Base Unit Short Title	Unit	Estimated Quantity	Unit Price (this column controls)	Total in Figures
52	13300 13315	Input/Output Module: Modular digital type for Siemens S7-300 programmable logic controllers, 16 channel universally scalable, channel-specifically configurable for input or output duty, including installation, termination, and configuration.	EA	20	[$1,000.00](2)	[$20,000.00](2)
53	13300 13315	Input/Output Module: Modular analog input type for Siemens S7-300 programmable logic controllers, 8 channel universal type, including installation, termination, and configuration.	EA	10	[$1,850.00](2)	[$18,500.00](2)
54	13300 13315	Input/Output Module: Modular analog output type for Siemens S7-300 programmable logic controllers, 8 channel universal type, including installation, termination, and configuration.	EA	5	[$2,000.00](2)	[$10,000.00](2)
55	13300 13315	Communications Module: Modular Profibus DP or FMS for Siemens S7-300 programmable logic controller, including installation and configuration.	EA	6	[$1,500](2)	[$9,000.00](2)
56	13300 13315	Software Programming Services: Programming services for Siemens S7-300 series programmable logic controller and or graphical user interface	Man Hours	250	[$125.00](2)	[$31,250.00](2)
57	13300 13315	Communications Module: Modular Ethernet for Siemens S7-300 programmable logic controller, including installation and configuration.	EA	3	[$1,500.00](2)	[$4,500.00](2)

Item No.	Spec Ref.	Base Unit Short Title	Unit	Estimated Quantity	Unit Price (this column controls)	Total in Figures
58	13300 13315	Control Voltage Relay: DPDT (double pole double throw) motor rated contacts, plug-in type continuous duty, 24 or 120 VAC, including mounting base, installation, and termination.	EA	125	_____ [$65.00](2)	_____ [$8,125.00](2)
59	13300 13315	Ladder Tray W/ Support	LF	350	_____ [$150.00](2)	_____ [$52,500.00](2)
60	13300 13315	Field Technician Services: Qualified controls & instrumentation technician field services as directed	Man Hours	700	_____ [$75.00](2)	_____ [$52,500.00](2)
61	Div. 02	Extra 6" Ductile Iron Pipe including excavation and restoration.	LF	50	_____ [$100.00](2)	_____ [$5,000.00](2)
62	Div. 16	Install new 2" underground conduits from Clarifier Building to new Grit Chambers including underground piping & utility location and horizontal boring.	LF	500	_____ [$40.00](2)	_____ [$20,000.00](2)
63	Div. 16	Provide additional days of portable electric power generation to main switchgear at Greenridge WWTP including fuel costs.	Days	7	_____ [$2500.00](2)	_____ [$17,500.00](2)
TOTAL EXTRA UNIT PRICES						$_____

REST OF PAGE INTENTIONALLY LEFT BLANK

D. CASH ALLOWANCE TABLE:

Item No.	Primary Spec Ref.	Cash Allowance Short Title	Cash Allowance in figures (1)
64	01110	City of Houston Building Permit – Keegan's Bayou WWTP and Greenridge WWTP Improvements	$30,000.00
65	01110	Street Cut Permit for Greenridge WWTP – Cash allowance for the actual cost of the permit fees associated with the Street Cut permit required by the City of Houston.	$2,000.00
66	01110	Utility Reimbursement – Cash allowance for the actual cost of a temporary utility connection, installation and overhead wire.	$5,000.00
TOTAL CASH ALLOWANCES			$37,000.00

E. ALTERNATES TABLE: - N/A

REST OF PAGE INTENTIONALLY LEFT BLANK

F. TOTAL BID PRICE: $_____
(Add Totals for Stipulated Price, Base Unit Price, Extra Unit Price, Cash Allowance, and All Alternates, if any)

2.0 SIGNATURES: By signing this Document, I agree that I have received and reviewed all Addenda and considered all costs associated with the Addenda in calculating the Total Bid Price.

Bidder: _____
(Print or type full name of your proprietorship, partnership, corporation, or joint venture.*)

**By: _____
Signature Date

Name: _____
(Print or type name) Title

Address: _____
(Mailing)

_____
(Street, if different)

Telephone and Fax Number: _____
(Print or type numbers)

* If Bid is a joint venture, add additional Bid Form signature sheets for each member of the joint venture.

** Bidder certifies that the only person or parties interested in this offer as principals are those named above. Bidder has not directly or indirectly entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free competitive bidding.

Note: This document constitutes a government record, as defined by § 37.01 of the Texas Penal Code. Submission of a false government record is punishable as provided in § 37.10 of the Texas Penal Code.

Footnotes for Tables B through E:
(1) Fixed Unit Price determined prior to Bid. Cannot be adjusted by the Bidder.
(2) Minimum Bid Price determined prior to Bid. Can be increased by the Bidder, but not decreased, by crossing out the Minimum and inserting revised price on the line above. **Cannot** be decreased by the Bidder.
(3) Maximum Bid Price determined prior to Bid. Can be decreased by the BIdder, but not increased, by crossing out the Maximum and inserting revised price on the line above. A Bid that increases the Maximum Bid Price may be found non-conforming and non-responsive. **Cannot** be increased by the Bidder.
(4) Fixed Range Bid Price determined prior to Bid. Unit Price can be adjusted by Bidder to any amount within the range defined by crossing out prices noted and noting revised price on the line above.

Document 00430

BIDDER'S BOND

THAT WE, _____, as Principal,
(Bidder)
("Bidder"), and the other subscriber hereto, _____, as Surety, do hereby acknowledge ourselves to be held and firmly bound to the City of Houston, a municipal corporation, in the sum of _____ Dollars ($_____) (an amount equal to 10 percent of the Total Bid Price, including Cash Allowances and Alternates, if any, for the payment of which sum, well and truly to be made to the City of Houston and its successors, the Bidder and Surety do bind themselves, their heirs, executors, administrators, successors, and assigns, jointly and severally.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH THAT:

WHEREAS, the Bidder has submitted on or about this day a proposal offering to perform the following:

_____
(Project Name, Location and Number)
in accordance with the Drawings, Specifications, and terms and conditions related thereto to which reference is hereby made.

NOW, THEREFORE, if the Bidder's offer as stated in the Document 00410 – Bid Form is accepted by the City, and the Bidder executes and returns to the City Document 00520 – Agreement, required by the City, on the forms prepared by the City, for the Work and also executes and returns the same number of the Performance, Payment and Maintenance Bonds (such bonds to be executed by a Corporate Surety authorized by the State Board of Insurance to conduct insurance business in the State of Texas, and having an underwriting limitation in at least the amount of the bond) and other submittals as required by Document 00495 - Post-Bid Procedures, in connection with the Work, within the Contract Time, then this obligation shall become null and void; otherwise it is to remain in full force and effect.

If Bidder is unable to or fails to perform the obligations undertaken herein, the undersigned Bidder and Surety shall be liable to the City for the full amount of this obligation which is hereby acknowledged as the amount of damages which will be suffered by the City on account of the failure of such Bidder to perform such obligations, the actual amount of such damages being difficult to ascertain.

Notices required or permitted hereunder shall be in writing and shall be deemed delivered when actually received or, if earlier, on the third day following deposit in a United States Postal Service post office or receptacle, with proper postage affixed (certified mail, return receipt requested), addressed to the respective other Party at the address prescribed in the Contract documents, or at such other address as the receiving Party may hereafter prescribe by written notice to the sending Party.

IN WITNESS THEREOF, the Bidder and Surety have signed and sealed this instrument on the respective dates written below their signatures and have attached current Power of Attorney.

ATTEST, SEAL: (if a corporation)
WITNESS: (if not a corporation)

By: _____
Name:
Title:

ATTEST/SURETY WITNESS: (SEAL)

By: _____
Name:
Title:
Date:

_____
(Name of Bidder)

By: _____
Name:
Title:
Date:

_____
(Full Name of Surety)

_____
(Address of Surety for Notice)

_____
(Telephone Number of Surety)

By: _____
Name:
Title:
Date:

END OF DOCUMENT

Document 00450

BIDDER'S STATEMENT OF MWBE/PDBE/DBE/SBE STATUS

This certifies that the status of the Bidder, _____, in
(Bidder's Name)
regard to the City of Houston Code of Ordinances, Chapter 15, Article V, relating to City-wide percentage goals for contracting with Minority and Women-owned Business Enterprises (MWBE) and Disadvantaged Business Enterprises (DBE), Chapter 15, Article VI, relating to City-wide percentage goals for contracting with Persons with Disabilities Business Enterprises (PDBE) and Chapter 15, Article IX, relating to City-wide percentage goals for contracting with a Small Business Enterprise (SBE) is as follows:

1. Bidder (individual, partnership, corporation) is [__] is not [__] a Minority Business Enterprise as certified by the Office of Business Opportunity.

2. Bidder (individual, partnership, corporation) is [__] is not [__] a Women-owned Business Enterprise as certified by the Office of Business Opportunity

3. Bidder (individual, partnership, corporation) does [__] does not [__] declare itself to be a Persons with Disabilities Business Enterprise as defined above.

4. Bidder (individual, partnership, corporation) does [__] does not [__] declare itself to be a Disadvantaged Business Enterprise as defined above.

5. Bidder (individual, partnership, corporation) does [__] does not [__] declare itself to be a Small Business Enterprise as defined above.

Signature: _____

Title: _____

Date: _____

END OF DOCUMENT

Document 00452
Form A
CONTRACTOR SUBMISSION LIST
CITY OF HOUSTON FAIR CAMPAIGN ORDINANCE

The City of Houston Fair Campaign Ordinance makes it unlawful for a Contractor to offer any contribution to a candidate for City elective office (including elected officers-elect) during a certain period of time prior to and following the award of the Contract by the City Council. The term "Contractor" includes proprietors of proprietorships, partners or joint venturers having an equity interest of 10 percent or more for the partnership or joint venture, and officers, directors and holders of 10 percent or more of the outstanding shares of corporations. Submission of a statement disclosing the names and business addresses of each of those persons is required with each Bid/Proposal for a City Contract. See Chapter 18 of the City of Houston Code of Ordinances for further information.

This list is submitted under the provisions of Section 18-36(b) of the City of Houston Code of Ordinances in connection with the attached Bid/Proposal of:

Firm or Company Name: _____
Firm or Company Address: _____
_____

The firm/company is organized as indicated below. Check one as applicable and attach additional pages if needed to supply the required names and addresses.

[ ] SOLE PROPRIETOR

Name _____ _____
Proprietor Address

[ ] A PARTNERSHIP

LIST EACH PARTNER HAVING EQUITY INTEREST OF 10% OR MORE OF PARTNERSHIP (IF NONE STATE "NONE")

Name _____ _____
Partner Address

Name _____ _____
Partner Address

[ ] A CORPORATION

LIST ALL DIRECTORS OF THE CORPORATION (IF NONE STATE "NONE")

Name _____ _____
Director Address

Name _____ _____
Director Address

Name _____ _____
Director Address

LIST ALL OFFICERS OF THE CORPORATION (IF NONE STATE "NONE")

Name _____ _____
Officer Address

Name _____ _____
Officer Address

Name _____ _____
Officer Address

LIST ALL INDIVIDUALS OWNING 10% OR MORE OF OUTSTANDING SHARES OF STOCK OF THE CORPORATION (IF NONE STATE "NONE")

Name _____ _____
Owner Address

Name _____ _____
Owner Address

Name _____ _____
Owner Address

I certify that I am duly authorized to submit this list on behalf of the firm, that I am associated with the firm in the capacity noted below, and that I have knowledge of the accuracy of the information provided herein.

_____
Signature

_____
Printed Name

_____
Title

Note: This list constitutes a government record as defined by § 37.01 of the Texas Penal Code.

END OF DOCUMENT

Document 00453

BIDDER'S STATEMENT OF RESIDENCY

The City may not award a contract for general construction, services, or purchases to a Nonresident Bidder unless Nonresident's Bid is lower than the lowest Bid submitted by a responsible Texas Resident Bidder by the same amount that a Texas Resident bidder would be required to underbid the Nonresident Bidder to obtain a comparable contract in the state in which Nonresident's principle place of business is located.

1. This certifies that the Bidder, _____, is a State of Texas Resident Bidder as defined in TEX. GOVT. CODE ANN. § 2252.001(4) (Vernon 1994).

   _____ _____
   Signature Title

   "Texas Resident Bidder" means a bidder whose principal place of business is in this State, and includes a Contractor whose ultimate parent company or majority owner has its principal place of business in this State. *When bidder cannot sign 1, above, proceed to 2.*

2. a. _____ is a resident of _____ and is a Nonresident Bidder as defined in TEX. GOVT. CODE ANN. § 2252.001(3) (Vernon 1994).

   _____ _____
   Signature Title

   "Nonresident Bidder" means a bidder whose principal place of business is not in this State, but excludes a contractor whose ultimate parent company or majority owner has its principal place of business in this State.

   b. The State of _____ _____ have a state statute giving
   Bidder's resident state Does or Does Not
   preference to resident bidders.

   _____ _____
   Signature Title

   If the answer to 2.b is that your state does have a statute giving preference to resident bidders, then you must provide a copy and proceed to 3.

3. A copy of the State of _____ statute is attached.

   _____ _____
   Signature Title

   _____
   Date

END OF DOCUMENT

Document 00454

AFFIDAVIT OF NON-INTEREST

BEFORE ME, the undersigned authority, a Notary Public in and for the State of Texas, on this day personally appeared _____, who
Affiant

being by me duly sworn on his oath stated that he is _____, of
Title

_____,
Name of Firm

the firm named and referred to and in the foregoing; and that he knows of no officer, agent, or employee of the City of Houston being in any manner interested either directly or indirectly in such Contract.

_____
Affiant's Signature

SWORN AND SUBSCRIBED before me on _____.
Date

_____
Notary Public in and for the State of TEXAS

_____
Print or type name

My Commission Expires: _____
Expiration Date

END OF DOCUMENT

Document 00455

AFFIDAVIT OF OWNERSHIP OR CONTROL

ORIG. DEPT.: DEPARTMENT OF PUBLIC WORKS AND ENGINEERING **FILE/I.D. NO.:** R-000265-0079-4

INSTRUCTION: ENTITIES USING AN ASSUMED NAME SHOULD DISCLOSE SUCH FACT TO AVOID REJECTION OF THE AFFIDAVIT. THE FOLLOWING FORMAT IS RECOMMENDED: CORPORATE/LEGAL NAME DBA ASSUMED NAME.

STATE OF _____ §
§ **AFFIDAVIT OF OWNERSHIP OR CONTROL**
COUNTY OF _____ §

BEFORE ME, the undersigned authority, on this day personally appeared _____ [*FULL NAME*] (hereafter "Affiant"), _____ [*STATE TITLE/CAPACITY WITH CONTRACTING ENTITY*] of _____ [*CONTRACTING ENTITY'S CORPORATE/LEGAL NAME*] ("Contracting Entity"), who being by me duly sworn on oath stated as follows:

1. Affiant is authorized to give this affidavit and has personal knowledge of the facts and matters herein stated.

2. Contracting Entity seeks to do business with the City in connection with _____ [*DESCRIBE PROJECT OR MATTER*] which is expected to be in an amount that exceeds $50,000.

3. The following information is submitted in connection with the proposal, submission or bid of Contracting Entity in connection with the above described project or matter.

4. Contracting Entity is organized as a business entity as noted below (check box as applicable).

FOR PROFIT ENTITY:

[ ] SOLE PROPRIETORSHIP
[ ] CORPORATION
[ ] PARTNERSHIP
[ ] LIMITED PARTNERSHIP
[ ] JOINT VENTURE
[ ] LIMITED LIABILITY COMPANY
[ ] OTHER (Specify type in space below)

_____

_____

_____

NON-PROFIT ENTITY:

[ ] NON-PROFIT CORPORATION
[ ] UNINCORPORATED ASSOCIATION

5. The information shown below is true and correct for the Contracting Entity and all owners of 5% or more of the Contracting Entity and, where the Contracting Entity is a non-profit entity, the required information has been shown for each officer, *i.e.*, president, vice-president, secretary, treasurer, etc. ***[NOTE: IN ALL CASES, USE FULL NAMES, LOCAL BUSINESS AND RESIDENCE ADDRESSES AND TELEPHONE NUMBERS. DO NOT USE POST OFFICE BOXES FOR ANY ADDRESS. INCLUSION OF E-MAIL ADDRESSES IS OPTIONAL, BUT RECOMMENDED. ATTACH ADDITIONAL SHEETS AS NEEDED.]***

Contracting Entity

Name: _____

Business Address *[NO./STREET]* _____

[CITY/STATE/ZIP CODE] _____

Telephone Number (_____)_____

Email Address *[OPTIONAL]* _____

Residence Address *[NO./STREET]* _____

[CITY/STATE/ZIP CODE] _____

Telephone Number (_____)_____

Email Address *[OPTIONAL]* _____

5% Owner(s) or More **(IF NONE, STATE "NONE.")**

Name: _____

Business Address *[NO./STREET]* _____

[CITY/STATE/ZIP CODE] _____

Telephone Number (_____)_____

Email Address *[OPTIONAL]* _____

Residence Address *[NO./STREET]* _____
[CITY/STATE/ZIP CODE] _____

Telephone Number (_____)_____

Email Address *[OPTIONAL]* _____

6. *Optional Information*

Contracting Entity and/or _____ [***NAME OF OWNER OR NON-PROFIT OFFICER***] is actively protesting, challenging or appealing the accuracy and/or amount of taxes levied against _____ [***CONTRACTING ENTITY, OWNER OR NON-PROFIT OFFICER***] as follows:

Name of Debtor: _____

Tax Account Nos. _____

Case or File Nos. _____

Attorney/Agent Name _____

Attorney/Agent Phone No. (_____)_____

Tax Years _____

Status of Appeal *[**DESCRIBE**]* _____

_____

_____

_____

Affiant certifies that he or she is duly authorized to submit the above information on behalf of the Contracting Entity, that Affiant is associated with the Contracting Entity in the capacity noted above and has personal knowledge of the accuracy of the information provided herein, and that the information provided herein is true and correct to the best of Affiant's knowledge and belief.

_____
Affiant

SWORN TO AND SUBSCRIBED before me this _____ day of _____, 20_____.

(Seal)

_____
Notary Public

NOTE:
This affidavit constitutes a **government record** as defined by Section 37.01 of the Texas Penal Code. Submission of a false government record is punishable as provided in Section 37.10 of the Texas Penal Code. Attach additional pages if needed to supply the required names and addresses.

Document 00457

Conflict of Interest Questionnaire

****

Print out latest version of CIQ form from website listed below:

****

Local Government Code Chapter 176 requires Bidders with the City of Houston ("City") to file a Conflict of Interest Questionnaire with the City Secretary of the City of Houston.

The Conflict of Interest Questionnaire is available for downloading on the Texas Ethics Commission's website at: http://www.ethics.state.tx.us/forms/CIQ.pdf. The completed Conflict of Interest Questionnaire will be posted on the City Secretary's website. Also you will find a list of the City Local Government Officers on the City Secretary's website.

For your convenience the CIQ form is attached as part of this document. Although the City has provided this document for the Bidders convenience, it is the Bidders responsibility to submit the latest version of the CIQ form as promulgated by the Texas Ethics Commission.

The Failure of any Bidder to comply with this law is a Class C misdemeanor.

END OF DOCUMENT

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

Document 00459

CONTRACTOR'S STATEMENT REGARDING PREVIOUS CONTRACTS SUBJECT TO EQUAL EMPLOYMENT OPPORTUNITY

Section 60-1.7(b) of the Regulations of the Secretary of Labor requires each bidder or prospective prime contractor and proposed subcontractor, where appropriate, to state in the bid or at the outset of negotiations for the contract whether it has participated in any previous contract or subcontract subject to the equal opportunity clause; and if so, whether it has filed with the Joint Reporting Committee, the Director, an agency, or the former President's Committee on Equal Employment Opportunity all reports due under the applicable filing requirements. In any case in which a bidder or prospective prime contractor or proposed subcontractor which participated in a previous contract subject to Executive Order 10925, 11114. or 11246 has not filed a report due under the applicable filing documents, no contract or subcontract shall be awarded unless such contractor submits a report covering the delinquent period or such other period specified by the FAA or the Director, OFCCP.

Contractor has has not participated in a previous contract subject to the equal opportunity clause prescribed by Executive Order 10925, or Executive Order 11114, or Executive Order 11246.

Contractor has has not submitted all compliance reports in connection with any such contract due under the applicable filing requirements; and that representations indicating submission of required compliance reports signed by proposed subcontractors will be obtained prior to award of subcontracts.

If Contractor has participated in a previous contract subject to the equal opportunity clause and has not submitted compliance reports due under applicable filing requirements, Contractor (Proposer) shall submit a compliance report on Standard Form 100, "Employee Information Report EEO-1" prior to the award of the Contract.

Standard Form 100 is normally furnished to contractors annually, based on a mailing list currently maintained by the Joint Reporting Committee. In the event Contractor has not received the form, Contractor may obtain it by writing to the following address:

Joint Reporting Committee
1800 G Street
Washington, DC 20506

_____
(Printed or typed Name of Signatory)

_____ _____
Signature Date

_____
Title

_____
Contractor's Firm Name

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

END OF DOCUMENT

Document 00460
(POP -1)
City of Houston
Pay or Play Program
Acknowledgement Form

It has been determined that the project currently open for bidding meets the criteria of the City of Houston Pay or Play program. This form acknowledges your awareness of the Pay or Play program which is authorized by Ordinance 2007-534. Your signature below affirms that you will comply with the requirements of the program if you are the successful bidder/proposer, and ensure the same on behalf of subcontracts subject to the Pay or Play Program.

I declare under penalty of perjury under the laws of the State of Texas that if awarded this contract which meets the criteria for the City of Houston's Pay or Play Program, I will comply with all requirements of the Pay or Play Program in accordance with Executive Order 1-7.

***Fill out all information below and submit this form with your bid/proposal packet.**

_____
Solicitation Number

_____ _____
Signature Date

_____ _____
Print Name City Vendor ID

_____ _____
Company Name Phone Number

_____
Email Address

Note: For more information contact your POP Liaison or the POP Contract Administrator. All contact information can be found on www.houstontx.gov **→Departments→Office of Business Opportunity→Pay or Play.**

Document 00470

BIDDER'S MWSBE PARTICIPATION PLAN

The Bidder or Proposer shall submit this completed form with the bid, to demonstrate the Bidder/Proposer's plan to meet the contract-specific MWSBE goal ("contract goal"). If the Bidder or Proposer cannot meet the contract goal, the Bidder/Proposer has the burden to demonstrate "Good Faith Efforts", which shall include correctly and accurately preparing and submitting this form, a Record of Good Faith Efforts (Document 00471), a Request for Deviation from the Goal (Document 00472), and providing supporting documentation evidencing their "Good Faith Efforts", as required by the City of Houston's Good Faith Efforts Policy (Document 00808). The City will review the Participation Plan and Good Faith Efforts at the time of bid opening. Visit http://www.houstontx.gov/obo for more information.

City Contract Goal	MBE Goal % 11%	WBE Goal % 7%	• MBE and WBE Goals are two separate Contract Goals. • Any excess of one Goal cannot be applied to meet another Goal. • An SBE can be applied to the MBE and/or WBE Goal, but not to exceed 4%.

NAICS Code (6 digit)	Description of Work (Plan Sheet #, Unit Price #, Scope of Work #, as applicable)	% of Total Bid Price (2 decimal places; for example, 5.00%)	Cert. Type for Goal: MBE, WBE, or SBE	Certified Firm Name Firm Address Contact Name Phone No. and E-Mail
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	

Bidder's Participation Plan Total	MBE	WBE	SBE

Signature for Company: _____*

Printed Name: _____

Company Name: _____

Phone #: _____

Date: _____

*I understand that supplying inaccurate information may violate Texas Penal Code Section 37.10 and lead to City sanctions.

Document 00470
CONTINUATION PAGE

NAICS Code (6 digit)	Description of Work (Plan Sheet #, Unit Price #, Scope of Work #, as applicable)	% of Total Bid Price (2 decimal places; for example, 5.00%)	Cert. Type for Goal MBE, WBE, or SBE	Certified Firm Name Firm Address Contact Name Phone No. and E-Mail
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	

Signature for Company: _____* Date: _____

Print Name/Company Name:_____ Phone: _____

*I understand that supplying inaccurate information may violate Texas Penal Code Section 37.10 and lead to City sanctions.

Document 00471

PRE-BID GOOD FAITH EFFORTS

Bidder Name: _____ **Project Name**_____

A Bidder or Proposer that may be unable to complete or follow a Participation Plan (Document 00470) to meet the Contract Goal in the Supplemental Conditions (Document 00800), must submit this completed form, Goal Deviation Request Form (Document 00472), providing supporting documentation evidencing their "Good Faith Efforts", as required by the City of Houston's Good Faith Efforts Policy (see Document 00808).

The Bidder or Prime Contractor has the burden to demonstrate "Good Faith Efforts" to meet the MWSBE goal, which includes correctly and accurately preparing and submitting this form and other efforts described in the City's Good Faith Efforts Policy (Document 00808). The Office of Business Opportunity will review Good Faith Efforts and Participation Plan after selection of an apparent low bidder.

UNLESS THE BIDDER'S/PROPOSER'S PARTICIPATION PLAN MEETS THE CONTRACT GOAL, FAILURE TO SUBMIT THIS FORM MAY RESULT IN THE BID BEING FOUND NON-RESPONSIVE.

NAICS Code	Plan Item No.	MWSBE Type for Goal	Certified Firm Name Address, Phone No., and E-Mail	Certified Firm Contact Person	Methods of Contact	Prime Contact Dates	Certified Firm Response	Results of Contact (why suitable or not suitable for work)
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			

Authorized Signature: _____ Date: _____ Phone: _____

Print Name: _____ Email Address: _____

Company Name: _____

CONTINUATION PAGE

NAICS Code	Plan Item No.	MWSBE Type for Goal	Certified Firm Name Address, Phone No., and E-Mail	Certified Firm Contact Person	Method of Contact	Prime Contact Dates	Certified Firm Respons e	Results of Contact (why suitable or not suitable for work)
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			

Authorized Signature: _____ Date: _____ Phone: _____

Print Name: _____ Email Address: _____

Company Name: _____

Document 00472
BIDDER'S MWSBE GOAL DEVIATION REQUEST

Company Name: _____

Project Name: _____

	MBE	WBE	Total
Department Approved Contract Goals	%	%	%

	MBE	WBE	SBE (Max 4% for Credit)	Total
Bidder's Proposed Participation Plan	%	%	%	%

Justification: Please provide the reason the Bidder is unable to meet the Contract Goal in Document 00800.

_____

_____

_____

Good Faith Efforts: Please list any efforts not listed in the Bidder's Pre-Bid Good Faith Effort (Document 00471) and provide supporting documentation evidencing "Good Faith Efforts", as required by the City of Houston's Good Faith Efforts Policy (Document 808).

_____

_____

_____

_____

Date: _____
Email: _____
Phone Number: _____

Company Name: _____
Company Representative: _____
Title: _____

FOR OFFICIAL USE ONLY: Approved [ ] Not Approved [ ]

OBO Representative _____ Date: _____

_____ Title: _____

Document 00495

POST-BID PROCEDURES

3.0 DOCUMENT ADDRESSES

A. Notice of Intent to Award

B. Monitoring Authority/Contracting Department

C. Requirements of Bidder

D. Failure of Bidder to comply with requirements

E. Notice to Proceed

4.0 NOTICE OF INTENT TO AWARD

A. The City will provide written Notice of Intent to Award to Low Bidder.

5.0 DEFINITIONS

A. The "Monitoring Authority" or "OBO" for this Project is:

Director, Office of Business Opportunity Division
City of Houston
611 Walker Street, 7th Floor
Houston, Texas 77002

B. The "Contracting Department" for this Project is:
Director, Department of DEPARTMENT OF PUBLIC WORKS AND ENGINEERING
City of Houston
611 Walker Street
Houston, Texas 77002
ATTN: **Gauher Khan, P.E.,**

6.0 REQUIREMENTS OF BIDDER

A. Within10 days of receipt of Notice of Intent to Award, Low Bidder shall execute and deliver to Gauher Khan, P.E., Project Manager and Monitoring Authority, for the City's approval, documents indicated by an "X" below:
[ ] Document 00570 – Revised MWSBE Participation Plan *(Do not submit if OBO Director approved Bidder's Plan – Document 00470)*

[X] Executed Subcontract(s), Letter(s) of Intent, or documentation of good faith efforts to meet the MWSBE goals

B. Within 10 days of receipt of Notice of Intent to Award, Low Bidder shall execute and deliver to Gauher Khan, P.E., Project Manager for the City's approval, documents indicated by an "X" below:

[ ] Document 00500 - Form of Business
[X] Document 00501 - Resolution of Contractor
[X] Document 00520 - Agreement
[X] Document 00600 - List of Proposed Subcontractors and Suppliers
[X] Document 00601 - Drug Policy Compliance Agreement
[X] Document 00602 - Contractor's Drug-free Workplace Policy *(Contractor creates this document.)*
[X] Document 00604 - History of OSHA Actions and List of On-the-job Injuries
[X] Document 00605 - List of Safety Impact Positions *(Contractor completes this list. Do not submit if submitting Document 00606.)*
[ ] Document 00606 - Contractor's Certification of No Safety Impact Positions *(Do not submit if submitting Document 00605.)*
[ ] Document 00607 - Certification Regarding Debarment, Suspension, and Other Responsibility Matters
[ ] Document 00608 - Contractor's Certification Regarding Non-segregated Facilities for Project Funded by AIP Grant
[X] Document 00610 - Performance Bond
[X] Document 00611 - Statutory Payment Bond
[X] Document 00612 - One-year Maintenance Bond
[X] Document 00613 - One-year Surface Correction Bond
[X] Document 00620 - Affidavit of Insurance *(with Certificate of Insurance attached)*
[X] Document 00622 - Name and Qualifications of Proposed Superintendent *(Contractor creates this document.)*
[ ] Document 00623 - Contractor's Act of Assurance (SRF Form ED-103)
[X] Document 00624 - Affidavit of Compliance with S/WMBE Program
[ ] Document 00625 - SRF Participation Summary
[ ] Document 00626 - SRF Affirmative Steps Solicitation Report
[ ] Document 00627 - SRF Prime Contractor Affirmative Steps Certification and Goals
[ ] Document 00629 - Affidavit for FAA Form 7460-1
[X] Document 00630 - Certification of Compliance with Pay or Play Program
[X] Document 00631 - City of Houston Pay or Play Program – List of Subcontractors
[ ] Document 00809 – CDBG Requirements for Federally Funded Projects

C. Within 10 days of receipt of Notice of Intent to Award, Low Bidder shall execute the following forms and deliver them directly to the Monitoring Authority.

1. Original forms contained in Document 00805 – Equal Employment Opportunity Program Requirements:
   [X] Pages 00805-3 to 00805-5, Certification by Bidder Regarding Equal

Employment Opportunity

[X] *Page 00805-6, Total Work Force Composition of the Company, or copy of latest EEO-1 form (required only if Contractor has a work force of 50 or more people and the Original Contract Price is $50,000 or more)*

[X] *Page 00805-7, Equal Employment Opportunity Compliance Program*

[X] *Page 00805-26, Certification by Proposed Subcontractor Regarding Equal Employment Opportunity*

[X] *Page 00805-29, Certification by Proposed Material Supplier, Lessor, and Professional Service Providers Regarding Equal Employment Opportunity*

2. Original completed form Document 00633 - Certification by Proposed Material Suppliers, Lessors, and Professional Service Providers Regarding Equal Employment Opportunity, for each proposed material supplier and equipment supplier.

3. Original forms contained in Document 00820 – Wage Scale for Engineering Construction.

[X] *Certificate from Contractor Appointing Officer or Employee to Supervise Payment of Employees*

[ ] *Certificate from SubContractor Appointing Officer or Employee to Supervise Payment of Employees*

[ ] Document 00812, Exhibit "A" – Certificate from Contractor Appointing Officer or Employee to Supervise Payment of Employees

D. Designations of Subcontractors and Suppliers, who have been selected by Bidder in Document 00600 - List of Proposed Subcontractors and Suppliers, and accepted by the City, may be changed only with prior notice and acceptance by Project Manager as provided in Conditions of the Contract. For each Product Supplier subsequently added or substituted, provide an original completed form, Document 00633 - Certification by Proposed Material Suppliers, Lessors, and Professional Service Providers Regarding Equal Employment Opportunity, directly to the Monitoring Authority.

E. On Bidder's written request, Gauher Khan, P.E., Project Manager may grant an extension of time, not to exceed 5 days, to furnish documents specified in Paragraphs 4.0.A and 4.0.B. If Bidder is required to resubmit documents specified in Paragraph 4.0.A or 4.0.B, Bidder shall do so within time limits provided in the request for resubmission.

F. Designations of Subcontractors and Suppliers, who have been selected by Bidder in its Participation Plan, and accepted by the City, may be changed only with prior notice and acceptance by the Monitoring Authority as provided in Document 00808 – Bidder/Contractor Requirements for the City of Houston Minority, Women, and Small Business Enterprise (MWSBE), and Persons with Disabilities Business Enterprise (PDBE).

5.0 FAILURE OF BIDDER TO COMPLY WITH REQUIREMENTS

A. Should Bidder, on receipt of Notice of Intent to Award, fail to comply with requirements of this Document 00495 within stated time, the City may declare award in default and require forfeiture of the Security Deposit.

B. After the City's written notice of default to Low Bidder, the City may award the Contract to Bidder whose offer is the next lowest bid, and Security Deposit of Bidder in default shall be forfeited to the City in accordance with provisions of Document 00200 - Instructions to Bidders.

6.0 NOTICE TO PROCEED

A. Upon the City's execution of the Agreement and delivery to Contractor, City Engineer will give Document 00551 - Notice to Proceed to Contractor, which establishes Date of Commencement of the Work.

END OF DOCUMENT

Document 00501

RESOLUTION OF CONTRACTOR

_____ ("Contractor"),
(Name of Contractor, e.g., "Biz. Inc.", "Biz LLP")

is a _____,
(Type of Organization, e.g.: Corporation, Limited Partnership, Limited Liability Partnership, Limited Liability Company, etc.)

which is bound by acts of _____,
(Name and Form of Governing Entity, e.g., "Biz Inc. Board of Directors", "Bill Smith, GP", etc.)

("Governing Entity").

On the _____ day of _____, 20___, the Governing Entity resolved, in accordance with all documents, rules, and laws applicable to the Contractor, that

_____, is authorized to act as the
(Contractor's Representative)

Contractor's Representative in all business transactions (initial one) ____ conducted in the State of Texas OR ____ related to this Contract; and

The Governing Entity warrants that the above resolution (a) was entered into without dissent or reservation by the Governing Entity, (b) has not been rescinded or amended, and (c) is now in full force and effect; and

In authentication of the adoption of this resolution, I subscribe my name on this day of _____, 20___.

_____ _____
(Authorized Signature for Governing Entity) (Print or Type Name and Title of Authorized Signatory)

SWORN AND SUBSCRIBED before me on _____
Date

_____
Notary Public in and for the State of Texas

My Commission Expires: _____ _____
Expiration Date Print or Type Name of Notary Public

Document 00520

AGREEMENT

Project: Keegans Bayou and Greenridge WWTP Improvements

Project Location: Keegans Bayou WWTP is located at 9400 White Chapel Lane in Houston, Texas. Greenridge WWTP is located at 6301 #1 W. Fuqua in Houston, Texas.(Key Map No. 530S, 571X)

Project No: WBS No. R-000265-0079-4

The City: THE CITY OF HOUSTON, 900 Bagby Street, Houston, Texas 77002 (the "City")

and

Contractor: _____

(Address for Written Notice) _____

_____

Fax Number: _____ **Phone Number:** _____

City Engineer, with respect to Sections 4.3 thru 4.5 of the General Conditions, is:

J. Timothy Lincoln, P.E. (or his successor)

P. O. Box 1562, Houston, Texas 77251-1562 (Address for Written Notice)

City Engineer, with respect to all other terms of the General Conditions, is:

Joseph T. Myers, P.E. (or his successor)

Fax Number: (832) 395-2410

THE CITY AND CONTRACTOR AGREE AS FOLLOWS:

ARTICLE 1
THE WORK OF THE CONTRACT

1.1 Contractor shall perform the Work in accordance with the Contract.

ARTICLE 2
CONTRACT TIME

2.1 Contractor shall achieve Date of Substantial Completion within **800** days after Date of Commencement of the Work, subject to adjustments of Contract Time as provided in the Contract.

2.2 The Parties recognize that time is of the essence for this Agreement and that the City will suffer financial loss if the Work is not completed within the Contract Time. Parties also recognize delays, expense, and difficulties involved in proving in a legal or arbitration proceeding actual loss suffered by the City if the Work is not completed on time. Accordingly, instead of requiring any such proof, the Parties agree that as

liquidated damages for delay (but not as a penalty), Contractor shall pay the City the amount stipulated in Document 00800 – Supplementary Conditions, for each day beyond Contract Time.

ARTICLE 3
CONTRACT PRICE

3.1 Subject to terms of the Contract, the City will pay Contractor in current funds for Contractor's performance of the Contract, Contract Price of $__ which includes Alternates, if any, accepted below.

3.2 The City accepts Alternates as follows:

****
Delete or add lines below to indicate all Alternates that were included in Request for competative sealed proposals. Remove brackets and instructions when done. Change color of remaining text to black.
****

Alternate No. 1 ___[*Accepted or Not Accepted*]_____
Alternate No. 2 ___[*Accepted or Not Accepted*]_____
Alternate No. 3 ___[*Accepted or Not Accepted*]_____
Alternate No. 4 ___[*Accepted or Not Accepted*]_____

ARTICLE 4
PAYMENTS

4.1 The City will make progress payments to Contractor as provided below and in Conditions of the Contract.

4.2 The Period covered by each progress payment is one calendar month ending on the [___] 15th or [___] last day of the month.

4.3 The City will issue Certificates for Payment and will make progress payments on the basis of such Certificates as provided in Conditions of the Contract.

4.4 Final payment, constituting entire unpaid balance of Contract Price, will be made by the City to Contractor as provided in Conditions of the Contract.

ARTICLE 5
CONTRACTOR REPRESENTATIONS

5.1 Contractor represents:

5.1.1 Contractor has examined and carefully studied Contract documents and other related data identified in Request For or Competitive Sealed Proposals or Competitive Sealed Bids.

5.1.2 Contractor has visited the site and become familiar with and is satisfied as to general, local, and site conditions that may affect cost, progress, and performance of the Work.

5.1.3 Contractor is familiar with and is satisfied as to all federal, state, and local laws and regulations that may affect cost, progress, and performance of the Work.

5.1.4 Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the site (except Underground Facilities) which have been identified in Contract documents and (2) reports and drawings of a hazardous environmental condition, if any, at the site which has been identified in Contract documents.

5.1.5 Contractor has obtained and carefully studied (or assumes responsibility for having done so) all additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, including applying specific means, methods, techniques, sequences, and procedures of construction, if any, expressly required by the Contract to be employed by Contractor, and safety precautions and programs incident thereto

5.1.6 Contractor does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for performance of the Work at Contract Price, within Contract Time, and in accordance with the Contract.

5.1.7 Contractor is aware of general nature of work to be performed by the City and others at the site that relates to the Work as indicated in Contract documents.

5.1.8 Contractor has correlated information known to Contractor, information and observations obtained from visits to the site, reports and drawings identified in the Contract, and all additional examinations, investigations, explorations, tests, studies, and data with the Contract.

5.1.9 Contractor has given City Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract, and written resolution thereof by City Engineer is acceptable to Contractor.

5.1.10 Contract documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

ARTICLE 6
MISCELLANEOUS PROVISIONS

6.1 The Contract may be terminated by either Party as provided in Conditions of the Contract.

6.2 The Work may be suspended by the City as provided in Conditions of the Contract.

ARTICLE 7
ENUMERATION OF CONTRACT DOCUMENTS

7.1 The following documents are incorporated into this Agreement:

7.1.1 Document 00700 - General Conditions.

7.1.2 Document 00800 - Supplementary Conditions.

7.1.3 Division 01 - General Requirements.

7.1.4 Divisions 02 through 16 of Specifications.

7.1.5 Drawings listed in Document 00015 - List of Drawings. Drawing No. _____and bound separately.

7.1.6 Addenda [and Riders] which apply to the Contract, are as follows:

Addendum No. 1, dated None

Addendum No. 2, dated None

Addendum No. 3, dated None

Rider No. [ ], dated None

7.1.7 Other documents:

	Document No.	Title
[X]	00410B	Bid Form – Part B
[X]	00470	Standard Pre-Bid Participation Plan Document
[ ]	00471	Pre-Bid Good Faith Efforts Report
[ ]	00472	Goal Deviation Request
[ ]	00500	Form of Business
[X]	00501	Resolution of Contractor (if a corporation)
[ ]	00570	Amended S/MWBE Participation Plan
[ ]	00571	Contractor's Good Faith Efforts Report
[ ]	00572	Plan Deviation Request
[ ]	00608	Contractor's Certification Regarding Non-Segregated Facilities for Project Funded by AIP Grant
[X]	00610	Performance Bond
[X]	00611	Statutory Payment Bond
[X]	00612	One-year Maintenance Bond
[X]	00613	One-year Surface Correction Bond
[X]	00620	Affidavit of Insurance (with the Certificate of Insurance attached)
[ ]	00623	Contractor's Act of Assurance (SRF Form ED-103)
[X]	00624	Affidavit of Compliance with Affirmative Action Program
[ ]	00628	Affidavit of Compliance with Disadvantaged Business Enterprise (DBE) Program for Project Funded By AIP Grant
[X]	00630	(POP-2) Certification of Compliance with Pay or Play Program
[X]	00631	(POP-3) City of Houston Pay or Play Program – List of Subcontractors
[X]	00800	Supplementary Conditions for Project CIP or AIP Funded
[ ]	00801	Supplementary Conditions for Project AIP Funded
[ ]	00802	SRF Supplementary Conditions
[X]	00805	Equal Employment Opportunity Program Requirements
[ ]	00806	EPA DBE and Wage Rate Requirements (SRF only)
[ ]	00807	Bidder/Contractor Requirements for DBE Program
[X]	00808	Minority and Women-owned Business Enterprise (MWBE) & Persons with Disabilities Business Enterprise (PDBE) Program
[ ]	00810	Federal Wage Rate - Highway
[ ]	00811	Federal Wage Rate - Building
[ ]	00812	Federal Wage Rate - Heavy
[X]	00820	Wage Rate for Engineering Construction
[ ]	00821	Wage Rate for Building Construction
[ ]	00830	Trench Safety Geotechnical Information
[X]	00840	Pay or Play Program
[ ]	00912	Rider

ARTICLE 8
SIGNATURES

8.1 This Agreement is executed in two original copies and is effective as of the date of countersignature by City Controller.

CONTRACTOR:

By: _____
Name: _____
Title: _____
Date: _____
Tax Identification Number: _____

(If Joint Venture)

By: _____
Name: _____
Title: _____
Date: _____
Tax Identification Number: _____

CITY OF HOUSTON, TEXAS

APPROVED:

By: _____
Director,
Department of Public Works and Engineering

SIGNED:

By: _____
Mayor

COUNTERSIGNED:

By: _____
City Controller

Date Countersigned:

_____

ATTEST/SEAL:

By: _____
City Secretary

8.2 This Contract and Ordinance have been reviewed as to form by the undersigned legal assistant and have been found to meet established Legal Department criteria. Legal Department has not reviewed the content of these documents.

_____ _____
Legal Assistant Date

END OF DOCUMENT

Document 00570

CONTRACTOR'S REVISED MWSBE PARTICIPATION PLAN

As soon as the Contractor becomes aware that the Contractor may not abide by the most current approved Plan, the Contractor shall submit this completed form with a Record of Post-Bid Good Faith Efforts (Document 00571), a Request for Plan Deviation (Document 00572), and any other document evidencing "Good Faith Efforts", as required by the Good Faith Efforts Policy (Document 00808). The City will review this Revised Participation Plan and may approve this Revised Plan if the Contractor has made Good Faith Efforts. For more information, visit http://www.houstontx.gov/obo.

Original Participation Plan Percentage	MBE	WBE	SBE	Revised Participation Plan Percentage	MBE	WBE	SBE

NAICS Code (6 digit)	Description of Work (Plan Sheet #, Unit Price #, Scope of Work #, as applicable)	% of Total Bid Price (2 decimal places)	Cert. Type for Goal (MBE, WBE, SBE)	Certified Firm Name Firm Address Contact Name Phone No. and E-Mail (if available)

Signature for Company: _____* Date: _____
Print Name: _____ Phone: _____

*I understand that supplying inaccurate information may violate Texas Penal Code Section 37.10 and lead to City sanctions.

Document 00570

CONTINUATION PAGE

NAICS Code (6 digit)	Plan Item Number (if applicable)/ Description of Work	% of Total Bid Price (2 decimal places)	Cert. Type for Goal (MBE, WBE, SBE)	Certified Firm Name Firm Address Contact Name Phone No. and E-Mail (if available)

Signature for Company: _____* Date: _____
Print Name: _____ Phone: _____

*I understand that supplying inaccurate information may violate Texas Penal Code Section 37.10 and lead to City sanctions.

Document 00571

RECORD OF POST-AWARD GOOD FAITH EFFORTS

Contractor Name: _____ **Project Name:** _____

A Contractor that may be unable to follow an agreed Participation Plan (Document 00470 or 00570) must submit this completed form, a Plan Deviation Request Form (Document 00572), and any other documentation of "Good Faith Efforts" (see Document 00808) that the OBO Representative may require. The Contractor shall submit one completed Document 00571 (Part A) for each Certified Firm that is no longer performing part or all of its work duties under the Approved Plan. The Contractor has the burden to demonstrate "Good Faith Efforts" to meet the MWSBE goal, which includes correctly and accurately preparing and submitting this form and other efforts described in the Good Faith Efforts Policy (Document 00808). The Office of Business Opportunity may review Participation Plan and Good Faith Efforts from time to time and may request that the Contractor submit this form and other information.

UNLESS THE CONTRACTOR MEETS THE GOALS IN THE AGREED PARTICIPATION PLAN, FAILURE TO SUBMIT THIS FORM MAY RESULT IN A DEFAULT OF THE CONTRACT.

PART A (REASON FOR NON-USE OF CERTIFIED FIRM IN AGREED PLAN)

NAICS Code	Plan Item No.	MWSBE Type for Goal	Certified Firm Name, Address, Phone No. and E-mail	Plan Goal & Actual Use (in % of total)	Method of Contact	Reason for Non-Use (why the Contractor was not able to use the Certified Firm in accordance with the Agreed Plan)
				Plan %: ____ Actual %: ____	Phone ☐ E-mail ☐ Fax ☐	

PART B (REASON FOR NONUSE OF REPLACEMENT CERTIFIED FIRMS—IF APPLICABLE)

NAICS Code	Plan Item No.	MWSBE Type for Goal	Certified Firm Name Address, Phone No. and E-Mail	Certified Firm Contact Person	Method of Contact	Prime Contact Date	Certified Firm Response	Results of Contact (why Certified Firm was unsuitable or unusable)
					Phone ☐ E-mail ☐ Fax ☐			
					Phone ☐ E-mail ☐ Fax ☐			

Authorized Signature: _____ Date: _____ Phone: _____

Print Name: _____ Email Address: _____

Document 00571

PART B CONTINUATION (REASON FOR NONUSE OF REPLACEMENT CERTIFIED FIRMS)

NAICS Code	Plan Item No.	MWSBE Type for Goal	Certified Firm Name Address, Phone No. and E-Mail	Certified Firm Contact Person	Method of Contact	Prime Contact Date	Certified Firm Response	Results of Contact (why Certified Firm was unsuitable or unusable)
					Phone ☐ E-mail ☐ Fax ☐			
					Phone ☐ E-mail ☐ Fax ☐			
					Phone ☐ E-mail ☐ Fax ☐			
					Phone ☐ E-mail ☐ Fax ☐			
					Phone ☐ E-mail ☐ Fax ☐			
					Phone ☐ E-mail ☐ Fax ☐			
					Phone ☐ E-mail ☐ Fax ☐			
					Phone ☐ E-mail ☐ Fax ☐			

Authorized Signature: _____ Date: _____ Phone: _____

Print Name: _____ Email Address: _____

Document 00572

CONTRACTOR'S REQUEST FOR PLAN DEVIATION

Contractor Name:_____

Project Name:_____

	MBE	WBE	SBE	Total
Approved Participation Plan Percentages	%	%	%	%

	MBE	WBE	SBE	Total
Contractor's Requested Participation Plan	%	%	%	%

Justification: Please provide the reason the Contractor is unable to meet the MWSBE goal in the Approved Plan.

_____

_____

_____

Good Faith Efforts: Please list any efforts not listed in Contractor's Record of Good Faith Effort (Document 00571).

_____

_____

_____

_____

Please attach additional pages if the space for Justification or Good Faith Efforts is insufficient.

Date:_____ *Contractor:_____

E-mail: _____ *By:_____

Phone Number: _____ Title:_____

*I understand that the approval of this deviation request does not constitute a final decision by OBO that Contractor has used Good Faith Efforts in meeting the Contracting Goal.

FOR OFFICIAL USE ONLY: Approved ☐ Not Approved ☐

OBO Representative Date:_____

_____ Title: _____

Document 00600

LIST OF PROPOSED SUBCONTRACTORS AND SUPPLIERS

PROJECT NAME: Keegans Bayou and Greenridge WWTP Improvements
TOTAL DBE AWARD: $ _____
ORIG. CONTRACT PRICE: $ _____ TOTAL MWSBE AWARD: $ _____
PROJECT NO.: WBS No. R-000265-0079-4 TOTAL HUB AWARD: $ _____
DATE OF REPORT: _____ TOTAL PDBE AWARD: $ _____

NAICS (6 digits)	SUBCONTRACTOR OR SUPPLIER (INCLUDE "MWSBE", "PDBE", "DBE", OR "HUB" DESIGNATION)[2]	ADDRESS	SCOPE OF WORK[3]

NOTES:
1. RETURN FOR ALL PROJECTS AS REQUIRED IN DOCUMENT 00800 – SUPPLEMENTARY CONDITIONS. RETURN WITHIN THE SPECIFIED NUMBER OF DAYS AFTER RECEIPT OF NOTICE OF INTENT TO AWARD
2. DESIGNATE FIRMS CERTIFIED BY THE CITY OFFICE OF BUSINESS OPPORTUNITY ON THIS FORM.
3. DESCRIBE THE WORK TO BE PERFORMED, FOR WHICH THE FIRM IS CERTIFIED, SUCH AS "PAVING", "ELECTRICAL", ETC.
4. **CONTRACTOR SHALL EXECUTE CONTRACTS WITH APPROVED SUBCONTRACTORS AND SUPPLIERS WITHIN 30 DAYS AFTER THE DATE OF THE NOTICE TO PROCEED. COPIES OF CONTRACTS WITH DESIGNNATED FIRMS MUST BE SENT TO THE OFFICE OF BUSINESS OPPORTUNITY.**

SIGNATURE: _____ COMPANY NAME: _____

NAME: _____ TITLE: _____
(Type or Print)

Document 00600

Continuation Page

PROJECT NAME: Keegans Bayou and Greenridge WWTP Improvements
DATE OF REPORT: _____
PROJECT NO.: WBS No. R-000265-0079-4

NAICS (6 digits)	SUBCONTRACTOR OR SUPPLIER (INCLUDE "MWSBE", "PDBE", "DBE", OR "HUB" DESIGNATION)[2]	ADDRESS	SCOPE OF WORK[3]

SIGNATURE: _____ COMPANY NAME: _____

NAME: _____ TITLE: _____
(Type or Print)

END OF DOCUMENT

Document 00601

DRUG POLICY COMPLIANCE AGREEMENT

I, _____ _____,
Name Title

of _____
Contractor

have authority to bind Contractor with respect to its Bid, Proposal, or performance of any and all contracts it may enter into with the City of Houston; and that by making this Agreement, I affirm that Contractor is aware of and by the time the Contract is awarded will be bound by and agree to designate appropriate safety impact positions for company employee positions, and to comply with the following requirements before the City issues a Notice to Proceed:

1. Develop and implement a written Drug Free Workplace Policy and related drug testing procedures for Contractor that meet the criteria and requirements established by the Mayor's Amended Policy on Drug Detection and Deterrence (Mayor's Drug Policy) and the Mayor's Drug Detection and Deterrence Procedures for Contractors (Executive Order No. 1-31).

2. Obtain a facility to collect urine samples consistent with Health and Human Services (HHS) guidelines and an HHS-certified drug-testing laboratory to perform drug tests.

3. Monitor and keep records of drug tests given and results; and upon request from the City of Houston, provide confirmation of such testing and results.

4. Submit semi-annual Drug Policy Compliance Declarations.

I affirm on behalf of Contractor that full compliance with the Mayor's Drug Policy and Executive Order No. 1-31 is a material condition of the Contract with the City of Houston,

I further acknowledge that falsification, failure to comply with or failure to timely submit declarations or documentation in compliance with the Mayor's Drug Policy or Executive Order No. 1-31 will be considered a breach of the Contract with the City and may result in non-award or termination of the Contract by the City.

_____ _____
Contractor Title

_____ _____
Signature Date

END OF DOCUMENT

Document 00603

CHECKLIST FOR DRUG POLICY SUBMITTAL

O:	**CARLOS MARTINEZ** **PWE/DIRECTOR'S OFFICE** **SECURITY MANAGEMENT SECTION** **611 WALKER STREET** **3RD FLOOR ANNEX** **HOUSTON, TEXAS 77002**	**FROM:**	**EBI NASSIRI, P.E.** **MANAGING ENGINEER** **WASTEWATER ENGINEERING SECTION** **ENGINEERING & CONSTRUCTION / PWE**
		DATE:	02-4-2015

CONTRACTOR: «LoBid1Name»

PROJECT NAME: KEEGANS BAYOU AND GREENRIDGE WWTP IMPROVEMENTS

PROJECT No.: WBS No. R-000265-0079-4

PROJECT MANAGER: GAUHER KHAN, P.E. **TELEPHONE: 832-395-2305 FAX: 832-395-2344**

DOCUMENTS CHECKED BELOW ARE BEING SUBMITTED: (Project Manager, check.)

- ☐ **DOC. 00601 - DRUG POLICY COMPLIANCE AGREEMENT (Standard Form)**
- ☐ **DOC. 00602 - CONTRACTOR'S DRUG-FREE WORKPLACE POLICY (Contractor creates this Document)**
- ☐ **DOC. 00605 - LIST OF SAFETY IMPACT POSITIONS (Contractor creates this List)**
  "OR"
- ☐ **DOC. 00606 - CONTRACTOR'S CERTIFICATION OF NO SAFETY IMPACT POSITIONS**

CCODT REVIEW: THE FOLLOWING CHECKED ITEM(S) ARE MISSING FROM SUBMISSION/POLICY AND NEED TO BE CORRECTED PRIOR TO AWARD:

NAME OF DRUG TESTING LAB

REASON FOR TESTING:

- ☐ **RANDOM TESTING - 25% ANNUALLY**
- ☐ **REASONABLE SUSPICION**
- ☐ **POST ACCIDENT**

REJECTED	_____
	_____
	_____
APPROVED	_____

- ☐ **SAFETY IMPACT POSITIONS INCOMPLETE**
- ☐ **EMPLOYEE ACKNOWLEDGMENT FORM**
- ☐ **DRUG TESTING PROCEDURES**
- ☐ **CONSEQUENCE OF POSITIVE TEST:** *PERMANENTLY REMOVED FROM ANY CONTRACT CITY WORKSITE.*
- ☐ **CONSEQUENCE OF REFUSAL TO CONSENT:** *PERMANENTLY REMOVED FROM ANY CONTRACT CITY WORKSITE.* ☐ **OTHER:** _____

COMMENTS: _____

DATE RECEIVED: _____ **RESUBMITTAL DATE:** _____

END OF DOCUMENT

Document 00604

HISTORY OF OSHA ACTIONS AND LIST OF ON-THE-JOB INJURIES

Prior to award of the Contract, Low Bidder will be required to file the following with the City:

1. A history of all OSHA actions, advisories, etc., Contractor has received on all jobs worked in any capacity, prime or subcontractor. The history shall be for the two-year period preceding the Bid Date of the Project.

2. A list of all on-the-job injuries, accidents, and fatalities suffered by any present or former employees of Contractor during the same two-year period.

3. If less than the two-year period, give the date Contractor started doing business.

This information must be submitted to the City within the time period stated in Document 00498 - Notice of Intent to Award. An officer of the company must certify in a notarized statement that the information submitted is true and correct.

END OF DOCUMENT

Document 00605

LIST OF SAFETY IMPACT POSITIONS

****

Contractor is to provide a complete List of Employee Classifications that are considered in a "Safety Impact Position" and the number of employees in each of those classifications.

****

Employee Classification	**Number of Employees**

END OF DOCUMENT

Document 00606

CONTRACTOR'S CERTIFICATION OF
NO SAFETY IMPACT POSITIONS IN PERFORMANCE OF A CITY CONTRACT

BEFORE ME, the undersigned authority, on this day personally appeared

_____,
Affiant

who being by me duly sworn on his oath stated that he is _____
Title

of _____
Contractor

and that no employee safety impact positions, as defined in §5.17 of Executive Order No. 1-31, will be involved in performing _____.
Project

Contractor agrees and covenants that it shall immediately notify the City of Houston Director of Personnel if any safety impact positions are established to provide services in performing this City Contract.

_____
Affiant's Signature

SWORN AND SUBSCRIBED before me on this day of _____, 20___.

_____
Notary Public in and for the State of TEXAS

_____
Print or Type Notary Public Name

My Commission Expires: _____
Expiration Date

END OF DOCUMENT

Document 00607

CERTIFICATION REGARDING DEBARMENT,
SUSPENSION, AND OTHER RESPONSIBILITY MATTERS

Contractor certifies to the best of its knowledge and belief that it and its principals:

1. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal, State, or local department or agency;

2. Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction: violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

3. Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph 2 of this certification; and

4. Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.

I understand that a false statement on this certification may be grounds for rejection of this proposal or termination of the award. In addition, under 18 USC Section 1001, a false statement may result in a fine of up to $10,000 or imprisonment for up to five years, or both.

Company:

_____
Typed Name & Title of Authorized Representative

_____ _____
Signature of Authorized Representative Date

☐ I am unable to certify the above statements. My explanation is attached.

END OF DOCUMENT

Document 00610

PERFORMANCE BOND

THAT WE, _____, as Principal, (the "Contractor"), and the other subscriber hereto, _____, as Surety, do hereby acknowledge ourselves to be held and firmly bound to the City of Houston (the "City"), a municipal corporation, in the penal sum of $_____ for the payment of which sum, well and truly to be made to the City, its successors and assigns, Contractor and Surety do bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH THAT:

WHEREAS, the Contractor has on or about this day executed a Contract in writing with the City for _____
_____,
all of such work to be done as set out in full in said Contract documents therein referred to and adopted by the City Council, all of which are made a part of this instrument as fully and completely as if set out in full herein.

NOW THEREFORE, if the said Contractor shall faithfully and strictly perform the Contract in all its terms, provisions, and stipulations in accordance with its true meaning and effect, and in accordance with the Contract documents referred to therein and shall comply strictly with each and every provision of the Contract and with this Bond, then this obligation shall become null and void and shall have no further force and effect; otherwise the same is to remain in full force and effect. Should the Contractor fail to faithfully and strictly perform the Contract in all its terms, including but not limited to the indemnifications thereunder, the Surety shall be liable for all damages, losses, expenses and liabilities that the City may suffer in consequence thereof, as more fully set forth herein.

It is further understood and agreed that the Surety does hereby relieve the City or its representatives from the exercise of any diligence whatever in securing compliance on the part of the Contractor with the terms of the Contract, and the Surety agrees that it shall be bound to take notice of and shall be held to have knowledge of all acts or omissions of the Contractor in all matters pertaining to the Contract. The Surety understands and agrees that the provision in the Contract that the City will retain certain amounts due the Contractor until the expiration of 30 days from the acceptance of the Work is intended for the City's benefit, and the City will have the right to pay or withhold such retained amounts or any other amount owing under the Contract without changing or affecting the liability of the Surety hereon in any degree.

It is further expressly agreed by Surety that the City or its representatives are at liberty at any time, without notice to the Surety, to make any change in the Contract documents and in the Work to be done thereunder, as provided in the Contract, and in the terms and conditions thereof, or to make any change in, addition to, or deduction from the Work to be done thereunder; and that such changes, if made, shall not in any way vitiate the obligation in this Bond and undertaking or release the Surety therefrom.

It is further expressly agreed and understood that the Contractor and Surety will fully indemnify and save harmless the City from any liability, loss, cost, expense, or damage arising out of Contractor's performance of the Contract.

If the City gives Surety notice of Contractor's default, Surety shall, within 45 days, take one of the following actions:

1. Arrange for Contractor, with consent of the City, to perform and complete the Contract; or

2. Take over and assume completion of the Contract itself, through its agents or through independent contractors, and become entitled to the payment of the balance of the Contract Price.

If the Surety fails to take either of the actions set out above, it shall be deemed to have waived its right to perform and complete the Contract and receive payment of the balance of the Contract Price and the City shall be entitled to enforce any remedies available at law, including but not limited to completing the Contract itself and recovering any cost in excess of the Original Contract Price from the Surety.

This Bond and all obligations created hereunder shall be performable in Harris County, Texas. This Bond is given in compliance with the provisions of Chapter 2253, Texas Government Code, as amended, which is incorporated herein by this reference.

Notices required or permitted hereunder shall be in writing and shall be deemed delivered when actually received or, if earlier, on the third day following deposit in a United States Postal Service post office or receptacle, with proper postage affixed (certified mail, return receipt requested), addressed to the respective other Party at the address prescribed in the Contract documents, or at such other address as the receiving party may hereafter prescribe by written notice to the sending party.

IN WITNESS THEREOF, the said Contractor and Surety have signed and sealed this instrument on the respective dates written below their signatures and have attached current Power of Attorney.

ATTEST, SEAL: (if a corporation)
WITNESS: (if not a corporation)

_____
Name of Contractor

By: _____
Name:
Title:

By: _____
Name:
Title:
Date:

ATTEST/SURETY WITNESS:

(SEAL)

_____
Full Name of Surety

_____
Address of Surety for Notice

_____

_____
Telephone Number of Surety

By: _____
Name:
Title:
Date:

By: _____
Name:
Title: Attorney-in-Fact
Date:

This Ordinance or Contract has been reviewed as to form by the undersigned legal assistant and have been found to meet established Legal Department criteria. The Legal Department has not reviewed the content of these documents.

_____ _____
Legal Assistant Date

END OF DOCUMENT

Document 00611

STATUTORY PAYMENT BOND

THAT WE, _____, as Principal, hereinafter called Contractor and the other subscriber hereto, _____, as Surety, do hereby acknowledge ourselves to be held and firmly bound unto the City of Houston, a municipal corporation, in the sum of $_____ for the payment of which sum, well and truly to be made to the City of Houston, and its successors, the said Contractor and Surety do bind themselves, their heirs, executors, administrators, successors, jointly and severally.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH THAT:

WHEREAS, the Contractor has on or about this day executed a contract in writing with the City of Houston for _____
_____,
all of such work to be done as set out in full in said Contract documents therein referred to and adopted by the City Council, all of which are made a part of this instrument as fully and completely as if set out in full herein;

NOW, THEREFORE, if the said Contractor shall pay all claimants supplying labor and materials to him or a Subcontractor in the prosecution of the Work provided for in the Contract, then, this obligation shall be void; otherwise the same is to remain in full force and effect;

PROVIDED HOWEVER, that this Bond is executed pursuant to the provisions of Chapter 2253, Texas Government Code, as amended, and all liabilities on this Bond shall be determined in accordance with the provisions of said Article to the same extent as if it were copied at length herein.

IN WITNESS THEREOF, the said Contractor and Surety have signed and sealed this instrument on the respective dates written below their signatures and have attached current Power of Attorney.

ATTEST, SEAL: (if a corporation)
WITNESS: (if not a corporation)

_____
Name of Contractor

By: _____
Name:
Title:

By: _____
Name:
Title:
Date:

ATTEST/SURETY WITNESS:

(SEAL)

_____
Full Name of Surety

_____
Address of Surety for Notice

_____

_____
Telephone Number of Surety

By: _____
Name:
Title:
Date:

By: _____
Name:
Title: Attorney-in-Fact
Date:

This Ordinance or Contract has been reviewed as to form by the undersigned legal assistant and have been found to meet established Legal Department criteria. The Legal Department has not reviewed the content of these documents.

_____
Legal Assistant

_____
Date

END OF DOCUMENT

Document 00612

ONE-YEAR MAINTENANCE BOND

THAT WE, _____, as Principal, hereinafter called Contractor, and the other subscriber hereto, _____, as Surety, do hereby acknowledge ourselves to be held and firmly bound to the City of Houston, a municipal corporation, in the sum of $_____, for the payment of which sum well and truly to be made to the City of Houston and its successors, the said Contractor and Surety do bind themselves, their heirs, executors, administrators, successors, jointly and severally.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH THAT:

WHEREAS, the Contractor has on or about this day executed a Contract in writing with the City of Houston for _____
_____,
all of such work to be done as set out in full in said Contract documents therein referred to and adopted by the City Council, all of which are made a part of this instrument as fully and completely as if set out in full herein.

NOW THEREFORE, if the said Contractor shall comply with the provisions of Paragraph 11.5.1 of the General Conditions, and correct work not in accordance with the Contract documents discovered within the established one-year period, then this obligation shall become null and void, and shall be of no further force and effect; otherwise, the same is to remain in full force and effect.

Notices required or permitted hereunder shall be in writing and shall be deemed delivered when actually received or, if earlier, on the third day following deposit in a United States Postal Service post office or receptacle, with proper postage affixed (certified mail, return receipt requested), addressed to the respective other party at the address prescribed in the Contract documents, or at such other address as the receiving party may hereafter prescribe by written notice to the sending party.

IN WITNESS THEREOF, the said Contractor and Surety have signed and sealed this instrument on the respective dates written below their signatures and have attached current Power of Attorney.

ATTEST, SEAL: (if a corporation)
WITNESS: (if not a corporation)

_____
Name of Contractor

By: _____
Name:
Title:

By: _____
Name:
Title:
Date:

ATTEST/SURETY WITNESS:

(SEAL)

_____
Full Name of Surety

_____
Address of Surety for Notice

_____

_____
Telephone Number of Surety

By: _____
Name:
Title:
Date:

By: _____
Name:
Title: Attorney-in-Fact
Date:

This Ordinance or Contract has been reviewed as to form by the undersigned legal assistant and have been found to meet established Legal Department criteria. The Legal Department has not reviewed the content of these documents.

_____
Legal Assistant

_____
Date

END OF DOCUMENT

Document 00613

ONE-YEAR SURFACE CORRECTION BOND

THAT WE, _____, as Principal, hereinafter called Contractor, and the other subscriber hereto, _____, as Surety, do hereby acknowledge ourselves to be held and firmly bound to the City of Houston, a municipal corporation, in the sum of $_____ such sum being equal to four percent of the Original Contract Price, for the payment of which sum to be made to the City of Houston and its successors, Contractor and Surety do bind themselves, their successors, jointly and severally.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH THAT:

WHEREAS, the Contractor has entered into a Contract in writing with the City of Houston, Texas, dated of even date herewith, for _____
_____,
all of such work to be done in accordance with the Contract documents therein referred to, and adopted by the City Council of the City of Houston.

NOW THEREFORE, if the Contractor shall comply with the provisions of Paragraph 11.5.1 of the General Conditions, and repair, replace, restore, and correct surface work associated with backfill operations of subsurface work not in accordance with the Contract documents discovered within one year from the date that the One-year Maintenance Bond has expired, then this obligation shall become null and void, and shall be of no further force and effect; otherwise, the same is to remain in full force and effect.

Notices required or permitted hereunder shall be in writing and shall be deemed delivered when actually received or, if earlier, on the third day following deposit in a United States Postal Service post office or receptacle, with proper postage affixed (certified mail, return receipt requested), addressed to the respective other party at the address prescribed in the Contract documents, or at such other address as the receiving party may hereafter prescribe by written notice to the sending party.

IN WITNESS THEREOF, the said Principal and Surety have signed and sealed this instrument on the respective dates written below their signatures.

ATTEST, SEAL: (if a corporation)
WITNESS: (if not a corporation)

_____
Name of Contractor

By: _____
Name:
Title:

By: _____
Name:
Title:
Date:

ATTEST/SURETY WITNESS:

(SEAL)

_____
Full Name of Surety

_____
Address of Surety for Notice

_____

_____
Telephone Number of Surety

By: _____
Name:
Title:
Date:

By: _____
Name:
Title: Attorney-in-Fact
Date:

This Ordinance or Contract has been reviewed as to form by the undersigned legal assistant and have been found to meet established Legal Department criteria. The Legal Department has not reviewed the content of these documents.

_____ _____
Legal Assistant Date

END OF DOCUMENT

Document 00620

AFFIDAVIT OF INSURANCE

BEFORE ME, the undersigned authority, on this day personally appeared

_____, who
Affiant

being by me duly sworn on his oath stated that he is _____, of
Title

_____,
Contractor's Company Name

the Contractor named and referred to within the Contract documents; that he is fully competent and authorized to give this affidavit and that the attached original insurance certificate truly and accurately reflects the insurance coverage that is now available and will be available during the term of the Contract.

_____
Affiant's Signature

SWORN AND SUBSCRIBED before me on _____.
Date

_____
Notary Public in and for the State of TEXAS

_____
Print or type Notary Public name

My Commission Expires: _____
Expiration Date

END OF DOCUMENT

Form Number: HOU3
Edition Date: 11/01/2014

CITY OF HOUSTON CERTIFICATE OF INSURANCE

This certificate of insurance is provided for informational purposes only, and does not confer any rights or obligations other than the rights and obligations conveyed by the policies referenced on this certificate. The terms of the referenced policies control over the terms of this certificate.

Prior to the beginning of work, the vendor shall obtain the minimum insurance and endorsements specified. Authorized Representatives must complete the form providing all requested information and submit by fax, U.S. mail, or e-mail as requested by the City of Houston. The listed endorsements shall be attached to this certificate; copies of the endorsements are also acceptable. PLEASE ATTACH ALL ENDORSEMENTS TO THIS FORM, AND INCLUDE THE MATCHING POLICY NUMBER ON THE ENDORSEMENT. **Only City of Houston certificates of insurance are acceptable; representatives' certificates are not.**

Producer: [Insert name of Producer]

Street/Mailing Address: [Insert address of Producer]

City: [Insert city] State: [Insert State] Zip Code: [Zip Code]

Insured: [Insert name of the Insured]

Street/Mailing Address: [Insert mailing address of Insured]

City: [Insert city] State: [Insert State] Zip Code: [Zip Code] Phone#: [Office Phone Number]

WORKERS COMPENSATION INSURANCE COVERAGE:
Endorsed with a Waiver of Subrogation in favor of *The City of Houston.*
Waiver of Subrogation Endorsement Number: [Enter Endorsement Form No.]

Carrier Name: [Insert insurance company name] NAIC#: [Insert NAICS code]			Carrier Phone Number: [Office Phone Number]	
Address: [Insert address of insurance company]		City: [Insert city]	State: [Insert State]	Zip: [Zip Code]
Type of Insurance	Policy Number	Effective Date	Expiration Date	Limits of Liability
Workers Compensation Insurance	[Enter Policy Number]	[Enter Effective Date]	[Enter Expiration Date]	☐ W.C. Statutory Limits E.L. Each Accident $[Enter policy amount] E.L. Disease – Each Employee $[Enter policy amount]
Employers' Liability	[Enter Policy Number]	[Enter Effective Date]	[Enter Expiration Date]	E.L. Disease – Policy Limit $[Enter policy amount]

COMMERCIAL GENERAL LIABILITY INSURANCE:
Endorsed with *The City of Houston* as Additional Insured and with a Waiver of Subrogation in favor of *The City of Houston.*
Additional Insured Endorsement #: [Enter Endorsement Form No.] **Waiver of Subrogation Endorsement #:** [Enter Endorsement Form No.]

Carrier Name: [Insert insurance company name] NAIC#: [Insert NAICS code]			Carrier Phone Number: [Office Phone Number]	
Address: [Insert address of insurance company]		City: [Insert city]	State: [Insert State]	Zip: [Zip Code]
Type of Insurance	Policy Number	Effective Date	Expiration Date	Limits of Liability
Commercial General Liability Insurance *(choose one)* ☐ Claims Made ☐ Occurrence	[Enter Policy Number]	[Enter Effective Date]	[Enter Expiration Date]	Each Occurrence: $[Enter policy amount] Products/Completed Operations Aggregate $[Enter policy amount] General Aggregate $[Enter policy amount]

AUTOMOBILE LIABILITY INSURANCE:
Endorsed with *The City of Houston* as Additional Insured and with a Waiver of Subrogation in favor of *The City of Houston*.
Additional Insured Endorsement Number: [Enter Endorsement Form No.] **Waiver of Subrogation Endorsement Number:** [Enter Endorsement Form No.]

Carrier Name: [Insert insurance company name] NAIC#: [Insert NAICS code]			Carrier Phone Number: [Office Phone Number]	
Address: [Insert address of insurance company]		City: [Insert city]	State: [Insert State]	Zip: [Zip Code]
Type of Insurance	Policy Number	Effective Date	Expiration Date	Limits of Liability
☐ Any auto ☐ All Owned autos ☐ Hired Autos ☐ Scheduled Autos ☐ Non-owned Autos	[Enter Policy Number]	[Enter Effective Date]	[Enter Expiration Date]	Combined Single Limit $[Enter policy amount] Bodily Injury (per person) $[Enter policy amount] Bodily Injury (per accident) $[Enter policy amount] Property Damage (per accident) $[Enter policy amount]

OTHER INSURANCE COVERAGE: (i.e. Excess Insurance, MCS-90, OCP or other needed insurance; use 3d page for needed information)

Carrier Name: [Insert insurance company name] NAIC#: [Insert NAICS code]			Carrier Phone Number: [Office Phone Number]	
Address: [Insert address of insurance company]		City: [Insert city]	State: [Insert State]	Zip: [Zip Code]
Type of Insurance	Policy Number	Effective Date	Expiration Date	Limits of Liability
Umbrella Liability	[Enter Policy Number]	[Enter Effective Date]	[Enter Expiration Date]	$[Enter policy amount]
Pollution	[Enter Policy Number]	[Enter Effective Date]	[Enter Expiration Date]	$[Enter policy amount]
Builder's Risk	[Enter Policy Number]	[Enter Effective Date]	[Enter Expiration Date]	$[Enter policy amount]
Other [Enter Other Insurance]	[Enter Policy Number]	[Enter Effective Date]	[Enter Expiration Date]	$[Enter policy amount]
Other [Enter Other Insurance]	[Enter Policy Number]	[Enter Effective Date]	[Enter Expiration Date]	$[Enter policy amount]

CANCELLATION
SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

PROJECT DESCRIPTION (Insert Project Manager Name, City Department and Mailing Address, and WBS Number, as needed)

[Insert Project Manager Name, City Department and Mailing Address, WBS Number, and Project Description]

AUTHORIZED REPRESENTATIVE CERTIFICATION
THIS IS TO CERTIFY TO THE CITY OF HOUSTON that the insurance policies above are in full force and effect.

Name of Authorized Representative: [Insert name of Authorized Representative]
Representative's Address: [Insert address of Authorized Representative]
City: [Insert city] State: [Insert State] Zip: [Zip Code]
Authorized Representative's Phone Number (including Area Code): [Authorized Representative's Office Phone Number]
Signature of Authorized Representative X
Date [Date of Signature]

Additional Notes:

WORKERS COMPENSATION INSURANCE COVERAGE (e.g., limits, self-insured retention, deductibles)

_____
_____
_____
_____

As applicable: Self-Insured Retention: _____ Deductible: _____

COMMERCIAL GENERAL LIABILITY INSURANCE (e.g., limits, self-insured retention, deductibles)

_____
_____
_____
_____

As applicable: Self-Insured Retention: _____ Deductible: _____

AUTOMOBILE LIABILITY INSURANCE (e.g., limits, self-insured retention, deductibles)

_____
_____
_____
_____

As applicable: Self-Insured Retention: _____ Deductible: _____

OTHER INSURANCE COVERAGE (e.g., limits, self-insured retention, deductibles)

_____
_____
_____
_____

As applicable: Self-Insured Retention: _____ Deductible: _____

Additional Carrier Information (if multiple carriers providing insurance)

Carrier Name: [Insert insurance company name]
NAIC#: [Insert NAICS code]
Carrier Phone Number: [Insert Office Phone Number]
Type of Insurance: [Insert specific type of insurance]
Policy #: [Enter Policy Number]
Limits of Liability: $[Enter policy amount]

Carrier Name: [Insert insurance company name]
NAIC#: [Insert NAICS code]
Carrier Phone Number: [Insert Office Phone Number]
Type of Insurance: [Insert specific type of insurance]
Policy #: [Enter Policy Number]
Limits of Liability: $[Enter policy amount]

Carrier Name: [Insert insurance company name]
NAIC#: [Insert NAICS code]
Carrier Phone Number: [Insert Office Phone Number]
Type of Insurance: [Insert specific type of insurance]
Policy #: [Enter Policy Number]
Limits of Liability: $[Enter policy amount]

Document 00624

AFFIDAVIT OF COMPLIANCE WITH
AFFIRMATIVE ACTION PROGRAM

BEFORE ME, the undersigned authority, on this day personally appeared

_____, who
Affiant

being by me duly sworn on his oath stated that he is _____,
Title

of _____,
Contractor

the Contractor named and referred to within the Contract documents; that he is fully competent and authorized to give this affidavit and that the Contract is in compliance with the Affirmative Action Program of the City and has done all that is required by the Contract documents, the Affirmative Action Program, and pursuant to Chapter 15, Code of Ordinances, City of Houston, §15.16 et seq.

_____
Affiant's Signature

SWORN AND SUBSCRIBED before me on this day of _____, 20___.

_____
Notary Public in and for the State of TEXAS

_____
Print or Type Notary Public Name

My Commission Expires: _____
Expiration

END OF DOCUMENT

Document 00630
(POP-2)
City of Houston
Certification of Compliance with
Pay or Play Program

Contractor Name: _____ $ _____
(Contractor/Subcontractor) *(Amount of Contract)*

Contractor Address: _____

Project No.: «WBSNo» _____

Project Name: «LegalPrjName» _____

POP Liaison Name: _____

In accordance with the City of Houston Pay or Play Program authorized by Ordinance 2007-534 and Executive Order 1-7, Contractor/Subcontractor agrees to abide by the terms of this Program. This certification is required of all contractors for contracts subject to the program. You must agree EITHER to PAY or to PLAY for all covered employees. The Contractor/Subcontractor may also Pay on behalf of some covered employees and Play on behalf of other covered employees.

The Contractor/Subcontractor will comply with all provisions of the Pay or Play Program and will furnish all information and reports requested to determine compliance with program requirements of the Pay or Play Program (See Executive Order 1-7 for the terms of the Pay or Play program) The criteria of the program is as follows:

The Contractor/Subcontractor agrees to **"Pay"** $1.00 per hour for work performed by covered employees under the contract with the City. If independent contract labor is utilized the Contractor/Subcontractor agrees to report hours worked by the independent contract laborer and pay $1.00 per hour for work performed.

Otherwise the Contractor/Subcontractor agrees to **"Play"** by providing health benefits to each covered employee. The health benefits must meet the following criteria:

1. The employer will contribute no less than $150 per employee per month toward the total premium cost for single coverage only; and
2. The employee contribution, if any amount, will be no greater than 50% of the total premium cost and no more than $150 per month.
3. Pursuant to E.O. 1-7 section 4.04 a contractor is deemed to have complied with respect to a covered employee who is not provided health benefits if the employee refuses the benefits and the employee's contribution to the premium is no more than $40 per month.

The Contractor/Subcontractor will file compliance reports with the City, which will include activity for covered employees subject to the program, in the form and to the extent requested by the administering department. Compliance reports shall contain information including, but not limited to, documentation showing employee health coverage and employee work records.
Note: The Contractor is responsible to the City for the compliance of covered employees of covered subcontractors and only forms that are accurate and complete will be accepted.

*Estimated Number of:	Prime Contractor	Sub-Contractor
Total Employees on City Job		
Covered Employees		
Non-Covered Employees		
Exempt Employees		

***Required**

I hereby certify that the above information is true and correct.

_____ _____
Contractor ***(Signature)*** Date

_____
Name and Title ***(Print or type)***

Document 00631
(POP-3)
City of Houston
Pay or Play Program
List of Subcontractors

Prime Contractor: _____
Project Number/Description: _____

POP Contact Person: _____
Address: _____
Email: _____
Phone: _____

Note: Include ALL subcontractors (use additional form if necessary)

Subcontractor Name	Supplier Y/N?	Amount of Subcontract	Check One: Pay	Check One: Play	Check One: Both (Pay and Play)	Check One: N/A	Contact Person	Phone	Email Address	Mailing Address

*If the above information is found to be submitted fraudulently with the intent to bypass or deceive the purpose of the Pay or Play Program the contractor will be held liable for all compliance requirements from the inception of the contract. All subcontracts that surpass the $200,000.00 threshold will be responsible for Pay or Play compliance from the inception of the contract.

Affidavit

I hereby solemnly affirm, certify and confirm that the total sub-contract value stated above is the final value of the contract (*) including all material costs, fuel, payroll, taxes, fees, profit sharing, labor or any payments in relation to the contracted work and no separate payment or contract has been made for the sub-contract under contract no._____ . The above sub-contract value includes all the costs related to work under the contract. The contractor and sub-contractor(s) agree to inform The Mayor's Office of Business Opportunity of any related cost(s) added to the contracted work and re-submit POP-3 with the current value of the sub-contract. I understand that compliance with "Pay or Play" program is mandatory and nothing has been hidden to circumvent the program requirements.

_____
Contractor Authorized Representative & Title Date
Name & Signature

Document 00633

CERTIFICATION BY PROPOSED MATERIAL SUPPLIERS,
LESSORS, AND PROFESSIONAL SERVICE PROVIDERS
REGARDING EQUAL EMPLOYMENT OPPORTUNITY

Company Name: _____ $_____
(Supplier, Lessor, Professional Service Provider) (Amount of Contract)

Company Address: _____

Company Telephone Number:_____ Fax:_____

E-mail Address: _____

Web Page/URL Address:_____

Company Tax Identification Number: _____

Project No.: [*WBS/CIP/AIP/File No.*] _____

Project Name: [*Legal Project Name*] _____

In accordance with the City of Houston Ordinance 78-1538, Supplier/Lessor/Professional Service Provider represents to be an equal opportunity employer and agrees to abide by the terms of the Ordinance. This certification is required of all Suppliers/Lessors/Professional Service Providers (herein Supplier) with contracts in the amount of $10,000.00 or more.

[ ] Yes [ ] No Supplier agrees not to discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, or age.

[ ] Yes [ ] No Supplier agrees that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex, national origin, or age.

[ ] Yes [ ] No Supplier will comply with all provisions of Executive Order No. 11246 and rules, regulations and applicable orders of the Department of Labor or other Federal Agency responsible for enforcement of applicable equal opportunity and affirmative action provisions and will likewise furnish all information and reports required by the Mayor or Contract Compliance Officers for the purpose of investigation to ascertain and effect compliance with the City of Houston's Office of Affirmative Action and Contract Compliance.

[ ] Yes [ ] No The Supplier shall file and cause their sub-tier contractors to file compliance reports with the City in the form and to the extent as may be prescribed by the Mayor or Contract Compliance Officers. Compliance reports filed at such times as directed shall contain information including, but not limited to, the practices, policies, programs, and employment policies.

I hereby certify that the above information is true and correct.

_____ _____
COMPANY OFFICER (Signature) DATE

_____
NAME AND TITLE (Print or type)

END OF DOCUMENT

Document 00642

MONTHLY SUBCONTRACTOR PAYMENT REPORTING FORM

Legal Project Name:_____

Outline Agreement No.:_____ WBS No.:_____

Contractor's Company Name: _____

Address: _____

CERTIFICATION

_____, Contractor's Representative for the above referenced Contract, hereby certifies that (1) Contractor has paid all subcontractors, except those noted below, (2) Contractor made such payments (a) in proportion to the amount City paid Contractor and (b) in accordance and compliance with all applicable Contract Documents and laws; and (3) Contractor withheld no sums from any subcontractor for allegations of deficiency in Work. The term "subcontractor", as used herein, includes all persons or firms furnishing work, materials, services or equipment Contractor ordered incorporated into Work or placed near the Project for which the City made partial payment.

EXCEPTION: Contractor sent Payment Notifications to the following subcontractors explaining why Contractor withheld payment. Copies are attached.

Subcontractor Name:_____	Subcontractor Name: _____
Street Address: _____	Street Address: _____
City, State, and Zip Code: _____	City, State, and Zip Code: _____
Amount of Payment Withheld:_____	Amount of Payment Withheld: _____
Date Payment First Withheld: _____	Date Payment First Withheld: _____
Description of Good Faith Reason:_____	Description of Good Faith Reason:_____
_____	_____

_____
(Signature of Contractor's Representative)

_____
(Print or Type Name of Contractor's Representative)

SWORN TO AND SUBSCRIBED before me on:

_____
Date

_____
Notary Public in and for the State of Texas

My Commission Expires: _____
Expiration Date

_____
Print or Type Name of Notary Public

Document 00646

PAYMENT NOTIFICATION – EXPLANATION OF WITHHOLDING

Legal Project Name:_____

Outline Agreement No.:_____ WBS No.:_____

Contractor's Company Name: _____

Address: _____

Date: _____

SUBCONTRACTOR PAYMENT INFORMATION:

Subcontractor Name:_____

Street Address: _____

City, State, and Zip Code: _____

Business Phone Number: _____

Amount of Subcontractor Invoice: _____

Amount of Payment Made: _____

Amount of Payment Withheld:_____

Date Payment First Withheld: _____

DETAILED EXPLANATION OF WITHHOLDING: _____

_____

_____

_____

_____

_____ _____

(Signature of Contractor's Representative) (Print or Type Name of Contractor's Representative)

Document 00700

GENERAL CONDITIONS

August 15, 2015 EDITION

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ARTICLE 1 - GENERAL PROVISIONS

1.1 DEFINITIONS

1.1.1 Agreement: Document signed by the Parties and binding the Parties, containing the name of Contractor, title and location of the Project, Original Contract Time, Original Contract Price, enumeration of documents included in the Contract, and other provisions.

1.1.2 Bonds: Performance Bond, Payment Bond, Maintenance Bond, and other Surety instruments executed by Surety. When in singular form, refers to individual instrument.

1.1.3 Business Enterprise: Any business entity registered in a program authorized by 49 C.F.R. § 26 (where applicable) or City Code of Ordinances, Chapter 15, Article II, relating to Equal Opportunity Employment and taking affirmative action to ensure that applicants are employed and employees are treated without regard to race, religion, color, sex, national origin, or age. The term "Business Enterprise" may include any Disadvantaged Business Enterprise ("DBE"), Minority Business Enterprise ("MBE"), Woman Business Enterprise ("WBE"), Small Business Enterprise ("SBE"), Person with Disability Enterprise ("PDBE"), and any Historically Underutilized Business ("HUB").

1.1.4 Business Enterprise Policy: Contract documents and applicable policies relating to Business Enterprises and authorized under 49 C.F.R. § 26 or City Code of Ordinances, Chapter 15, Article II.

1.1.5 Cash Allowance: An estimated sum of money to be used only for a limited class of expenditures such as utility relocation costs, fees for special licenses or permits, or other "pass-through" costs that would be the same for any contractor. Cash Allowances may not be used to purchase goods or services that are not specified in the Contract. The unspecified items must be purchased according to the terms of Article 7.

1.1.6 Change Order: Written instrument prepared by the City and signed by City Engineer and Contractor, specifying the following:

1.1.6.1 a change in the Work;
1.1.6.2 a change in Contract Price, if any; and
1.1.6.3 a change in Contract Time, if any.

The value of a Change Order is the net amount after offsetting all deductions against all additions effected by the Change Order.

1.1.7 City: The City of Houston, a home rule municipality located principally within Harris County, Texas, including its successors and its authorized representatives.

1.1.8 City Engineer: The City Engineer, or the City employee representing the City Engineer, designated in the Agreement and authorized to represent the City, or successors.

1.1.9 Claim: Written demand or written assertion by one Party seeking adjustment of the Contract, payment of money, extension of time, or other relief under the Contract and includes, but is not limited to, claims for materials, labor, equipment, delay, changes, adjustments, substitutions, fees and third party claims. The Party making the Claim has the responsibility to substantiate the Claim.

1.1.10 Conditions of the Contract: General Conditions and Supplementary Conditions.

1.1.11 Construction Manager: Person or firm under contract with the City as its authorized representative to oversee and administer construction of the Work, and who may perform the role of Project Manager and Inspector, as designated by City Engineer in writing.

1.1.12 Contract: The Agreement; documents enumerated in and incorporated into the Agreement, Modifications, and amendments.

1.1.13 Contract Price: The monetary amount stated in the Agreement adjusted by Change Order, and increases or decreases in Unit Price Quantities, if any.

1.1.14 Contract Time: The number of days stated in the Agreement to substantially complete the Work, plus days authorized by Change Order.

1.1.15 Contractor: Person or firm identified as such in the Agreement including its successors and its authorized representatives.

1.1.16 Date of Commencement of the Work: Date established in Notice to Proceed on which Contract Time will commence. This date will not be changed by failure of Contractor, or persons or entities for whom Contractor is responsible, to act.

1.1.17 Date of Substantial Completion: Date that construction, or portion thereof designated by City Engineer, is certified by City Engineer to be substantially complete.

1.1.18 Design Consultant: Person or firm, under contract with the City, to provide professional services during construction and its authorized representatives. If a Design Consultant is not employed for services during construction, Project Manager will perform duties of Design Consultant designated in the Contract in addition to usual duties of Project Manager.

1.1.19 Drawings: Graphic and pictorial portions of the Contract that define the character and scope of the Work.

1.1.20 Extra Unit Price: Unit Prices, which may be required for completion of the Work. These Unit Prices and Unit Price Quantities are in the Contract and are included in Original Contract Price.

1.1.21 Furnish: To supply, pay for, deliver to the site, and unload.

1.1.22 General Requirements: The sections of Division 01 Specifications that specify administrative and procedural requirements and temporary facilities required for the Work.

1.1.23 Inspector: City's employee or agent authorized to assist with inspection of the Work.

1.1.24 Install: Unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, clean, protect, and similar operations.

1.1.25 Legal Holiday: Day established by the City Council as a holiday.

1.1.26 Major Unit Price Work: An individual Unit Price item,

1.1.26.1 whose value is greater than five percent of Original Contract Price,

1.1.26.2 whose value becomes greater than five percent of Original Contract Price as the result of an increase in quantity, or

1.1.26.3 whose value is $100,000, whichever is least.

1.1.27 Minor Change in the Work: A written change in the Work, ordered by City Engineer, that does not change Contract Price or Contract Time, and that is consistent with the general scope of the Contract.

1.1.28 Modification: Change Order, Work Change Directive, or Minor Change in the Work.

1.1.29 Notice of Noncompliance: A written notice by City Engineer to Contractor regarding defective or nonconforming work that does not meet the Contract requirements, and that establishes a time by which Contractor shall correct the defective or nonconforming work.

1.1.30 Notice to Proceed: A written notice by City Engineer to Contractor establishing Date of Commencement of the Work.

1.1.31 Office of Business Opportunity: any reference to, or use of, the "Office of Affirmative Action" shall mean the Office of Business Opportunity, or any such future name to which it is changed.

1.1.32 Original Contract Price: The monetary amount originally stated in the Agreement.

1.1.33 Parties: Contractor and the City. When in singular form, refers to Contractor or the City.

1.1.34 Pollutant: Any materials subject to the Texas Solid Waste Disposal Act.

1.1.35 Pollutant Facility: Any facility regulated by the State of Texas to protect the health and environment from contamination by Pollutants, including without limitation, landfills, oil and gas production and storage facilities, wastewater facilities, waste injection wells, and storage tanks (including drums).

1.1.36 Product: Materials, equipment, or systems incorporated into the Work or to be incorporated into the Work.

1.1.37 Product Data: Illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by Contractor to illustrate a Product.

1.1.38 Project: Total construction, of which the Work performed under the Contract may be the whole or a part, and which may include construction by the City or by separate contractors.

1.1.39 Project Manager: City Engineer's authorized representative for administration of the Work. Titles used within the City's departments may be different than those used in this definition.

1.1.40 Provide: Furnish and Install, complete, ready for intended use.

1.1.41 *Samples:* Physical examples that illustrate Products, or workmanship, and establish standards by which the Work is judged.

1.1.42 *Shop Drawings:* Drawings, diagrams, schedules, and other data specially prepared for the Work by Contractor, Subcontractor or Supplier, to illustrate a portion of the Work.

1.1.43 *Specifications:* Divisions 01 through 16 of the documents that are incorporated into the Agreement, consisting of written General Requirements and requirements for Products, standards, and workmanship for the Work, and performance of related services.

1.1.44 *Stipulated Price:* Single lump sum amount stated in the Contract for completion of the Work, or for designated portion of the Work.

1.1.45 *Subcontractor:* Person or firm that has direct or indirect contract with Contractor or with another Subcontractor to perform a portion of the Work and its authorized representatives.

1.1.46 *Superintendent:* Employee of Contractor having authority and responsibility to act for and represent Contractor.

1.1.47 *Supplementary Conditions:* Part of Conditions of the Contract that amends or supplements General Conditions.

1.1.48 *Supplier:* Manufacturer, distributor, materialman, or vendor having a direct agreement with Contractor or Subcontractor for Products, or services and its authorized representatives.

1.1.49 *Surety:* Corporate entity that is bound by one or more Bonds, and is responsible for completion of the Work, including the correction period, and for payment of debts incurred in fulfilling the Contract. Surety shall include co-surety or reinsurer, as applicable.

1.1.50 *Underground Facilities:* Pipes, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments and encasements containing such facilities that exist below ground level.

1.1.51 *Unit Price:* An amount stated in the Contract for an individual, measurable item of work, which, when multiplied by actual quantity incorporated into the Work, amounts to full compensation for completion of the item, including work incidental to it.

1.1.52 *Unit Price Quantities:* Quantities indicated in the Contract that are approximations made by the City for contracting purposes.

1.1.53 *Work:* Entire construction required by the Contract, including all labor, Products, and services provided by Contractor to fulfill Contractor's obligations. The Work may constitute the whole or a portion of the Project.

1.1.54 *Work Change Directive:* A written change in the Work, ordered by City Engineer, that is within the general scope of the Contract and consisting of additions, deletions, or other revisions. A Work Change Directive will state proposed basis for adjustment, if any, in Contract Price or Contract Time, or both.

1.2 *EXECUTION, CORRELATION, AND INTENT*

1.2.1 Execution of the Contract by Contractor is conclusive that Contractor has visited the Work site, become familiar with local conditions under which the Work will be performed, and fully informed itself as to conditions and matters which can affect the Work or costs. Contractor further agrees that it has carefully correlated personal observations with requirements of the Contract.

1.2.2 The Contract and Modifications have been read and carefully considered by Contractor, who understands and agrees to their sufficiency for the Work. The Contract may not be more strongly construed against the City than against Contractor and Surety.

1.2.3 Contractor shall include all items necessary for proper execution and completion of the Work.

1.2.4 Reference to standard specifications, manuals, or codes of a technical society, organization, or association, or to laws or regulations of a governmental authority, whether specific or implied, mean the latest edition in effect as of date of receipt of bids, except as may be otherwise specifically stated in the Contract.

1.2.5 No provision of any referenced standard, specification, or manual changes the duties and responsibilities of the City, City Engineer, Contractor, or Design Consultant from those set forth in the Contract. Nor do these provisions assign to Design Consultant any duty or authority to supervise or direct performance of the Work or any duty or

authority to undertake any actions contrary to provisions of the Contract.

1.2.6 Organization of Specifications into divisions, sections, and articles and arrangement of Drawings does not control Contractor in dividing the Work among Subcontractors or in establishing the extent of work to be performed by any trade.

1.2.7 Unless otherwise defined in the Contract, words which have well-known construction industry technical meanings are used in the Contract in accordance with these recognized meanings.

1.3 OWNERSHIP AND USE OF DOCUMENTS

1.3.1 Drawings, Specifications, and other documents prepared by the City or by Design Consultant are instruments of service through which the Work to be executed by Contractor is described. Contractor may retain one Contract record set.

1.3.2 Neither Contractor, Subcontractor, nor Supplier will own or claim a copyright to documents contained in the Contract or any part of the Contract.

1.3.3 Documents contained in the Contract, prepared by the City or by Design Consultant, and copies furnished to Contractor, are for use solely with respect to the Work. They may not be used by Contractor, Subcontractor or Supplier on other projects or for additions to the Work, outside the scope of the Work, without the specific written consent of City Engineer, and Design Consultant, when applicable.

1.3.4 Contractor, Subcontractors, and Suppliers are granted a limited license to use and reproduce applicable portions of the Contract appropriate to and for use in execution of their work under the Contract.

1.4 *INTERPRETATION*

1.4.1 Specifications are written in an imperative streamlined form and are directed to Contractor, unless noted otherwise. When written in this form, words "shall be" are included by inference where a colon (:) is used within sentences or phrases.

1.4.2 In the interest of brevity, the Contract frequently omits modifying words such as "all" and "any" and articles such as "the" and "an", but an absent modifier or article is not intended to affect interpretation of a statement.

ARTICLE 2 - THE CITY

2.1 *LIMITATIONS OF THE CITY'S OFFICERS AND EMPLOYEES*

2.1.1 No officer or employee of the City may authorize Contractor to perform an act or work contrary to the Contract, except as otherwise provided in the Contract.

2.2 *DUTIES OF THE CITY*

2.2.1 If a building permit is required, the City will process an application for, and Contractor shall purchase the building permit before Date of Commencement of the Work.

2.2.2 The City will make available to Contractor a reproducible set of Drawings. Additional copies will be furnished, on Contractor's request, at the cost of reproduction.

2.2.3 When necessary for performance of the Work, the City will provide surveys describing physical characteristics, legal limitations, legal description of site, and horizontal and vertical control adequate to lay out the Work.

2.2.4 Information or services that the City is required to provide under the Contract will be provided by the City with reasonable promptness to avoid delay in orderly progress of the Work.

2.2.5 The Contract imposes no implied duty on the City. The City does not warrant any plans or specifications associated with the Contract.

2.2.6 Except as expressly stated in this Article, the City owes no duty to the Contractor or any subcontractor.

2.3 *AVAILABILITY OF LAND AND USE OF SITE*

2.3.1 The City will furnish, as indicated in the Contract, rights-of-way, land on which the Work is to be performed, and other land designated in the Contract for use by Contractor unless otherwise provided in the Contract.

2.3.2 Contractor shall confine operations at site to those areas permitted by law, ordinances, permits, and the Contract, and may not unreasonably encumber site with materials or equipment.

2.3.3 In addition to land provided by the City under Section 2.3, Contractor shall provide all land and access to land that may be required for use by Contractor for temporary construction facilities or for storage of materials and equipment, and shall indemnify the City during its use of the land as stated in Section 3.25.

2.4 *THE CITY'S RIGHT TO STOP THE WORK*

2.4.1 If Contractor fails to carry out the Work in accordance with the Contract, or fails to correct work which is not in accordance with requirements of the Contract as required in Sections 12.1 and 12.2, the City may, by Notice of Noncompliance, order Contractor to stop the Work or any portion of the Work until the cause for the order has been eliminated. However, the right of the City to stop the Work will not give rise to a Claim for delay or to a duty on the part of the City to exercise this right for the benefit of Contractor or any other person or entity, except to the extent required by Section 6.2. If Contractor corrects the defective or nonconforming work within the time established in Notice of Noncompliance, City Engineer will give written notice to Contractor to resume performance of the Work.

2.5 *THE CITY'S RIGHT TO CARRY OUT WORK*

2.5.1 If Contractor fails to carry out work in accordance with the Contract, and fails within the period established in a Notice of Noncompliance to correct the nonconforming work, the City may, after expiration of the required period, correct the deficiencies without prejudice to other remedies the City may have, including rights of the City under Section 14.1.

2.5.1.1 When the City corrects deficiencies, City Engineer will issue an appropriate Change Order and deduct from payments then or thereafter due Contractor the cost of correcting the deficiencies, including compensation for Design Consultant's and Construction Manager's additional services and expenses made necessary by such default, neglect, or failure. This action by the City and amounts charged to Contractor are both subject to prior approval of City Engineer. If payments, then or thereafter due Contractor, are not sufficient to cover these amounts, Contractor shall pay the difference to the City.

2.5.2 Notwithstanding the City's right to carry out work, maintenance and protection of the Work remains Contractor's responsibility, as provided in the Contract.

ARTICLE 3 - CONTRACTOR

3.1 *RESPONSIBILITIES*

3.1.1 Contractor shall maintain office with agent in the greater City of Houston area during the Contractor's performance under the Contract. Contractor shall file its street address with City Engineer.

3.1.2 Contractor and Contractor's employees shall not give or lend money or anything of value to an officer or employee of the City. Should this Paragraph 3.1.2 be violated, City Engineer may terminate the Contract under Section 14.1.

3.2 *REVIEW OF CONTRACT AND FIELD CONDITIONS BY CONTRACTOR*

3.2.1 Contractor shall carefully study and compare documents contained in the Contract with each other and with information furnished by the City pursuant to Section 2.2 and shall immediately report, in writing, any errors, inconsistencies, or omissions to City Engineer. If work is affected, Contractor shall obtain a written interpretation or clarification from City Engineer before proceeding with the affected work. However, Contractor will not be liable to the City for failure to report an error, inconsistency, or omission in the Contract unless Contractor had actual knowledge or should have had knowledge of the error, inconsistency, or omission.

3.2.2 Contractor shall take field measurements and verify field conditions, and shall carefully compare the conditions and other information known to Contractor with the Contract, before commencing activities. Contractor shall immediately report, in writing, to City Engineer for interpretation or clarification of discrepancies, inconsistencies, or omissions discovered during this process.

3.2.3 Contractor shall make a reasonable attempt to understand the Contract before requesting interpretation from City Engineer.

3.3 *SUPERVISION AND CONSTRUCTION PROCEDURES*

3.3.1 Contractor shall supervise, direct, and inspect the Work competently and efficiently, devoting the attention and applying the skills and

expertise as necessary to perform the Work in accordance with the Contract. Contractor is solely responsible and has control over construction means, methods, techniques, sequences, and procedures of construction; for safety precautions and programs in connection with the Work; and for coordinating all work under the Contract.

3.3.2 Regardless of observations or inspections by the City or City's consultants, Contractor shall perform and complete the Work in accordance with the Contract and submittals approved pursuant to Section 3.18. The City is not liable or responsible to Contractor or Surety for work performed by Contractor that is not in accordance with the Contract regardless of whether discovered during construction or after acceptance of the Work.

3.4 *SUPERINTENDENT*

3.4.1 Contractor shall employ a competent Superintendent and necessary assistants who shall be present at the site during performance of the Work. Communications given to Superintendent are binding on the Contractor.

3.4.2 Contractor shall notify City Engineer in writing of its intent to replace the Superintendent. Contractor may not replace the Superintendent if City Engineer makes a reasonable objection in writing.

3.5 *LABOR*

3.5.1 Contractor shall provide competent, qualified personnel to survey and lay out the Work and perform construction as required by the Contract. The City may, by written notice, require Contractor to remove from the Work any employee of Contractor or Subcontractors to whom City Engineer makes reasonable objection.

3.5.2 Contractor shall comply with the applicable Business Enterprise Policy set out in this Agreement and in the Supplementary Conditions, as set out in Chapter 15, Article V of the City of Houston Code of Ordinances.

3.5.3 When Original Contract Price is greater than $1,000,000, Contractor shall make Good Faith Efforts to award subcontracts or supply agreements in at least the percentages set out in the Supplementary Conditions for Business Enterprise Policy. Contractor acknowledges that it has reviewed the requirements for Good Faith Efforts on file with the City's Office of Business Opportunity and shall comply with them.

3.5.3.1 Contractor shall require written subcontracts with Business Enterprises and shall submit all disputes with Business Enterprises to voluntary mediation. Business Enterprise subcontracts complying with City Code of Ordinances Chapter 15, Article II must contain the terms set out in Subparagraph 3.5.3.2. If Contractor is an individual person, as distinguished from a corporation, partnership, or other legal entity, and the amount of the subcontract is $50,000 or less, the subcontract must also be signed by the attorneys of the respective parties.

3.5.3.2 Contractor shall ensure that subcontracts with Business Enterprise firms are clearly labeled **"THIS CONTRACT MAY BE SUBJECT TO MEDIATION ACCORDING TO THE TEXAS ALTERNATIVE DISPUTE RESOLUTION ACT"** and contain the following terms:

3.5.3.2.1 (Business Enterprise) may not delegate or subcontract more than 50 percent of work under this subcontract to any other subcontractor without the express written consent of the City's OBO Director (the "Director").

3.5.3.2.2 (Business Enterprise) shall permit representatives of the City of Houston, at all reasonable times, to perform (1) audits of the books and records of the Subcontractors and Suppliers, and (2) inspections of all places where work is to be undertaken in connection with this subcontract. (Business Enterprise) shall keep the books and records available for this purpose for at least four years after the end of its performance under this subcontract. Nothing in this provision shall affect the time for bringing a cause of action nor the applicable statute of limitations.

3.5.3.2.3 Within five business days of execution of this subcontract, Contractor and (Business Enterprise) shall designate in writing to the Director an agent for receiving any notice required or permitted to be given pursuant to Chapter 15 of the Houston City Code of Ordinances, along with the street and mailing address and phone number of the agent.

3.5.4 The requirements and terms of the City of Houston Pay or Play Program, as set out in Executive Order 1-7 and Ordinance 2007-0534, are incorporated into the Contract for all purposes. Contractor shall comply with the terms and conditions of the Pay or Play Program as they are set out at the time of City Council approval of this

agreement. IF CONTRACTOR DOES NOT PAY IN ACCORDANCE WITH THE PAY OR PLAY PROGRAM WITHIN 30 DAYS OF THE DATE CITY ENGINEEER SENDS CONTRACTOR WRITTEN NOTIFICATION, CITY CONTROLLER MAY DEDUCT FUNDS UP TO THE AMOUNT OWED FROM ANY PAYMENTS OWED TO CONTRACTOR UNDER THIS AGREEMENT, AND CONTRACTOR WAIVES ANY RECOURSE.

3.6 *PREVAILING WAGE RATES*

3.6.1 Contractor shall comply with governing statutes providing for labor classification of wage scales for each craft or type of laborer, worker, or mechanic.

3.6.2 Prevailing wage rates applicable to the Work may be one or a combination of the following wage rates identified in Division 00:

- 3.6.2.1 Federal Wage Rate General Decisions
  - 3.6.2.1.1 Highway Rates
  - 3.6.2.1.2 Building Rates
  - 3.6.2.1.3 Heavy Construction Rates
  - 3.6.2.1.4 Residential Rates
- 3.6.2.2 City Prevailing Wage Rates
  - 3.6.2.2.1 Building Construction Rates
  - 3.6.2.2.2 Engineering Construction Rates
  - 3.6.2.2.3 Asbestos Worker Rates

3.6.3 Each week Contractor shall submit to the City's Mayor's Office of Business Opportunity certified copies of payrolls showing classifications and wages paid by Contractor, Subcontractors, and Suppliers for each employee under the Contract, for any day included in the Contract.

3.7 *LABOR CONDITIONS*

3.7.1 In the event of labor disputes affecting Contractor or Contractor's employees, Contractor shall utilize all possible means to resolve disputes in order that the Work not be delayed to any extent. These means will include seeking injunctive relief and filing unfair labor practice charges, and any other action available to Contractor.

3.7.2 When Contractor has knowledge that any actual or potential labor dispute is delaying or is threatening to delay timely performance of the Work, Contractor shall immediately notify City Engineer in writing. No Claims will be accepted by City Engineer for costs incurred as a result of jurisdictional or labor disputes.

3.8 *DRUG DETECTION AND DETERRENCE*

3.8.1 It is the policy of the City to achieve a drug-free work force and to provide a workplace that is free from the use of illegal drugs and alcohol. It is also the policy of the City that manufacture, distribution, dispensation, possession, sale, or use of illegal drugs or alcohol by contractors while on the City's premises is prohibited. By executing the Contract, Contractor represents and certifies that it meets and will comply with all requirements and procedures set forth in the Mayor's Policy on Drug Detection and Deterrence, City Council Motion No. 92-1971 ("Mayor's Policy") and the Mayor's Drug Detection and Deterrence Procedures for Contractors, Executive Order No. 1-31, (Revised) ("Executive Order"). Mayor's Policy is on file in the office of the City Secretary. Copies of Executive Order may be obtained at the location specified in the Advertisement for Bids.

3.8.1.1 The Executive Order applies to the City's contracts for labor or services except the following:

- 3.8.1.1.1 contracts authorized by Emergency Purchase Orders,
- 3.8.1.1.2 contracts in which imposition of requirements of the Executive Order would exclude all potential bidders or proposers, or would eliminate meaningful competition for the Contract,
- 3.8.1.1.3 contracts with companies that have fewer than 15 employees during any 20-week period during a calendar year and no safety impact positions,
- 3.8.1.1.4 contracts with non-profit organizations providing services at no cost or reduced cost to the public, and
- 3.8.1.1.5 contracts with federal, state, or local governmental entities.

3.8.1.2 Prior to execution of the Contract, Contractor shall have filed with the City:

- 3.8.1.2.1 a Drug Policy Compliance Agreement form (Attachment "A" to the Executive Order), and
- 3.8.1.2.2 a copy of Contractor's drug free workplace policy, and
- 3.8.1.2.3 a written designation of all safety impact positions, if applicable, or a Contractor's Certification of a No Safety Impact Positions form (Attachment "C" to the Executive Order).

3.8.1.3 Every six months during performance of the Contract and upon completion of the Contract, Contractor shall file a Drug Policy Compliance Declaration form (Attachment "B" to the Executive Order). The Contractor shall submit the Drug Policy Compliance Declaration within 30 days of expiration of each six-month period of performance and within 30 days of completion of the Contract. The first six-month period shall begin on Date of Commencement of the Work.

3.8.1.4 Contractor shall have a continuing obligation to file updated designation of safety impact positions when additional safety impact positions are added to Contractor's employee workforce during performance of the Work.

3.8.1.5 Contractor shall require its Subcontractors and Suppliers to comply with the Mayor's Policy and Executive Order. Contractor is responsible for securing and maintaining required documents from Subcontractors and Suppliers for the City inspection throughout the term of the Contract.

3.8.1.6 Failure of Contractor to comply with requirements will be a material breach of the Contract entitling the City to terminate in accordance with Section 14.1.

3.9 *MATERIALS & EQUIPMENT*

3.9.1 Unless otherwise provided in the Contract, Contractor shall provide and assume full responsibility for Products, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, transportation, temporary facilities, supplies, and other facilities and incidentals necessary for Furnishing, performing, testing, starting-up, and completing the Work.

3.9.1.1 Contractor, Subcontractors, and Suppliers shall use Ultra Low Sulfur Diesel Fuel in all diesel operating vehicles and motorized equipment utilized in performing the Work. Ultra Low Sulfur Diesel Fuel is defined as diesel fuel having 15 ppm or the applicable standard set by state or federal law or rules and regulations of the Texas Commission on Environmental Quality, or the Environmental Protection Agency, whichever is less in sulfur content. Off-road Ultra Low Sulfur Diesel Fuel may be used in lieu of on-road Ultra Low Sulfur Diesel Fuel. Contractor shall provide, upon request by City Engineer, proof that Contractor, Subcontractors, and Suppliers are using Ultra Low Sulfur Diesel Fuel.

3.9.2 Contractor shall provide Products that are:

3.9.2.1 new, unless otherwise required or permitted by the Contract, and

3.9.2.2 of specified quality.

If required by City Engineer, Contractor shall furnish satisfactory evidence, including reports of required tests, as to kind and quality of Products.

3.9.3 Contractor shall store Products in a safe, neat, compact, and protected manner. Contractor shall also store Products delivered during the work, along the right-of-way:

3.9.3.1 so as to cause the least inconvenience to property owners, tenants, and general public; and

3.9.3.2 so as not to block access to, or be closer than, three feet to any fire hydrant.

Contractor shall protect trees, lawns, walks, drives, streets, and other improvements that are to remain, from damage. If private or public property is damaged by Contractor, Contractor shall, at its sole expense, restore the damaged property to at least its original condition.

3.9.3.1 Contractor shall obtain City Engineer's approval for storage areas used for Products for which payment has been requested under Paragraph 9.6.1. Contractor shall provide the City access to the storage areas for inspection purposes. Products, once paid for by the City, become the property of the City and may not be removed from place of storage, without City Engineer's written permission except for a movement to the site. Contractor's Installation Floater, required under Section 11.2, shall cover all perils, including loss or damage to Products during storage, loading, unloading, and transit to the site.

3.10 *PRODUCT OPTIONS AND SUBSTITUTIONS*

3.10.1 For Products specified by reference standards or by description only, Contractor may provide any Product meeting those standards or description.

3.10.2 For Products specified by naming one or more manufacturers with provision for substitutions or equal, Contractor may submit a request for substitution for any manufacturer not named.

3.10.3 City Engineer will consider requests for substitutions only within the first 15 percent of Contract Time, or first 90 days after date of Notice to Proceed, whichever is less.

3.10.4 Contractor shall document each request for substitution with complete data

substantiating compliance of proposed substitution with the Contract.

3.10.5 A request for substitution constitutes a representation that Contractor:

3.10.5.1 has investigated the proposed Product and determined that it meets or exceeds the quality level of the specified Product;

3.10.5.2 shall provide the same warranty for the substitution as for the specified Product;

3.10.5.3 shall coordinate installation of the proposed substitution and make changes to other work which may be required for the Work to be completed, with no additional cost or increase in time to the City;

3.10.5.4 confirms that cost data is complete and includes all related costs under the Contract;

3.10.5.5 waives Claim for additional costs or time extensions that may subsequently become apparent; and

3.10.5.6 shall provide review or redesign services by a design consultant with appropriate professional license and shall obtain re-approval and permits from authorities.

3.10.6 City Engineer will not consider and will not approve substitutions when:

3.10.6.1 they are indicated or implied on Shop Drawing or Product Data submittals without separate written request; or

3.10.6.2 acceptance will require revision to the Contract.

3.10.7 City Engineer may reject requests for substitution, and his decision will be final and binding on the Parties.

3.11 *CASH ALLOWANCES*

3.11.1 Contract Price includes Cash Allowances as identified in the Contract.

3.11.2 The City will pay the actual costs of Cash Allowance item exclusive of profit, overhead or administrative costs. If actual costs exceed the Cash Allowance, City Engineer must approve a Change Order for the additional costs.

3.12 *WARRANTY*

3.12.1 Contractor warrants to the City that Products furnished under the Contract are:

3.12.1.1 free of defects in title;

3.12.1.2 of good quality; and

3.12.1.3 new, unless otherwise required or permitted by the Contract.

If required by the City Engineer, Contractor shall furnish satisfactory evidence as to kind, quality and title of Products, and that Products conform to requirements of the Contract.

3.12.2 In the event of a defect in a Product, either during construction or warranty period, Contractor shall take appropriate action with manufacturer of Product to assure correction or replacement of defective Product with minimum delay.

3.12.3 Contractor warrants that the Work is free of defects not inherent in the quality required or permitted, and that the Work does conform with the requirements of the Contract. Contractor further warrants that the Work has been performed in a thorough and workmanlike manner.

3.12.4 Contractor warrants that the Work is free of concentrations on polychlorinated biphenyl (PCB) and other substances defined as hazardous by the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) or any other applicable law or regulation.

3.12.5 Work not conforming to requirements of Section 3.12, including substitutions not properly approved and authorized, may be considered nonconforming work.

3.12.6 Contractor's warranty excludes remedy for damage or defect caused by:

3.12.6.1 improper or insufficient maintenance by the City;

3.12.6.2 normal wear and tear under normal usage; or

3.12.6.3 claim that hazardous material was incorporated into the Work, if that material was specified in the Contract.

3.12.7 Contractor warrants that title to all work covered by Contractor's request for payment passes to the City upon incorporation into the Work or upon Contractor's receipt of payment, whichever occurs first. The Contractor further warrants that the title is free of all liens, claims, security interests or other interests ("Encumbrances"). If not, upon written demand from City Engineer, Contractor shall immediately take legal action necessary to remove Encumbrances.

3.13 *TAXES*

3.13.1 Contractor shall pay all sales, consumer, use, and similar taxes, which are in effect or scheduled to go into effect on or before bids are received, related to work provided by Contractor.

3.13.2 Contractor shall obtain, and require Subcontractors and Suppliers to obtain, necessary permits from the state and local taxing authorities to perform contractual obligations under the Contract, including sales tax permits.

3.13.3 The City is exempt from the Federal Transportation and Excise Tax. Contractor shall comply with federal regulations governing the exemptions.

3.13.4 Products incorporated into the Work are exempt from state sales tax according to provisions of the TEX. TAX CODE ANN. CH. 151, Subsection H.

3.14 *PERMITS, FEES, AND NOTICES*

3.14.1 Unless otherwise provided in the Contract, Contractor shall secure and pay for all construction permits, licenses, and inspections:

3.14.1.1 necessary for proper execution and completion of the Work; and

3.14.1.2 legally required at time bids are received.

3.15 *CONSTRUCTION SCHEDULES*

3.15.1 On receipt of Notice to Proceed, Contractor shall promptly prepare and submit construction schedule for the Work for City Engineer's review. The schedule must reflect the minimum time required to complete the Work not to exceed Contract Time.

3.15.2 Contractor shall give 24-hour written notice to City Engineer before commencing work or resuming work where work has been stopped. Contractor shall also give the same notice to inspectors.

3.15.3 Contractor shall incorporate milestones specified in Summary of Work Specification into the construction schedule. Contractor's failure to meet a milestone, as determined by City Engineer, may be considered a material breach of the Contract.

3.15.4 Each month, Contractor shall submit to City Engineer a copy of an updated construction schedule indicating actual progress, incorporating applicable changes, and indicating courses of action required to assure completion of the Work within Contract Time.

3.15.5 Contractor shall keep a current schedule of submittals that coordinates with the construction schedule, and shall submit the initial schedule of submittals to City Engineer for approval.

3.16 *DOCUMENTS AND SAMPLES AT THE SITE*

3.16.1 Contractor shall maintain at the site, and make available to City Engineer, one record copy of Drawings, Specifications, and Modifications. Contractor shall maintain the documents in good order and marked currently to record changes and selections made during construction. In addition, Contractor shall maintain at the site, approved Shop Drawings, Product Data, Samples, and similar submittals, which will be delivered to City Engineer prior to final inspection as required in Paragraph 9.11.4.

3.16.2 Contractor shall maintain all books, documents, papers, accounting records, and other relevant documentation pursuant to the Work and shall make the books, documents, papers, and accounting records available to representatives of the City for review and audits during the Contract term and for the greater of three years following Date of Substantial Completion or until all litigation or audits are fully resolved.

3.16.3 Contractor shall provide to City Attorney all documents and records that City Attorney deems necessary to assist in determining Contractor's compliance with the Contract, with the exception of those documents made confidential by federal or state law or regulation.

3.17 *MANUFACTURER'S SPECIFICATIONS*

3.17.1 Contractor shall handle, store, and Install Products and perform all work in the manner required by Product manufacturer. Should the Contract and manufacturer's instructions conflict, Contractor shall report conflict to City Engineer for resolution prior to proceeding with the affected work.

3.17.2 References in the Contract to the manufacturer's specifications, directions, or recommendations, mean manufacturer's current published documents in effect as of date of receipt of bids, or in the case of a Modification, as of date of Modification.

3.18 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

3.18.1 Shop Drawings, Product Data, and Samples are not part of the Contract. The purpose of Contractor submittals is to demonstrate, for those portions of the Work for which submittals are required, the way Contractor proposes to conform to information given and design concept expressed in the Contract.

3.18.2 Contractor shall submit to Project Manager for review the Shop Drawings, Product Data, and Samples, which are required by the Contract. Review by Project Manager is subject to limitations of Paragraph 4.1.4. Contractor shall transmit the submittals to the Project Manager with reasonable promptness and in a sequence, so as to cause no delay in the Work or in activities of the City or of separate contractors. Contractor shall transmit submittals in time to allow a minimum of 30 days for Project Manager's review prior to date Contractor needs reviewed submittals returned. This time may be shortened for a particular job requirement if approved by Project Manager in advance of submittal.

3.18.3 Contractor shall certify that the content of submittals conforms to the Contract without exception by affixing Contractor's approval stamp and signature. By certifying and submitting Shop Drawings, Product Data, and Samples, Contractor represents, and Contractor's stamp of approval shall state, that Contractor has determined and verified materials, quantities, field measurements, and field construction criteria related to the submittal, and has checked and coordinated information contained within the submittals with requirements of the Contract.

3.18.4 Contractor may not perform any work requiring submittal and review of Shop Drawings, Product Data, or Samples until the submittal has been returned with appropriate review decision by the Project Manager. Contractor shall perform work in accordance with the review.

3.18.5 If Contractor performs any work requiring submittals prior to review and acceptance of the submittals by Project Manager, such work is at Contractor's risk and the City is not obligated to accept work if the submittals are later found to be unacceptable.

3.18.6 If, in the opinion of Project Manager, the submittals are incomplete, or demonstrate an inadequate understanding of the Work or lack of review by the Contractor, then submittals may be returned to the Contractor for correction and resubmittal.

3.18.7 Contractor shall direct specific attention in writing and on the resubmitted Shop Drawings, Product Data, or Samples to any additional proposed revisions, other than those revisions requested by Project Manager on previous submittals.

3.18.8 Contractor is not relieved of responsibility for deviations from requirements of the Contract by Project Manager's review of Shop Drawings, Product Data, or Samples unless Contractor has specifically informed Project Manager in writing of the deviation at the time of the submittal, and Project Manager has given written approval of the deviation.

3.18.9 When professional certification of performance criteria of Products is required by the Contract, the City may rely upon accuracy and completeness of the calculations and certifications.

3.18.10 For Product colors or textures to be selected by the City, Contractor shall submit all samples together to allow preparation of a complete selection schedule.

3.18.11 Contractor shall submit informational submittals, on which Project Manager is not expected to take responsive action, as required by the Contract.

3.18.12 Submittals made by Contractor which are not required by the Contract may be returned to Contractor without action.

3.19 CULTURAL RESOURCES AND ENDANGERED SPECIES

3.19.1 Contractor may not remove or disturb, or cause to be removed or disturbed, any historical, archaeological, architectural, or other cultural artifacts, relics, vestiges, remains, or objects of antiquity. If Contractor discovers one of these items, Contractor shall immediately notify City Engineer and further comply with the requirements of 13 Tex. Admin. Code Chs. 25 and 26 (2002), or successor regulation. Contractor shall protect site and cultural resources from further disturbance until professional examination can be made or until clearance to proceed is authorized in writing by City Engineer.

3.19.2 Should either threatened or endangered plant or animal species be encountered,

Contractor shall cease work immediately in the area of encounter and notify City Engineer.

3.20 *CUTTING AND PATCHING*

3.20.1 Contractor is responsible for necessary cutting, fitting, and patching to accomplish the Work and shall suitably support, anchor, attach, match, and trim or seal materials to work of other contractors. Contractor shall coordinate the Work with work of other contractors to minimize conflicts, as provided in Article 6.

3.20.2 Contractor may not endanger work by cutting, digging, or other action, and may not cut or alter work of other contractors except by written consent of City Engineer and affected contractor.

3.21 *CLEANING*

3.21.1 Contractor shall perform daily cleanup of all dirt, debris, scrap materials and other disposable items resulting from Contractor's operations, whether on-site or off-site. Unless otherwise authorized in writing by City Engineer, Contractor shall keep all streets, access streets, driveways, areas of public access, walkways, and other designated areas clean and open at all times.

3.21.2 Failure of Contractor to maintain a clean site, including access streets, is the basis for City Engineer to issue a Notice of Noncompliance. Should compliance not be attained within the time period in the Notice of Noncompliance, City Engineer may authorize necessary cleanup to be performed by others and the cost of the cleanup will be deducted from monies due Contractor.

Contractor shall legally dispose off-site, all waste materials and other excess materials resulting from Contractor's operations.

3.22 *SANITATION*

3.22.1 Contractor shall provide and maintain sanitary facilities at site for use of all construction forces under the Contract. Newly-constructed or existing sanitary facilities may not be used by Contractor.

3.23 *ACCESS TO WORK AND TO INFORMATION*

3.23.1 Contractor shall provide the City, Design Consultant, testing laboratories, and governmental agencies which have jurisdictional interests, access to the Work in preparation and in progress wherever located. Contractor shall provide proper and safe conditions for the access.

3.23.2 If required by City Engineer, Contractor shall furnish information concerning character of Products and progress and manner of the Work, including information necessary to determine cost of the Work, such as number of employees, pay of employees, and time employees worked on various classes of the Work.

3.24 *TRADE SECRETS*

3.24.1 Contractor will not make any claim of ownership of trade secrets as to products used in the Work, or preparation of any mixture for the Work. City Engineer will at all times have the right to demand and Contractor shall furnish information concerning materials or samples of ingredients of any materials used, or proposed to be used, in preparation of concrete placed or other work to be done. Mixtures, once agreed on, shall not be changed in any manner without knowledge and consent of City Engineer. The City will make its best efforts to protect confidentiality of proprietary information.

3.25 *INDEMNIFICATION*

3.25.1 CONTRACTOR AGREES TO AND SHALL DEFEND, INDEMNIFY, AND HOLD THE CITY, ITS AGENTS, EMPLOYEES, OFFICERS, AND LEGAL REPRESENTATIVES (COLLECTIVELY THE "CITY") HARMLESS FOR ALL CLAIMS, CAUSES OF ACTION, LIABILITIES, FINES, AND EXPENSES (INCLUDING, WITHOUT LIMITATION, ATTORNEYS' FEES, COURT COSTS, AND ALL OTHER DEFENSE COSTS AND INTEREST) FOR INJURY, DEATH, DAMAGE, OR LOSS TO PERSONS OR PROPERTY SUSTAINED IN CONNECTION WITH OR INCIDENTAL TO PERFORMANCE UNDER THE CONTRACT INCLUDING, WITHOUT LIMITATION, THOSE CAUSED BY:

3.25.1.1 CONTRACTOR'S AND/OR ITS AGENTS', EMPLOYEES', OFFICERS', DIRECTORS', CONTRACTORS', OR SUBCONTRACTORS' (COLLECTIVELY IN NUMBERED SUBPARAGRAPHS .1 through .3, "CONTRACTOR") ACTUAL OR ALLEGED NEGLIGENCE OR INTENTIONAL ACTS OR OMISSIONS;

3.25.1.2 THE CITY'S AND CONTRACTOR'S ACTUAL OR ALLEGED CONCURRENT NEGLIGENCE, WHETHER CONTRACTOR IS IMMUNE FROM LIABILITY OR NOT;

3.25.1.3 THE CITY'S AND CONTRACTOR'S ACTUAL OR ALLEGED STRICT PRODUCTS LIABILITY OR STRICT STATUTORY LIABILITY, WHETHER CONTRACTOR IS IMMUNE FROM LIABILITY OR NOT.

CONTRACTOR SHALL DEFEND, INDEMNIFY, AND HOLD THE CITY HARMLESS DURING THE TERM OF THE CONTRACT AND FOR FOUR YEARS AFTER THE CONTRACT TERMINATES. CONTRACTOR SHALL NOT INDEMNIFY THE CITY FOR THE CITY'S SOLE NEGLIGENCE.

3.25.2 NOTWITHSTANDING ANYTHING TO THE CONTRARY, THE LIABILITY OF CONTRACTOR FOR THE CITY'S CONCURRENT NEGLIGENCE SHALL NOT EXCEED $1,000,000.

3.26 *RELEASE AND INDEMNIFICATION – PATENT, COPYRIGHT, TRADEMARK, AND TRADE SECRET INFRINGEMENT*

3.26.1 UNLESS OTHERWISE SPECIFICALLY REQUIRED BY THE CONTRACT, CONTRACTOR AGREES TO AND SHALL RELEASE AND DEFEND, INDEMNIFY, AND HOLD HARMLESS THE CITY, ITS AGENTS, EMPLOYEES, OFFICERS, AND LEGAL REPRESENTATIVES (COLLECTIVELY THE "CITY") FROM ALL CLAIMS OR CAUSES OF ACTION BROUGHT AGAINST THE CITY BY ANY PARTY, INCLUDING CONTRACTOR, ALLEGING THAT THE CITY'S USE OF ANY EQUIPMENT, SOFTWARE, PROCESS, OR DOCUMENTS CONTRACTOR FURNISHES DURING THE TERM OF THE CONTRACT INFRINGES ON A PATENT, COPYRIGHT, OR TRADEMARK, OR MISAPPROPRIATES A TRADE SECRET. CONTRACTOR SHALL PAY ALL COSTS (INCLUDING, WITHOUT LIMITATION, ATTORNEYS' FEES, COURT COSTS, AND ALL OTHER DEFENSE COSTS, AND INTEREST) AND DAMAGES AWARDED.

3.26.2 CONTRACTOR SHALL NOT SETTLE ANY CLAIM ON TERMS WHICH PREVENT THE CITY FROM USING THE EQUIPMENT, SOFTWARE, PROCESS, OR PRODUCT WITHOUT THE CITY ENGINEER'S PRIOR WRITTEN CONSENT.

3.26.3 UNLESS OTHERWISE SPECIFICALLY REQUIRED BY THE CONTRACT, WITHIN 60 DAYS AFTER BEING NOTIFIED OF THE CLAIM, CONTRACTOR SHALL, AT ITS OWN EXPENSE, EITHER:

3.26.3.1 OBTAIN FOR THE CITY THE RIGHT TO CONTINUE USING THE EQUIPMENT, SOFTWARE, PROCESS, OR PRODUCT, OR

3.26.3.2 IF BOTH PARTIES AGREE, REPLACE OR MODIFY THEM WITH COMPATIBLE AND FUNCTIONALLY EQUIVALENT PRODUCTS.

IF NONE OF THESE ALTERNATIVES IS REASONABLY AVAILABLE, THE CITY MAY RETURN THE EQUIPMENT, SOFTWARE, OR PRODUCT, OR DISCONTINUE THE PROCESS, AND CONTRACTOR SHALL REFUND THE PURCHASE PRICE.

3.27 *INDEMNIFICATION PROCEDURES*

3.27.1 *Notice of Indemnification Claims:* If the City or Contractor receives notice of any claim or circumstances which could give rise to an indemnified loss, the receiving party shall give written notice to the other Party within 10 days. The notice must include the following:

3.27.1.1 a description of the indemnification event in reasonable detail,

3.27.1.2 the basis on which indemnification may be due, and

3.27.1.3 the anticipated amount of the indemnified loss.

This notice does not estop or prevent the City from later asserting a different basis for indemnification or a different amount of indemnified loss than that indicated in the initial notice. If the City does not provide this notice within the 10-day period, it does not waive any right to indemnification except to the extent that Contractor is prejudiced, suffers loss, or incurs expense because of the delay.

3.27.2 *Defense of Indemnification Claims:*

3.27.2.1 *Assumption of Defense:* Contractor may assume the defense of the claim at its own expense with counsel chosen by it that is reasonably satisfactory to the City. Contractor shall then control the defense and any negotiations to settle the claim. Within 10 days after receiving written notice of the indemnification request, Contractor must advise the City as to whether or not it will defend the claim. If Contractor does not assume the defense, the City shall assume and control the defense, and all defense expenses constitute an indemnified loss.

3.27.2.2 *Continued Participation:* If Contractor elects to defend the claim, the City may

retain separate counsel to participate in, but not control, the defense and to participate in, but not control, any settlement negotiations. Contractor may settle the claim without the consent or agreement of the City, unless it:

3.27.2.2.1 would result in injunctive relief or other equitable remedies or otherwise require the City to comply with restrictions or limitations that adversely affect the City;

3.27.2.2.2 would require the City to pay amounts that Contractor does not fund in full; or

3.27.2.2.3 would not result in the City's full and complete release from all liability to the plaintiffs or claimants who are parties to or otherwise bound by the settlement.

3.28 ***CONTRACTOR DEBT***

IF CONTRACTOR, AT ANY TIME DURING THE TERM OF THIS AGREEMENT, INCURS A DEBT, AS THE WORD IS DEFINED IN SECTION 15-122 OF THE HOUSTON CITY CODE OF ORDINANCES, IT SHALL IMMEDIATELY NOTIFY CITY CONTROLLER IN WRITING. IF CITY CONTROLLER BECOMES AWARE THAT CONTRACTOR HAS INCURRED A DEBT, IT SHALL IMMEDIATELY NOTIFY CONTRACTOR IN WRITING. IF CONTRACTOR DOES NOT PAY THE DEBT WITHIN 30 DAYS OF EITHER SUCH NOTIFICATION, CITY CONTROLLER MAY DEDUCT FUNDS IN AN AMOUNT EQUAL TO THE DEBT FROM ANY PAYMENTS OWED TO CONTRACTOR UNDER THIS AGREEMENT, AND CONTRACTOR WAIVES ANY RECOURSE THEREFOR. CONTRACTOR SHALL FILE A NEW AFFIDAVIT OF OWNERSHIP, USING THE FORM DESIGNATED BY CITY, BETWEEN FEBRUARY 1 AND MARCH 1 OF EVERY YEAR DURING THE TERM OF THE CONTRACT.

ARTICLE 4 - ADMINISTRATION OF THE CONTRACT

4.1 *CONTRACT ADMINISTRATION*

4.1.1 City Engineer will provide administration of the Contract and City Engineer is authorized to issue Change Orders, Work Change Directives, and Minor Changes in the Work.

4.1.2 City Engineer may act through Project Manager, Design Consultant, or Inspector. When the term "City Engineer" is used in the Contract, action by City Engineer is required unless City Engineer delegates his authority in writing. The City Engineer may not delegate authority to render decisions under Section 4.4.

The City does not have control over or charge of, and is not responsible for, supervision, construction, and safety procedures enumerated in Section 3.3. The City does not have control over or charge of and is not responsible for acts or omissions of Contractor, Subcontractors, or Suppliers.

4.1.3 The City and Design Consultant may attend project meetings and visit the site to observe progress and quality of the Work. The City and Design Consultant are not required to make exhaustive or continuous on-site inspections to check quality or quantity of the Work.

4.1.4 Project Manager will review and approve or take other appropriate action on Contractor's submittals, but only for limited purpose of checking for conformance with information given and design concept expressed in the Contract.

4.1.5 Project Manager's review of the submittals is not conducted for purpose of determining accuracy and completeness of other details, such as dimensions and quantities, or for substantiating instructions for installation or performance of Products, all of which remain the responsibility of Contractor.

4.1.6 Project Manager's review of submittals does not relieve Contractor of its obligations under Sections 3.3, 3.12, and 3.18. Review does not constitute approval of safety precautions or, unless otherwise specifically stated by Project Manager in writing, of construction means, methods, techniques, sequences, or procedures. Project Manager's review of a specific item does not indicate approval of an assembly of which the item is a component.

4.1.7 Based on field observations and evaluations, Project Manager will process Contractor's progress payments, certify amounts due Contractor, and issue Certificates for Payment in the amount certified.

4.1.8 Project Manager will receive and forward to City Engineer for his review and records, written warranties and related documents required by the Contract and assembled by Contractor.

4.1.9 Upon written request by Contractor or Project Manager, City Engineer will resolve matters of interpretation of or performance of the Contract, which are not Claims. City Engineer's decisions are final and binding on the Parties.

4.1.10 City Engineer may reject work which does not conform to the Contract.

4.1.11 When City Engineer considers it necessary to implement the intent of the Contract, City Engineer may require additional inspection or testing of work in accordance with Paragraphs 13.6.3 and 13.6.4, whether such work is fabricated, Installed, or completed.

4.2 *COMMUNICATIONS IN ADMINISTRATION OF THE CONTRACT*

4.2.1 Except as otherwise provided in the Contract or when authorized by City Engineer in writing, Contractor shall communicate with Project Manager. Contractor shall communicate with Design Consultant, Design Consultant's subconsultants, and separate contractors through Project Manager. The City will communicate with Subcontractors and Suppliers through Contractor.

4.3 *CLAIMS AND DISPUTES*

4.3.1 *Documentation by Project Manager:* Contractor shall submit Claims, including those alleging an error or omission by Project Manager or Design Consultant, to Project Manager for documentation and recommendation to City Engineer.

4.3.2 *Decision of City Engineer:* Upon submission of Claim by Project Manager or Contractor, City Engineer will resolve Claims in accordance with Section 4.4.

4.3.3 *Time Limits on Claims:* Claims by Contractor must be made within 90 days after occurrence of event giving rise to the Claim.

4.3.4 *Continuing the Contract Performance:* Pending final resolution of a Claim including referral to non-binding mediation, unless otherwise agreed in writing, Contractor shall proceed diligently with the performance of the Contract and the City will continue to make payments in accordance with the Contract.

4.3.4.1 Pending final resolution of a Claim including referral to non-binding mediation, Contractor is responsible for safety and protection of physical properties and conditions at site.

4.3.5 *Claims for Concealed or Unknown Conditions:* Concealed or unknown physical conditions include utility lines, other man-made structures, storage facilities, Pollutants and Pollutant Facilities, and the like, but do not include conditions arising from Contractor operations, or failure of Contractor to properly protect and safeguard subsurface facilities. Concealed conditions also include naturally-occurring soil conditions outside the range of soil conditions identified through geotechnical investigations, but do not include conditions arising from groundwater, rain, or flood.

4.3.5.1 If conditions are encountered at the site which are Underground Facilities or otherwise concealed or unknown conditions which differ materially from:

4.3.5.1.1 those indicated by the Contract; or

4.3.5.1.2 conditions which Contractor could have discovered through site inspection, geotechnical testing, or otherwise;

then Contractor will give written notice to City Engineer no later than five days after Contractor's first observation of the condition and before condition is disturbed. Contractor's failure to provide notice constitutes a waiver of a Claim.

4.3.5.2 City Engineer will promptly investigate concealed or unknown conditions. If City Engineer determines that conditions at the site are not materially different and that no change in Contract Price or Contract Time is justified, City Engineer will notify Contractor in writing, stating reasons. If City Engineer determines the conditions differ materially and cause increase or decrease in Contractor's cost or time required for performance of part of the Work, City Engineer will recommend an adjustment in Contract Price or Contract Time, or both, as provided in Article 7. Opposition by a Party to the City Engineer's determination must be made within 21 days after City Engineer has given notice of the decision. If the Parties cannot agree on adjustment to Contract Price or Contract Time, adjustment is subject to further proceedings pursuant to Section 4.4.

4.3.6 *Claims for Additional Cost:* If Contractor wishes to make a Claim for increase in Contract Price, Contractor shall give written notice before proceeding with work for which Contractor intends to submit a Claim. Prior notice is not required for Claims relating to an emergency

endangering life or property arising under Section 10.4.

4.3.6.1 Contractor may file a Claim in accordance with Section 4.4 if Contractor believes it has incurred additional costs, for the following reasons:

- 4.3.6.1.1 written interpretation of City Engineer;
- 4.3.6.1.2 order by City Engineer to stop the Work when Contractor is not at fault;
- 4.3.6.1.3 suspension of the Work by City Engineer;
- 4.3.6.1.4 termination of the Contract by City Engineer; or
- 4.3.6.1.5 The City's non-compliance with another provision of the Contract.

4.3.6.2 No increase in Contract Price is allowed for delays or hindrances to the Work, except for direct and unavoidable extra costs to Contractor caused by failure of the City to provide information and services, or to make land and materials available, when required of the City under the Contract. Any increase claimed is subject to the provisions of Section 4.4 and Article 7.

4.3.6.3 The City is not liable for Claims for delay when Date of Substantial Completion occurs prior to expiration of Contract Time.

4.3.7 *Claims for Additional Time:* If Contractor wishes to make a Claim for an increase in Contract Time, Contractor shall give written notice as provided in Section 8.2. In case of continuing delay, only one Claim is necessary.

4.4 *RESOLUTION OF CLAIMS AND DISPUTES*

4.4.1 City Engineer will review Claims and take one or more of the following preliminary actions within 30 days of receipt of Claim:

- 4.4.1.1 submit a suggested time to meet and discuss the Claim with City Engineer;
- 4.4.1.2 reject Claim, in whole or in part, stating reasons for rejection;
- 4.4.1.3 recommend approval of the Claim by the other Party;
- 4.4.1.4 suggest a compromise; or
- 4.4.1.5 take other actions as City Engineer deems appropriate to resolve the Claim.

4.4.2 City Engineer may request additional supporting data from claimant. Party making Claim shall, within 10 days after receipt of City Engineer's request, submit additional supporting data requested by City Engineer.

4.4.3 At any time prior to rendering a written decision regarding a Claim, City Engineer may refer Claim to non-binding mediation. If Claim is resolved, City Engineer will prepare and obtain all appropriate documentation. If Claim is not resolved, City Engineer will take receipt of Claim and begin a new review under Section 4.4.

4.4.4 If Claim is not referred to or settled in non-binding mediation, City Engineer may conduct a hearing and will render a written decision, including findings of fact, within 75 days of receipt of Claim, or a time mutually agreed upon by the Parties in writing. City Engineer may notify Surety and request Surety's assistance in resolving Claim. City Engineer's decision is final and binding on the Parties.

4.5 *CONDITION PRECEDENT TO SUIT; WAIVER OF ATTORNEY FEES AND INTEREST*

4.5.1 Neither the City nor Contractor may recover attorney fees for any claim brought in connection with this Contract.

4.5.2 Neither the City nor the Contractor may recover interest for any damages claim brought in connection with this Contract except as allowed by TEXAS LOCAL GOVERNMENT CODE Chapter 2251.

4.6 *INTERIM PAYMENT WAIVER & RELEASE*

4.6.1 In accordance with section 4.3, the Contractor shall use due diligence in the discovery and submission of any Claim against the City related to the Contractor's work.

4.6.2 The Contractor shall submit any Claim to the City not later than the 90th day after the occurrence of the event giving rise to the Claim.

4.6.3 Any failure to timely comply with the requirements of section 4.6.2 waives and releases any Claim when the Contractor submits an application for payment after the 90th day.

4.6.4 This waiver does not cover any retainage. In case of any conflict of law, this language shall be revised to the minimum extent necessary to avoid legal conflict. This waiver is made specifically for the benefit of the City.

ARTICLE 5 - SUBCONTRACTORS AND SUPPLIERS

5.1 *AWARD OF SUBCONTRACTS OTHER CONTRACTS FOR PORTIONS OF THE WORK*

5.1.1 Contractor may not contract with a Subcontractor, Supplier, person, or entity that City Engineer has made a reasonable and timely objection to.

5.1.2 If City Engineer has a reasonable objection to person or entity proposed by Contractor, Contractor shall propose another with whom City Engineer has no reasonable objection.

5.1.3 Contractor shall execute contracts with approved Subcontractors, Suppliers, persons, or entities before the Subcontractors or Suppliers begin work under the Contract. All such contracts must be executed and sent to the OBO Director and Contracting Department within 30 days after the date of the Notice to Proceed and must include provisions set forth in Articles 3 and 5 of this Document.

5.1.4 Contractor shall notify City Engineer in writing of any proposed change of Subcontractor, Supplier, person, or entity previously accepted by the City.

5.1.5 Contractor shall make timely payments to Subcontractors and Suppliers for performance of the Contract. Contractor shall protect, defend, and indemnify the City from any claim or liability arising out of Contractor's failure to make the payments. Disputes relating to payment of Business Enterprise Subcontractors or Suppliers will be submitted to arbitration in same manner as other disputes under Business Enterprise subcontracts. Failure of Contractor to comply with decisions of arbitrator may be determined by City Engineer a material breach leading to termination of the Contract.

5.2 *CONTRACTOR RESPONSIBILITY FOR SUBCONTRACTORS*

5.2.1 Contractor is responsible to the City, as may be required by laws and regulations, for all acts and omissions of Subcontractors, Suppliers, and other persons and organizations performing or furnishing any of the Work under direct or indirect contract with Contractor.

5.2.2 Contractor shall make available to each proposed Subcontractor, prior to execution of subcontract, copies of the Contract to which Subcontractor is bound by this Section 5.2. Contractor shall notify Subcontractor of any terms of proposed subcontract which may be at variance with the Contract.

5.2.3 The City's approval of Subcontractor or Suppliers does not relieve Contractor of its obligation to perform, or to have performed to the full satisfaction of the City, the Work required by the Contract.

5.2.4 Unless there is a contractual relationship between Contractor and a Subcontractor or Supplier to the contrary, Contractor shall withhold no more retainage from Subcontractors or Suppliers than City withholds from Contractor under this Agreement. However, once a Subcontractor or Supplier completes performance, Contractor shall release all retainage to that Subcontractor or Supplier regardless if City continues to retain under this Agreement.

5.2.5 Prior to a Subcontractor or Supplier commencing performance for Contractor, Contractor shall meet with that Subcontractor or Supplier to provide instructions on invoicing procedures, dispute resolution procedures, and statutory rights, such as claim filing procedures under the McGregor Act. Subcontractors and Suppliers must certify to the City Engineer that Contractor has fulfilled the requirements of this Section.

ARTICLE 6 - CONSTRUCTION BY THE CITY OR BY SEPARATE CONTRACTORS

6.1 *THE CITY'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS*

6.1.1 The City may perform on-site construction operations related to the Work and as part of the Project with the City's workforce or with separate contractors.

6.2 *COORDINATION*

6.2.1 The City will coordinate activities of the City's workforce and of each separate contractor with work of Contractor, and Contractor shall cooperate with the City and separate contractors.

6.2.1.1 Contractor shall participate with other separate contractors and the City in reviewing their construction schedules when directed to do so by the Project Manager. Contractor shall make revisions to construction schedule and Contract Price deemed

necessary after joint review and mutual agreement. Construction schedules shall then constitute schedules to be used by Contractor, separate contractors, and the City, until subsequently revised.

6.2.2 Contractor shall afford to the City and to separate contractors reasonable opportunity for introduction and storage of their materials and equipment, and for performance of their activities.

6.2.3 If part of Contractor's work depends on proper execution of construction or operations by the City or a separate contractor, Contractor shall, prior to proceeding with that portion of the Work, inspect the other work and promptly report to City Engineer apparent discrepancies or defects in the other construction that would render it unsuitable for the proper execution of the Work. Failure of Contractor to report apparent discrepancies or defects in the other construction shall constitute acknowledgment that the City's or separate contractor's completed or partially completed construction is fit and proper to receive Contractor's work, except as to discrepancies or defects not then reasonably discoverable.

6.3 *MUTUAL RESPONSIBILITY*

6.3.1 The responsible party bears the costs caused by delays, by improperly timed activities, or by nonconforming construction.

6.3.2 Contractor shall promptly remedy damage caused by Contractor to completed or partially completed construction or to property of the City or separate contractor.

6.3.3 Claims or disputes between Contractor and other City contractors, or subcontractors of other City contractors, working on the Project must be submitted to binding arbitration in accordance with Construction Industry Arbitration Rules of the American Arbitration Association upon demand by any party to the dispute or by the City.

6.4 *THE CITY'S RIGHT TO CLEAN UP*

6.4.1 If dispute arises among Contractor, separate contractors, and the City as to responsibility under their respective contracts for maintaining premises and surrounding area free from waste materials and rubbish as described in Section 3.21, the City may clean up and allocate cost among those responsible, as determined by City Engineer.

ARTICLE 7 - CHANGES IN THE WORK

7.1 *CHANGES*

7.1.1 Changes in scope of the Work, subject to limitations in Article 7 and elsewhere in the Contract, may be accomplished without invalidating the Contract, or without notifying Surety by:

- 7.1.1.1 Change Order;
- 7.1.1.2 Work Change Directive; or
- 7.1.1.3 Minor Change in the Work.

7.1.2 The following types of Change Orders require City Council approval:

- 7.1.2.1 a single Change Order that exceeds five percent of Original Contract Price,
- 7.1.2.2 a Change Order which, when added to previous Change Orders, exceeds five percent of Original Contract Price,
- 7.1.2.3 a Change Order, in which the total value of increases outside of the general scope of work approved by City Council, when added to increases outside the general scope of work approved by City Council in previous Change Orders, exceeds 40 percent of the Original Contract Price, even if the net increase to the Original Contract Price is five percent or less.

  In this context, "increase" means an increase in quantity resulting from the addition of locations not within the scope of work approved by City Council, or the addition of types of goods or services not bid as unit price items.

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

7.1.3 Contractor shall proceed promptly to execute changes in the Work provided in Modifications, unless otherwise stated in the Modification.

7.2 *WORK CHANGE DIRECTIVES*

7.2.1 A Work Change Directive cannot change Contract Price or Contract Time, but is evidence that the Parties agree that a change, ordered by directive, will be incorporated in a subsequently issued Change Order as to its effect, if any, on Contract Price or Contract Time.

7.2.2 Failure by Contractor to commence work identified in a Work Change Directive within the time specified by City Engineer, or to complete the

work in a reasonable period of time, may be determined by City Engineer to be a material breach of Contract.

7.2.3 A Work Change Directive is used in the absence of total agreement of the terms of a Change Order. Interim payments are made in accordance with Paragraph 9.6.1.

7.2.4 If Contractor signs a Work Change Directive, then Contractor agrees to its terms including adjustment in Contract Price and Contract Time or method for determining them. Agreement by the Parties to adjustments in Contract Price and Contract Time are immediately recorded as a Change Order.

7.2.5 City Engineer, by Work Change Directive, may direct Contractor to take measures as necessary to expedite construction to achieve Date of Substantial Completion on or before expiration of Contract Time. When the Work is expedited solely for convenience of the City and not due to Contractor's failure to prosecute timely completion of the Work, then Contractor is entitled to an adjustment in Contract Price equal to actual costs determined in accordance with Article 7.

7.3 *ADJUSTMENTS IN CONTRACT PRICE*

7.3.1 Adjustments in Contract Price are accomplished by Change Order and are based on one of the following methods:

- 7.3.1.1 mutual acceptance of fixed price, properly itemized and supported by sufficient data to permit evaluation;
- 7.3.1.2 unit prices stated in the Contract or subsequently agreed upon;
- 7.3.1.3 cost to be determined in a manner agreed upon by the Parties and mutually acceptable fixed or percentage fee; or
- 7.3.1.4 as provided in Paragraph 7.3.2.

7.3.2 If 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 City Engineer. If Project Manager or Contractor disagree with City Engineer's determination they then may file a Claim in accordance with Section 4.4.

7.3.2.1 If City Engineer determines a method and adjustment in Contract Price under Paragraph 7.3.2, Contractor shall provide, in a form as City Engineer may prescribe, appropriate supporting data for items submitted under Paragraph 7.3.2. Failure to submit the data within 21 days of request for the data by City Engineer shall constitute waiver of a Claim.

7.3.2.2 Unless otherwise provided in the Contract, costs for the purposes of this Paragraph 7.3.2 are limited to the following:

- 7.3.2.2.1 costs of labor, including labor burden as stated below for social security, unemployment insurance, customary and usual fringe benefits required by agreement or custom, and Workers' Compensation insurance;
  - 7.3.2.2..1.1 the maximum labor burden applied to costs of labor for changes in the Work is 55 percent;
- 7.3.2.2.2 costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
- 7.3.2.2.3 rental costs of machinery and equipment, exclusive of hand tools, whether rented from Contractor or others, with prior approval of City Engineer;
- 7.3.2.2.4 costs of premiums for Bonds and insurance and permit fees related to the change in the Work;
- 7.3.2.2.5 additional costs of direct supervision of work and field office personnel directly attributable to the change; and
- 7.3.2.2.6 allowances for overhead and profit as stated below.
  - 7.3.2.2.6.1 the maximum allowances for overhead and profit on increases due to Change Orders:
  - 7.3.2.2.6.2 for changes in the Work performed by Contractor and Subcontractors, allowance for overhead and profit are applied to an amount equal to cost of all additions less cost of all deletions to the Work. Allowance for overhead to Contractor and first tier Subcontractors on changes performed by Subcontractors are applied to an amount equal to the sum of all increases to the Work by applicable Subcontractors.

	Overhead	Profit
to Contractor for change in the Work performed by Subcontractors:	10 percent	0 percent
to first tier Subcontractors for change in the Work performed by its Subcontractors:	10 percent	0 percent
to Contractor and Subcontractor for change in the Work performed by their respective firms:	10 percent	5 percent

7.3.3 If the City deletes or makes a change, which results in a net decrease in Contract Price, the City is entitled to a credit calculated in accordance with Paragraphs 7.3.1 and 7.3.2 and Subparagraphs 7.3.2.1, and 7.3.2.2.1 through 7.3.2.2.5. When both additions and credits covering related work or substitutions are involved in a change, allowance for overhead and profit is figured on the basis of a net increase, if any, with respect to that change in accordance with Subparagraph 7.3.2.2.6.

7.3.4 When Contractor agrees with the determination made by City Engineer concerning adjustments in Contract Price and Contract Time, or the Parties otherwise reach agreement upon the adjustments, the agreement will be immediately recorded by Change Order.

7.4 *MINOR CHANGES IN THE WORK*

7.4.1 A Minor Change in Work is binding on the Parties. Contractor shall acknowledge, in a written form acceptable to City Engineer, that there is no change in Contract Time or Contract Price and shall carry out the written orders promptly.

ARTICLE 8 - TIME

8.1 *PROGRESS AND COMPLETION*

8.1.1 Time is of the essence in the Contract. By executing the Contract, Contractor agrees that Contract Time is a reasonable period for performing the Work.

8.1.2 *Computation of Time:* In computing any period of time prescribed or allowed by the General Conditions, the day of the act, event, or default after which designated period of time begins to run is not to be included. Last day of the period so computed is to be included, unless it is a Sunday or Legal Holiday, in which event the period runs until end of next day which is not a Sunday or Legal Holiday. Sundays and Legal Holidays are considered to be days and are to be included in all other time computations relative to Contract Time.

8.1.3 Contractor may not commence the Work prior to the effective date of insurance and Bonds required by Article 11.

8.1.4 Contractor shall proceed expeditiously and without interruption, with adequate forces, and shall achieve Date of Substantial Completion within Contract Time.

8.1.5 Should progress of the Work fall behind construction schedule, except for reasons stated in Paragraph 8.2.1, Contractor shall promptly submit at the request of Project Manager, updated construction schedule to City Engineer for approval. Contractor's failure to submit updated schedule may, at City Engineer's discretion, constitute a material breach of the Contract. Contractor shall take action necessary to restore progress by working the hours, including night shifts and lawful overtime operations as necessary, to achieve Date of Substantial Completion within Contract Time.

8.1.6 Except in connection with safety or protection of persons or the Work or property at the site or adjacent to the site, and except as otherwise indicated in the Contract, all the Work at the site will be performed Monday through Saturday between the hours of 7:00 a.m. and 7:00 p.m. Contractor may not perform work between 7:00 p.m. and 7:00 a.m., on a Sunday, or on a Legal Holiday, without giving City Engineer 24-hour prior written notice and receiving written consent of City Engineer.

8.2 *DELAYS AND EXTENSIONS OF TIME*

8.2.1 Contractor may request extension of Contract Time for a delay in performance of work that arises from causes beyond control and without fault or negligence of Contractor. Examples of these causes are:

- 8.2.1.1 acts of God or of the public enemy;
- 8.2.1.2 acts of government in its sovereign capacity;
- 8.2.1.3 fires;
- 8.2.1.4 floods;
- 8.2.1.5 epidemics;
- 8.2.1.6 quarantine restrictions;
- 8.2.1.7 strikes;
- 8.2.1.8 freight embargoes;
- 8.2.1.9 unusually severe weather; and
- 8.2.1.10 discovery of Pollutants or Pollutant Facilities at the site.

8.2.2 For any reason other than those listed in Section 4.3.6.2, if the Contractor's work is delayed in any manner or respect, the Contractor shall have no claim for damages and shall have no right of additional compensation from the City by reason of any delay or increased expense to the Contractor's work, except for an extension of time as provided in this provision.

8.2.3 Contractor may request an extension of Contract Time for delay only if:

8.2.3.1 delay is caused by failure of Subcontractor or Supplier to perform or make progress; and

8.2.3.2 cause of failure is beyond control of both Contractor and Subcontractor or Supplier.

8.2.4 Claims relating to Contract Time must be made in accordance with Paragraph 4.3.7.

8.2.5 Claims for extending or shortening Contract Time are based on written notice promptly delivered by the Party making Claim to other Party. Claim must accurately describe occurrence generating Claim, and a statement of probable effect on progress of the Work.

8.2.6 Claims for extension of Contract Time are considered only when a Claim is filed within the time limits stated in Paragraph 4.3.3.

8.2.6.1 Notwithstanding paragraph 4.3.3, an extension of time for delays under this paragraph may be granted only upon written application by the Contractor within 48 hours from the claimed delay.

8.2.7 Written notice of Claim must be accompanied by claimant's written statement that adjustment claimed is entire adjustment to which claimant is entitled as a result of the occurrence of the event. When the Parties cannot agree, Claims for adjustment in Contract Time are determined by City Engineer in accordance with Section 4.4.

8.2.8 Adjustments to Contract Time are accomplished by Change Order.

ARTICLE 9 - PAYMENTS AND COMPLETION

9.1 *UNIT PRICE WORK*

9.1.1 Where the Contract provides that all or part of the Work is based on Unit Prices, the Original Contract Price includes, for all Unit Price work, an amount equal to the sum of Unit Prices times Unit Price Quantities for each separately identified item of Unit Price work.

9.1.2 Each Unit Price includes an amount to cover Contractor's overhead and profit for each separately identified item.

9.1.3 The Contractor may not make a Claim against the City for excess or deficiency in Unit Price Quantities provided in the Contract, except as provided in Subparagraph 9.1.4. Payment at the prices stated in the Contract is in full for the completed work. Contractor is not entitled to additional payment for materials, supplies, labor, tools, machinery and all other expenditures incidental to satisfactory completion of the Work.

9.1.4 City Engineer may increase or decrease quantities of the Work within limitations stated in Paragraph 7.1.2. Contractor is entitled to payment for actual quantities of items provided at Unit Prices set forth in the Contract.

9.1.5 Where the final quantity of work performed by Contractor on Major Unit Price Work item differs by more than 25 percent from quantity of the item stated in the Contract, a Party may request an adjustment in Unit Price, for the portion that differs by more than 25 percent, by a Change Order under Section 7.3.

9.2 *ESTIMATES FOR PAYMENT, UNIT PRICE WORK*

9.2.1 Following the day of each month indicated in the Contract, Project Manager will prepare a Certificate for Payment for the preceding monthly period based on estimated units of work completed. Prior to preparing Certificate of Payment, Contractor shall have submitted to City Engineer, on a form approved by the Director of the Office of Business Opportunity, evidence satisfactory to the City Engineer of payments made to Subcontractors and Suppliers for the month preceding the month for which the Certificate for Payment is prepared, including evidence of electronic submission of certified payrolls.

9.2.2 Before final completion, City Engineer will review and confirm with Contractor the actual final installed Unit Price quantities. City Engineer's determination of actual final installed Unit Price quantities will be included in the final Certificate for Payment and any previous underpayments and overpayments will be reconciled with the actual final Unit Price quantities. Contractor shall file written notice of intent to appeal, if any, City Engineer's

determination within 10 days of receipt of final Certificate for Payment. Upon expiration of the 10-day period, City Engineer's decision is final and binding on the Parties. If Contractor submits notice within the 10-day period, Contractor shall submit a Claim in accordance with Section 4.4.

9.3 *STIPULATED PRICE WORK*

9.3.1 For work contracted on a Stipulated Price basis, 10 days before submittal of first Application for Payment, Contractor shall submit to City Engineer a Schedule of Values allocated to various portions of the Work, prepared in the form and supported by the data as City Engineer may require to substantiate its accuracy. This schedule, as approved by City Engineer, is used as a basis for approval of Contractor's Applications for Payment.

9.4 *APPLICATIONS FOR PAYMENT, STIPULATED PRICE WORK*

9.4.1 For work contracted on a Stipulated Price basis, Contractor shall submit Applications for Payment to City Engineer each month on a form acceptable to City Engineer in accordance with Schedule of Values. Application must indicate percentages of completion of each portion of the Work listed in Schedule of Values as of the end of the period covered by the Application for Payment.

9.4.2 Applications for Payment must be supported by substantiating data as City Engineer may require and must reflect retainages as provided below. Evidence satisfactory to the City Engineer of payments made to Subcontractors and Suppliers for the month preceding the month for which the Application for Payment is submitted must accompany each Application for Payment on a form approved by the Director of the Office of Business Opportunity. Evidence of electronic submission of certified payrolls must be included. Application must be sworn and notarized.

9.5 *CERTIFICATES FOR PAYMENT*

9.5.1 City Engineer will, within 10 days after the date specified in the Contract for Unit Price work, or upon receipt of Contractor's Application for Payment for Stipulated Price work, issue a Certificate for Payment for work based on amount which City Engineer determines is properly due, with copy to Contractor.

9.5.2 Unless otherwise provided in the Contract, payment for completed work and for properly stored Products is conditioned upon compliance with procedures satisfactory to City Engineer to protect the City's interests. Procedures will include applicable insurance, storage, and transportation to site for materials and equipment stored off-site. Contractor is responsible for maintaining materials and equipment until Date of Substantial Completion.

9.5.3 Contractor shall document its use of Ultra Low Sulfur Diesel Fuel by providing invoices and receipts evidencing Contractor's use.

9.6 *COMPUTATIONS OF CERTIFICATES FOR PAYMENT*

9.6.1 Subject to the provisions of the Contract, the amount of each Certificate for Payment is calculated as follows:

- 9.6.1.1 that portion of Contract Price allocated to completed work as determined by:
  - 9.6.1.1.1 multiplying the percentage of completion of each portion of the Work listed in the Schedule of Values by the value of that portion of the Work, or
  - 9.6.1.1.2 multiplying Unit Price quantities Installed times the Unit Prices listed in the Contract;
- 9.6.1.2 plus progress payments for completed work that has been properly authorized by Modifications;
- 9.6.1.3 less retainage of five percent;
- 9.6.1.4 plus actual costs, properly substantiated by certified copies of invoices and freight bills, of non-perishable materials and equipment delivered and properly stored, if approved in advance by Project Manager, less 15 percent;
- 9.6.1.5 less any previous payments by the City.

9.7 *DECISIONS TO WITHHOLD CERTIFICATION*

9.7.1 City Engineer may decline to certify payment and may withhold payment in whole or in part to the extent reasonably necessary to protect the City if, in City Engineer's opinion, there is reason to believe that:

- 9.7.1.1 nonconforming work has not been remedied;
- 9.7.1.2 the Work cannot be completed for unpaid balance of Contract Price;
- 9.7.1.3 there is damage to the City or another contractor;
- 9.7.1.4 the Work will not be completed within Contract Time and that unpaid balance

will not be adequate to cover actual and liquidated damages;

9.7.1.5 probable evidence that third party claims will be filed in court, in arbitration, or otherwise;

9.7.1.6 Contractor has failed to make payments to Subcontractors or Suppliers for labor, material, or equipment; or

9.7.1.7 Contractor has persistently failed to carry out work in accordance with the Contract.

9.7.1.8 Contractor has not paid Subcontractors or Suppliers because of a payment dispute; or

9.7.1.9 Contractor has failed to provide satisfactory evidence described in Paragraphs 9.2.1, 9.4.2, and 9.8.2.

9.7.2 When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.

9.7.3 City Engineer may decline to certify payment and may withhold request for payment in whole or in part upon failure of Contractor to submit initial construction schedule or monthly schedule updates, as required in Paragraphs 3.15.1 and 3.15.3.

9.8 *PROGRESS PAYMENTS*

9.8.1 The City will make payment, in an amount certified by City Engineer, within 20 days after City Engineer has issued a Certificate for Payment.

9.8.2 The City has no obligation to pay or to facilitate the payment to a Subcontractor or Supplier, except as may otherwise be required by law. Contractor shall comply with the prompt payment requirements of Chapter 2251 of the Government Code. State law requires payment of Subcontractors and Suppliers by Contractor within 7 calendar days of Contractor's receipt of payment from the City, unless there is a payment dispute between Contractor and a Subcontractor or Supplier evidenced on a form approved by the Director of Mayor's Office of Business Opportunity and submitted to the City Engineer each month with Application for Payment or Estimate for Payment. **CONTRACTOR SHALL DEFEND AND INDEMNIFY THE CITY FROM ANY CLAIMS OR LIABILITY ARISING OUT OF CONTRACTOR'S FAILURE TO MAKE THESE PAYMENTS.**

9.8.2.1 The City may, upon request and at the discretion of City Engineer, furnish to Subcontractor information regarding percentages of completion or the amounts applied for by Contractor, and action taken thereon by the City because of work done by the Subcontractor.

9.8.2.2 Contractor shall prepare and submit to City Engineer a Certification of Payment to Subcontractors and Suppliers form to be attached to each monthly Estimate for Payment or Application for Payment.

9.8.3 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Work by the City, does not constitute acceptance of work which is not in accordance with the Contract.

9.9 *DATE OF SUBSTANTIAL COMPLETION*

9.9.1 When Contractor considers the Work, or a portion thereof designated by City Engineer, to be substantially complete, Contractor shall prepare and submit to Project Manager a comprehensive punch list of items to be completed or corrected. Failure to include an item on the punch list does not alter the responsibility of Contractor to comply with the Contract.

9.9.1.1 By submitting the punch list to Project Manager, Contractor represents that work on the punch list will be completed within the time provided for in Subparagraph 9.9.4.3.

9.9.2 Upon receipt of Contractor's punch list, Project Manager will inspect the Work, or designated portion thereof, to verify that the punch list contains all items needing completion or correction. If Project Manager's inspection discloses items not on Contractor's punch list, the items must be added to the punch list of items to be completed or corrected. If Project Manager's inspection reveals that Contractor is not yet substantially complete, Contractor shall complete or correct the deficiencies and request another inspection by Project Manager. The City may recover the costs of re-inspection from Contractor.

9.9.3 Prior to City Engineer's issuing a Certificate of Substantial Completion, Contractor shall also provide:

9.9.3.1 Certificate of Occupancy for new construction, or Certificate of Compliance for remodeled work, as applicable, and

9.9.3.2 compliance with Texas Accessibility Standards through state inspection of the Work, if required. If Contractor calls for inspection in a timely manner and the inspection is delayed through no fault of Contractor, and City Engineer so confirms, City Engineer may, upon request by Contractor, add the inspection to the punch list in Paragraph 9.9.2 and issue a Certificate of Substantial Completion.

9.9.4 When the Work, or designated portion thereof, is determined by City Engineer to be sufficiently complete in accordance with the Contract so the City can occupy or utilize the Work, or designated portion thereof, for the purpose for which it is intended, City Engineer will prepare a Certificate of Substantial Completion that incorporates the punch list in Paragraph 9.9.2 and establishes:

9.9.4.1 Date of Substantial Completion;

9.9.4.2 responsibilities of the Parties for security, maintenance, heating, ventilating and air conditioning, utilities, damage to the Work, and insurance; and

9.9.4.3 fixed time within which Contractor shall complete all items on punch list of items to be corrected accompanying the certificate.

9.9.5 Warranties required by the Contract shall commence on the Date of Substantial Completion unless otherwise provided by City Engineer in Certificate of Substantial Completion. Warranties may not commence on items not substantially completed.

9.9.6 After Date of Substantial Completion and upon application by Contractor and approval by City Engineer, the City may make payment, reflecting adjustment in retainage, if any, as follows:

9.9.6.1 with the consent of Surety, the City may increase payment to Contractor to 96 percent of Contract Price, less value of items to be completed and accrued liquidated damages.

9.9.7 Contractor shall complete or correct the items in Paragraph 9.9.2 within the time period set out in the Certificate of Substantial Completion. If Contractor fails to do so, the City may issue a Notice of Noncompliance and proceed according to Section 2.5.

9.10 *PARTIAL OCCUPANCY OR USE*

9.10.1 The City may occupy or use any completed or partially completed portion of the Work at any stage, provided the occupancy or use is consented to by Contractor and Contractor's insurer and authorized by public authorities having jurisdiction over the Work. Consent of Contractor to partial occupancy or use may not be unreasonably withheld.

9.10.2 Immediately prior to the partial occupancy or use, Project Manager and Contractor shall jointly inspect the area to be occupied or portion of the Work to be used to determine and record condition of the Work.

9.10.3 Partial occupancy or use of a portion of the Work does not constitute acceptance of work not in compliance with requirements of the Contract.

9.11 *FINAL COMPLETION AND FINAL PAYMENT*

9.11.1 Contractor shall review the Contract and inspect the Work prior to Contractor notification to City Engineer that the Work is complete and ready for final inspection. Contractor shall submit affidavit that the Work has been inspected and that the Work is complete in accordance with requirements of the Contract.

9.11.2 Project Manager will make final inspection within 15 days after receipt of Contractor's written notice that the Work is ready for final inspection and acceptance. If Project Manager finds the Work has been completed in accordance with the Contract, Contractor shall submit items set out in Paragraph 9.11.4 and, for stipulated price contracts, a final Application for Payment. City Engineer will, within 10 days, issue Certificate of Final Completion stating that to the best of City Engineer's knowledge, information, and belief, the Work has been completed in accordance with the Contract, and will recommend acceptance of the Work by City Council.

9.11.3 Should work be found not in compliance with requirements of the Contract, City Engineer will notify Contractor in writing of items of noncompliance. Upon inspection and acceptance of the corrections by Project Manager, compliance with all procedures of Paragraph 9.11.2, and Contractor's submission of the items set out in Paragraph 9.11.4, the City Engineer will issue Certificate of Final Completion to Contractor as provided in Paragraph 9.11.2.

9.11.4 Contractor shall submit the following items to City Engineer before City Engineer will issue a Certificate of Final Completion:

9.11.4.1 affidavit that payrolls, invoices for materials and equipment, and other indebtedness of Contractor connected

with the Work, less amounts withheld by the City, have been paid or otherwise satisfied. If required by City Engineer, Contractor shall submit further proof including waiver or release of lien or claims from laborers or Suppliers of Products;

9.11.4.2 certificate evidencing that insurance required by the Contract to remain in force after final payment is currently in effect, will not be canceled or materially changed until at least 30 days written notice has been given to the City;

9.11.4.3 written statement that Contractor knows of no substantial reason that insurance will not be renewable to cover correction and warranty period required by the Contract;

9.11.4.4 consent of Surety to final payment; and

9.11.4.5 copies of record documents, maintenance manuals, tests, inspections, and approvals.

Upon City Engineer's issuance of a Certificate of Final Completion, Contractor may request increase in payment to 99 percent of Contract Price, less accrued liquidated damages.

9.11.5 If Contractor fails to submit required items in Paragraph 9.11.4 within 10 days of Project Manager's inspection of the Work under Paragraph 9.11.2 or Paragraph 9.11.3, City Engineer may, but is not obligated to:

9.11.5.1 deduct liquidated damages accrued from monies held;

9.11.5.2 proceed to City Council for acceptance of the Work, minus some or all of the items Contractor fails to submit under Paragraph 9.11.4; and,

9.11.5.3 upon acceptance by City Council of the portion of the Work completed, make final payment as set out in Paragraph 9.11.8.

9.11.6 If final completion is materially delayed through no fault of Contractor, or by issuance of Change Orders affecting date of final completion, and City Engineer so confirms, the City may, upon application by Contractor and certification by City Engineer, and without terminating the Contract, make payment of balance due for that portion of the Work fully completed and accepted.

9.11.7 If remaining balance due for work not corrected is less than retainage stipulated in the Contract, Contractor shall submit to City Engineer written consent of Surety to payment of balance due for that portion of the Work fully completed and accepted, prior to certification of the payment. The payment is made under terms governing final payment, except that it does not constitute waiver of Claims.

9.11.8 The City will make final payment to Contractor within 30 days after acceptance of the Work by City Council, subject to limitations, if any, as stated in the Contract.

9.11.9 Acceptance of final payment by Contractor shall constitute a waiver of all Claims, whether known or unknown, by Contractor, except those previously made in writing and identified by Contractor as unsettled at time of final Application for Payment.

9.12 *LIQUIDATED DAMAGES*

9.12.1 Contractor, Surety, and the City agree that failure to complete the Work within Contract Time will cause damages to the City and that actual damages from harm are difficult to estimate accurately. Therefore, Contractor, Surety, and the City agree that Contractor and Surety are liable for and shall pay to the City the amount stipulated in Supplementary Conditions as liquidated damages, and that the amount of damages fixed therein is a reasonable forecast of just compensation for harm to the City resulting from Contractor's failure to complete the Work within Contract Time. The amount stipulated will be paid for each day of delay beyond Contract Time until Date of Substantial Completion.

9.12.2 Contractor shall pay the City an amount equal to $1,200.00 per diesel operating vehicle or piece of motorized equipment per incident of high sulfur diesel fuel usage.

ARTICLE 10 - SAFETY PRECAUTIONS

10.1 *SAFETY PROGRAMS*

10.1.1 Contractor is responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with performance of the Contract. Contractor shall submit a safety program to City Engineer prior to mobilizing for the Work, and is solely responsible for safety, efficiency, and adequacy of ways, means, and methods, and for damage which might result from failure or improper construction, maintenance, or operation performed by Contractor.

10.2 *POLLUTANTS AND POLLUTANT FACILITIES*

10.2.1 If Contractor encounters material on-site which it reasonably believes to be a Pollutant or facilities which it reasonably believes to be a Pollutant Facility, Contractor shall immediately stop work in affected area and immediately notify City Engineer, confirming the notice thereafter in writing.

10.2.2 If City Engineer determines that the material is a Pollutant or facility is a Pollutant Facility, work in affected area may not be resumed except by Modification, and only if the work would not violate applicable laws or regulations.

10.2.3 If City Engineer determines that the material is not a Pollutant or a facility is not a Pollutant Facility, work in affected area will be resumed upon issuance of a Modification.

10.2.4 Contractor is not required to perform, unless authorized by Change Order, work relating to Pollutants or Pollutant Facilities except for that work relating to Pollutants or Pollutant Facilities specified in the Contract.

10.3 *SAFETY OF THE ENVIRONMENT, PERSONS, AND PROPERTY*

10.3.1 Contractor shall take reasonable precautions for safety and shall provide reasonable protection to prevent damage, injury, or loss from all causes, to:

10.3.1.1 employees performing work on-site, and other persons who may be affected thereby;

10.3.1.2 work, including Products to be incorporated into the Work, whether in proper storage, under control of Contractor or Subcontractor; and

10.3.1.3 other property at or adjacent to the site, such as trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal or replacement in course of construction.

10.3.2 Contractor shall give notices and comply with applicable laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on safety of persons, property, or environment.

10.3.2.1 Contractor shall comply with requirements of Underground Facility Damage Prevention and Safety Act TEX. UTIL. CODE ANN. Ch. 251 (Vernon Supp. 2002).

10.3.2.2 Contractor shall comply with all safety rules and regulations of the Federal Occupational Health and Safety Act of 1970 and subsequent amendments (OSHA).

10.3.3 Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection of persons and property, including posting danger signs and other warnings against hazards, promulgating safety regulations, and notifying owners and users of adjacent sites and utilities.

10.3.4 Contractor shall designate responsible member of Contractor's organization at site whose duty is prevention of accidents. This person will be Contractor's Superintendent unless otherwise designated by Contractor in writing to City Engineer.

10.3.5 Contractor shall prevent windblown dust and may not burn or bury trash debris or waste products on-site. Contractor shall prevent environmental pollution, including but not limited to particulates, gases and noise, as a result of the Work.

10.3.6 When use or storage of hazardous materials or equipment, or unusual methods are necessary for execution of the Work, Contractor shall exercise utmost care and carry on the activities under supervision of properly qualified personnel.

10.3.7 Contractor shall promptly remedy damage and loss to property referred to in Subparagraphs 10.3.1.2 and 10.3.1.3, caused in whole or in part by Contractor, or Subcontractors, which is not covered by insurance required by the Contract. Contractor is not required to remedy damage or loss attributable to the City, Design Consultant, or other contractors.

10.4 *EMERGENCIES*

10.4.1 In emergencies affecting safety of persons or property, Contractor shall act at Contractor's discretion to prevent imminent damage, injury, or loss. Additional compensation or extension of time claimed by Contractor because of emergencies are determined as provided in Article 7.

ARTICLE 11 - INSURANCE AND BONDS

11.1 *GENERAL INSURANCE REQUIREMENTS*

11.1.1 With no intent to limit Contractor's liability under indemnification provisions set forth in Paragraphs 3.25 and 3.26, Contractor shall provide and maintain in full force and effect during term of the Contract and all extensions and amendments thereto, at least the following insurance and available limits of liability.

11.1.2 If any of the following insurance is written as "claims made" coverage and the City is required to be carried as additional insured, then Contractor's insurance shall include a two-year extended discovery period after last date that Contractor provides any work under the Contract.

11.1.3 Aggregate amounts of coverage, for purposes of the Contract, are agreed to be amounts of coverage available during fixed 12-month policy period.

11.2 *INSURANCE TO BE PROVIDED BY CONTRACTOR*

11.2.1 *Risks and Limits of Liability:* Contractor shall maintain the insurance coverages in the listed amounts, as set out in Table 1.

11.2.2 If Limit of Liability for Excess Coverage is $2,000,000 or more, Limit of Liability for Employer's Liability may be reduced to $500,000.

11.2.3 *Insurance Coverage*: At all times during the term of this Contract and any extensions or renewals, Contractor shall provide and maintain insurance coverage that meets the Contract requirements. Prior to beginning performance under the Contract, at any time upon the Director's request, or each time coverage is renewed or updated, Contractor shall furnish to the Director current certificates of insurance, endorsements, all policies, or other policy documents evidencing adequate coverage, as necessary. Contractor shall be responsible for and pay (a) all premiums and (b) any claims or losses to the extent of any deductible amounts. Contractor waives any claim it may have for premiums or deductibles against the City, its officers, agents, or employees. Contractor shall also require all subcontractors or consultants whose subcontracts exceed $100,000 to provide proof of insurance coverage meeting all requirements stated above except amount. The amount must be commensurate with the amount of the subcontract, but no less than $500,000 per claim.

11.2.4 *Form of insurance*: The form of the insurance shall be approved by the Director and the City Attorney; such approval (or lack thereof) shall never (a) excuse non-compliance with the terms of this Section, or (b) waive or estop the City from asserting its rights to terminate this Contract. The policy issuer shall (1) have a Certificate of Authority to transact insurance business in Texas, or (2) be an eligible non-admitted insurer in the State of Texas and have a Best's rating of at least B+, and a Best's Financial Size Category of Class VI or better, according to the most current Best's Key Rating Guide. Each insurer is subject to approval by City Engineer in City Engineer's sole discretion as to conformance with these requirements.

11.2.5 *Required Coverage*: The City shall be an Additional Insured under this Contract, and all policies except Professional Liability and Worker's Compensation must name the City as an Additional Insured. Contactor waives any claim or right of subrogation to recover against the City, its officers, agents, or employees, and each of Contractor's insurance policies except professional liability must contain coverage waiving such claim. Each policy, except Workers' Compensation and Professional Liability, must also contain an endorsement that the policy is primary to any other insurance available to the Additional Insured with respect to claims arising under this Contract. If professional liability coverage is written on a "claims made" basis, Contractor shall also provide proof of renewal each year for two years after substantial completion of the Project, or in the alternative: evidence of extended reporting period coverage for a period of two years after substantial completion, or a project liability policy for the Project covered by this Contract with a duration of two years after substantial completion.

11.2.6 *Deductibles:* Contractor assumes and bears any claims or losses to extent of deductible amounts and waives any claim it may ever have for same against the City, its officers, agents, or employees.

11.2.7 *Notice*: **CONTRACTOR SHALL GIVE 30 DAYS' ADVANCE WRITTEN NOTICE TO THE DIRECTOR IF ANY OF ITS INSURANCE POLICIES ARE CANCELED OR NON-RENEWED**. Within the 30-day period, Contractor shall provide other suitable policies in order to maintain the required coverage. If Contractor does not comply with this requirement, the Director, at his or her sole discretion, may immediately suspend Contractor from any further performance under this Agreement and begin procedures to terminate for default.

11.2.8 *Subrogation:* Contractor waives any claim or right of subrogation to recover against the City, its officers, agents, or employees. Each policy,

except professional liability, must contain an endorsement waiving such claim.

11.2.9 *Endorsement of Primary Insurance:* Each policy, except Workers' Compensation policies, must contain an endorsement that the policy is primary insurance to any other insurance available to additional insured with respect to claims arising hereunder.

11.2.10 *Liability for Premium:* Contractor is solely responsible for payment of all insurance premium requirements hereunder and the City is not obligated to pay any premiums.

11.2.11 *Additional Requirements for Workers' Compensation Insurance Coverage:* Contractor shall, in addition to meeting the obligations set forth in Table 1, maintain throughout the term of the Contract Workers' Compensation coverage as required by statute, and Contractor shall specifically comply with requirements set forth in Paragraph 11.2.10. The definitions set out below shall apply only for purposes of this Paragraph 11.2.10.

11.2.12 Definitions:

11.2.12.1 *Certificate of Coverage:* A copy of certificate of insurance, or coverage agreement (TWCC-81, TWCC-82, TWCC-83, or TWCC-84), showing statutory Workers' Compensation insurance coverage for Contractor's, Subcontractor's, or Supplier's employees providing services for the duration of the Contract.

11.2.12.2 *Duration of the Work:* Includes the time from Date of Commencement of the Work until Contractor's work under the Contract has been completed and accepted by City Council.

11.2.12.3 *Persons providing services for the Work (Subcontractor in Texas Labor Code § 406.096):* includes all persons or entities performing all or part of services Contractor has undertaken to perform on the Work, regardless of whether that person contracted directly with Contractor and regardless of whether that person has employees. This includes, without limitation, independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of the entity, or employees of entity which furnishes persons to provide services on the Work. Services include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to the Work. Services do not include activities unrelated to the Work, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

11.2.13 Contractor shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of coverage agreements, which meets the statutory requirements of TEX. LAB. CODE ANN., Section 401.011(44) for employees of Contractor providing services on the Work, for duration of the Work.

11.2.14 Contractor shall provide a Certificate of Coverage to the City prior to being awarded the Contract.

11.2.15 If coverage period shown on Contractor's original Certificate of Coverage ends during duration of the Work, Contractor shall file new Certificate of Coverage with the City showing that coverage has been extended.

11.2.16 Contractor shall obtain from each person providing services on the Work, and provide to City Engineer:

11.2.16.1 Certificate of Coverage, prior to that person beginning work on the Work, so the City will have on file Certificates of Coverage showing coverage for all persons providing services on the Work; and

11.2.16.2 no later than seven days after receipt by Contractor, new Certificate of Coverage showing extension of coverage, if coverage period shown on current Certificate of Coverage ends during the duration of the Work.

11.2.17 Contractor shall retain all required Certificates of Coverage for the duration of the Work and for one year thereafter.

11.2.18 Contractor shall notify City Engineer in writing by certified mail or personal delivery, within 10 days after Contractor knew or should have known, of any change that materially affects provision of coverage of any person providing services on the Work.

11.2.19 Contractor shall post on-site a notice, in text, form and manner prescribed by Texas Workers'

Compensation Commission, informing all persons providing services on the Work that they are required to be covered, and stating how person may verify coverage and report lack of coverage.

11.2.20 Contractor shall contractually require each person with whom it contracts to provide services on the Work to:

11.2.20.1 provide coverage, based on proper reporting of classification codes, payroll amounts and filing of any coverage agreements, which meets statutory requirements of TEX. LAB. CODE ANN., Section 401.011(44) for all its employees providing services on the Work, for the duration of the Work;

11.2.20.2 provide to Contractor, prior to that person's beginning work on the Work, a Certificate of Coverage showing that coverage is being provided for all employees of the person providing services on the Work, for the duration of the Work;

11.2.20.3 provide Contractor, prior to the end of the coverage period, a new Certificate of Coverage showing extension of coverage, if the coverage period shown on the current Certificate of Coverage ends during the duration of the Work;

11.2.20.4 obtain from each other person with whom it contracts, and provide to Contractor: (1) Certificate of Coverage, prior to other person's beginning work on the Work; and (2) new Certificate of Coverage showing extension of coverage, prior to end of coverage period, if coverage period shown on the current Certificate of Coverage ends during duration of the Work.

11.2.20.5 retain all required Certificates of Coverage on file for the duration of the Work and for one year thereafter;

11.2.20.6 notify City Engineer in writing by certified mail or personal delivery within 10 days after person knew, or should have known, of change that materially affects provision of coverage of any person providing services on the Work; and

11.2.20.7 contractually require each person with whom it contracts to perform as required by Paragraphs 11.2.10.1 through 11.2.10.7, with Certificates of Coverage to be provided to person for whom they are providing services.

11.2.21 By signing the Contract or providing or causing to be provided a Certificate of Coverage, Contractor is representing to the City that all employees of Contractor who will provide services on the Work will be covered by Workers' Compensation coverage for the duration of the Work, that coverage will be based on proper reporting of classification codes and payroll amounts, and that all coverage agreements will be filed with appropriate insurance carrier. Contractor is not allowed to self-insure Workers' Compensation. Contractor may be subject to administrative penalties, criminal penalties, civil penalties, or other civil actions for providing false or misleading information.

11.2.22 Contractor's failure to comply with Paragraph 11.2.10 is a breach of the Contract by Contractor, which entitles the City to declare the Contract void if Contractor does not remedy breach within 10 days after receipt of notice of breach from City Engineer.

11.2.23 *Subcontractor Insurance Requirements:* Contractor shall require Subcontractors and Suppliers to obtain Commercial General Liability, Workers' Compensation, Employer's Liability and Automobile Liability coverage that meets all the requirements of Paragraph 11.2. The amount must be commensurate with the amount of the subcontract, but not less than $500,000 per occurrence. Contractor shall require all Subcontractors with whom it contracts directly, whose subcontracts exceed $100,000, to provide proof of Commercial General Liability and Automobile Liability insurance coverage meeting the above requirements. Contractor shall comply with all requirements set out under Paragraph 11.2.10 as to Workers' Compensation Insurance for all Subcontractors and Suppliers.

REQUIRED COVERAGE

(Coverage)	(Limit of Liability)
.1 Workers' Compensation	• Statutory Limits for Workers' Compensation
.2 Employer's Liability	• Bodily Injury by Accident $1,000,000 (each accident) • Bodily Injury by Disease $1,000,000 (policy limit) • Bodily Injury by Disease $1,000,000 (each employee)
.3 Commercial General Liability: Including Contractor's Protective, Broad Form Property Damage, Contractual Liability, Explosion, Underground and Collapse, Bodily Injury, Personal Injury, Products, and Completed Operations (for a period of one year following completion of the Work).	• Combined single limit of $1,000,000 (each occurrence), subject to general aggregate of $1,000,000; • Products and Completed Operations $1,000,000 aggregate.
.4 Owner's and Contractor's Protective Liability	• $1,000,000 combined single limit each Occurrence/ aggregate
.5 Installation Floater (Unless alternative coverage approved by City Attorney)	• Value of stored material or equipment, listed on Certificates of Payments, but not yet incorporated into the Work
.6 Automobile Liability Insurance: (For automobiles furnished by Contractor in course of his performance under the Contract, including Owned, Non-owned, and Hired Auto coverage)	• $1,000,000 combined single limit each occurrence for (1) Any Auto or (2) All Owned, Hired, and Non-Owned Autos
.7 Excess Coverage	• $1,000,000 each occurrence/combined aggregate in excess of limits specified for Employer's Liability, Commercial General Liability, and Automobile Liability
Aggregate Limits are per 12-month policy period unless otherwise indicated.	

11.3 *PROOF OF INSURANCE*

11.3.1 Prior to commencing services and at time during the term of the Contract, Contractor shall furnish City Engineer with Certificates of Insurance, along with Affidavit from Contractor confirming that Certificate accurately reflects insurance coverage that is available during term of the Contract. If requested in writing by City Engineer, Contractor shall furnish City Engineer with certified copies of Contractor's actual insurance policies. Failure of Contractor to provide certified copies, as requested, may be deemed, at City Engineer's or City Attorney's discretion, a material breach of the Contract.

11.3.2 Notwithstanding the proof of insurance requirements, Contractor shall continuously maintain in effect required insurance coverage set forth in Paragraph 11.2. Failure of Contractor to comply with this requirement does constitute a material breach by Contractor allowing the City, at its option, to immediately suspend or terminate work, or exercise any other remedy allowed under the Contract. Contractor agrees that the City has not waived or is not estopped to assert a material breach of the Contract because of any acts or omissions by the City regarding its review or non-review of insurance documents provided by Contractor, its agents, employees, or assigns.

11.3.3 Contractor shall provide updated certificates of insurance to the Director upon request. The Contractor shall be responsible for delivering a current certificate of insurance in the proper form to the Director as long as Contractor is required to furnish insurance coverage under Paragraph 11.2.

11.3.4 Every certificate of insurance Contractor delivers in connection with this Contract shall

11.3.4.1 be less than 12 months old;

11.3.4.2 include all pertinent identification information for the Insurer, including the company name and address, policy

number, NAIC number or AMB number, and authorized signature;

11.3.4.3 include in the Certificate Holder Box the Project name and reference numbers, contractor's email address, and indicates the name and address of the Project Manager;

11.3.4.4 include the Contractor's email address in the Certificate Holder Box;

11.3.4.5 include the Project reference numbers on the City address so the Project reference number is visible in the envelope window; and

11.3.4.6 be appropriately marked to accurately identify all coverages and limits of the policy, effective and expiration dates, and waivers of subrogation in favor of the City for Commercial General Liability, Automobile Liability, and Worker's Compensation/Employers' Liability.

11.4 *PERFORMANCE AND PAYMENT BONDS*

11.4.1 For Contracts over the value of $25,000, Contractor shall provide Bonds on the City's standard forms covering faithful performance of the Contract and payment of obligations arising thereunder as required in the Contract pursuant to Chapter 2253 of the Government Code. The Bonds must be for 100 percent of Original Contract Price and in accordance with conditions stated on standard City Performance and Payment Bond and Statutory Payment Bond forms. Bonds may be obtained from Contractor's usual source and cost for the Bonds are included in Contract Price.

11.5 *MAINTENANCE BONDS*

11.5.1 *One-year Maintenance Bond:* Contractor shall provide Bond on standard City One-year Maintenance Bond form, providing for Contractor's correction, replacement, or restoration of any portion of the Work which is found to be not in compliance with requirements of the Contract during one-year correction period required in Paragraph 12.2. The Maintenance Bond must be for 100 percent of the Original Contract Price.

11.6 *SURETY*

11.6.1 A Bond that is given or tendered to the City pursuant to the Contract must be executed by a surety company that is authorized and admitted to write surety Bonds in the State of Texas.

11.6.2 If a Bond is given or tendered to the City pursuant to the Contract in an amount greater than 10 percent of Surety's capital and surplus, Surety shall provide certification that Surety has reinsured that portion of the risk that exceeds 10 percent of Surety's capital and surplus. The reinsurance must be with one or more reinsurers who are duly authorized, accredited, or trusted to do business in the State of Texas. The amount reinsured by reinsurer may not exceed 10 percent of reinsurer's capital and surplus. The amount of allowed capital and surplus must be based on information received from State Board of Insurance.

11.6.3 If the amount of a Bond is greater than $100,000, Surety shall:

11.6.3.1 also hold certificate of authority from the United States Secretary of Treasury to qualify as surety on obligations permitted or required under federal law; or,

11.6.3.2 Surety may obtain reinsurance for any liability in excess of $100,000 from reinsurer that is authorized and admitted as a reinsurer in the State of Texas and is the holder of a certificate of authority from the United States Secretary of the Treasury to qualify as surety or reinsurer on obligations permitted or required under federal law.

11.6.4 Determination of whether Surety on the Bond or the reinsurer holds a certificate of authority from the United States Secretary of the Treasury is based on information published in Federal Register covering the date on which Bond was executed.

11.6.5 Each Bond given or tendered to the City pursuant to the Contract must be on City forms with no changes made by Contractor or Surety, and must be dated, executed, and accompanied by power of attorney stating that the attorney in fact executing such the bond has requisite authority to execute such Bond. The Bonds must be dated and must be no more than 30 days old.

11.6.6 Surety shall designate in its Bond, power of attorney, or written notice to the City, an agent resident in Harris County to whom any requisite notices may be delivered and on whom service of process may be had in matters arising out of the suretyship.

11.6.7 Contractor shall furnish information to a payment bond beneficiary as required by TEX. GOV'T CODE ANN. CH. 2253.

11.7 *DELIVERY OF BONDS*

11.7.1 Contractor shall deliver required Bonds to the City within time limits stated in Notice of Intent to Award and prior to Date of Commencement of the Work.

ARTICLE 12 - UNCOVERING AND CORRECTION OF THE WORK

12.1 *UNCOVERING OF THE WORK*

12.1.1 If a portion of the Work has been covered which City Engineer has not specifically requested to observe prior to its being covered, City Engineer may request to see such work and it must be uncovered by Contractor. If such work is in accordance with the Contract, the costs of uncovering and covering such work are charged to the City by Change Order. If such work is not in accordance with the Contract, Contractor shall pay for uncovering and shall correct the nonconforming Work promptly after receipt of Notice of Noncompliance to do so.

12.2 *CORRECTION OF THE WORK*

12.2.1 Contractor shall promptly correct or remove work rejected by City Engineer or work failing to conform to requirements of the Contract, whether observed before or after Date of Substantial Completion and whether fabricated, Installed, or completed.

12.2.2 Contractor bears costs of correcting the rejected or nonconforming work including additional testing and inspections, and compensation for Design Consultant's services and expenses made necessary thereby.

12.2.3 If within one year after Date of Substantial Completion, or after date for commencement of warranties established under Paragraph 9.9.5 or by other applicable special warranty required by the Contract, whichever is later in time, any of the Work is found not to be in accordance with the requirements of the Contract, Contractor shall correct such work promptly after receipt of Notice of Noncompliance to do so.

12.2.4 One-year correction period for portions of the Work completed after Date of Substantial Completion will begin on the date of acceptance of that portion of the Work. This obligation under this Paragraph survives acceptance of the Work under the Contract and termination of the Contract.

12.2.5 The one-year correction period does not establish a duration for the Contractor's general warranty under Paragraph 3.12. The City retains the right to recover damages from the Contractor as long as may be permitted by the applicable statute of limitations.

12.2.6 If Contractor does not proceed with correction of the nonconforming work within time fixed by Notice of Noncompliance, the City may correct nonconforming work or remove nonconforming work and store salvageable Products at Contractor's expense. Contractor shall pay the costs of correction of nonconforming work and removal and storage of salvageable Products to the City. If Contractor does not pay costs of the correction or removal and storage within 10 days after written notice, the City may sell the Products at auction or at private sale. The City will account for proceeds thereof after deducting costs and damages that would have been borne by Contractor, including compensation for services of Design Consultant and necessary expenses. If the proceeds of sale do not cover costs which Contractor should have borne, Contractor shall pay the value of the deficiency to the City.

12.2.7 Contractor bears cost of correcting work originally installed by Contractor, the City, or by separate contractors and damaged by Contractor's correction or removal of Contractor's work.

12.3 *ACCEPTANCE OF NONCONFORMING WORK*

12.3.1 If City Engineer prefers to accept work which is not in accordance with requirements of the Contract, City Engineer may do so only by issuance of Change Order, instead of requiring its removal and correction. City Engineer will determine Contract Price reduction. The reduction will become effective even if final payment has been made.

ARTICLE 13 - MISCELLANEOUS PROVISIONS

13.1 *GOVERNING LAWS*

13.1.1 The Contract is subject to the laws of the State of Texas, the City Charter and Ordinances, the laws of the federal government of the United States, and all rules and regulations of any regulatory body or officer having jurisdiction.

13.1.2 Venue for any litigation relating to the Contract is Harris County, Texas.

13.2 *SUCCESSORS*

13.2.1 The Contract binds and benefits the Parties and their legal successors and permitted assigns; however, this Paragraph 13.2.1 does not alter the restrictions on assignment and disposal of assets set out in Paragraph 13.3.1. The Contract does not create any personal liability on the part of any officer or agent of the City.

13.3 *BUSINESS STRUCTURE AND ASSIGNMENTS*

13.3.1 Contractor may not assign the Contract at law or otherwise, or dispose of all or substantially all of its assets without City Engineer's prior written consent. Nothing in this Section, however, prevents the assignment of accounts receivable or the creation of a security interest as described in §9.406 of the Texas Business & Commerce Code. In the case of such an assignment, Contractor shall immediately furnish the City with proof of the assignment and the name, telephone number, and address of the assignee and a clear identification of the fees to be paid to the assignee.

13.3.2 Any series, as defined by the TEX. BUS. ORG. CODE ANN., affiliate, subsidiary, or successor to which Contractor assigns or transfers assets shall join in privity and be jointly and severally liable under this Contract.

13.4 *WRITTEN NOTICE*

13.4.1 All notices required or permitted by the Contract must be in writing and must be effected by hand delivery; registered or certified mail, return receipt requested; or facsimile with confirmation copy mailed to receiving Party. Notice is sufficient if made or addressed with proper postage to the address stated in the Agreement for each Party ("Notice Address") or faxed to the facsimile number stated in the Agreement for each Party. The notice is deemed delivered on the earlier of:

- 13.4.1.1 the date the Notice is actually received;
- 13.4.1.2 the third day following deposit in a United States Postal Service post office or receptacle; or
- 13.4.1.3 the date the facsimile is sent unless the facsimile is sent after 5:00 p.m. local time of the recipient and then it is deemed received on the following day.

Any Party may change its Notice Address or facsimile number at any time by giving written notice of the change to the other Party in the manner provided for in this Paragraph at least 15 days prior to the date the change is affected.

13.5 *RIGHTS AND REMEDIES*

13.5.1 Duties and obligations imposed by the Contract and rights and remedies available thereunder are in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

13.5.2 No act or failure to act by the City or Contractor is a waiver of rights or duties afforded them under the Contract, nor is the act or failure to act constitute approval of or acquiescence in a breach of the Contract. No waiver, approval or acquiescence is binding unless in writing and, in the case of the City, signed by City Engineer.

13.6 *TESTS AND INSPECTIONS*

13.6.1 Contractor shall give City Engineer, Construction Manager, and Design Consultant timely notice of the time and place where tests and inspections are to be made. Contractor shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

13.6.2 The City will employ and pay for services of an independent testing laboratory to perform inspections or acceptance tests required by the Contract except:

- 13.6.2.1 inspections or tests covered by Paragraph 13.6.3;
- 13.6.2.2 those otherwise specifically provided in the Contract; or
- 13.6.2.3 costs incurred in connection with tests or inspections conducted pursuant to Paragraph 12.2.2.

13.6.3 Contractor is responsible for and shall pay all costs in connection with inspection or testing required in connection with City Engineer's acceptance of a Product to be incorporated into the Work, or of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation into the Work.

13.6.4 Neither observations by the City, Construction Manager, or Design Consultant, nor inspections, tests, or approvals by others, relieves Contractor from Contractor's obligations to perform the Work in accordance with the Contract.

13.7 *INTEREST*

13.7.1 No interest will accrue on late payments by the City except as provided under Chapter 2251 of the Government Code.

13.8 *PARTIES IN INTEREST*

13.8.1 The Contract does not bestow any rights upon any third party, but binds and benefits the Parties only.

13.9 *ENTIRE CONTRACT*

13.9.1 The Contract merges the prior negotiations and understandings of the Parties and embodies the entire agreement of the Parties. No other agreements, assurances, conditions, covenants, express or implied, or other terms of any kind, exist between the Parties regarding the Contract.

13.10 *WRITTEN AMENDMENT*

13.10.1 Changes to the Contract that cannot be effected by Modifications, must be made by written amendment, which will not be effective until approved by City Council.

13.11 *COMPLIANCE WITH LAWS*

13.11.1 Contractor shall comply with the Americans with Disabilities Act of 1990 as amended (ADA) and Texas Architectural Barriers Act and all regulations relating to either statute.

13.11.2 Contractor shall comply with all applicable federal, state, and city laws, rules and regulations.

13.12 *SEVERABILITY*

13.12.1 If any part of the Contract is for any reason found to be unenforceable, all other parts remain enforceable to the extent permitted by law.

ARTICLE 14 - TERMINATION OR SUSPENSION OF THE CONTRACT

14.1 *TERMINATION BY THE CITY FOR CAUSE*

14.1.1 Each of the following acts or omissions of Contractor or occurrences shall constitute an "Event of Default" under the Contract:

14.1.1.1 Contractor refuses or fails to supply enough properly skilled workers or proper Products;

14.1.1.2 Contractor disregards laws, ordinances, rules, regulations, or orders of a public authority having jurisdiction;

14.1.1.3 Contractor is guilty of material breach of any duty or obligation of Contractor under the Contract, including, but not limited to, failure to submit certified payrolls electronically;

14.1.1.4 Contractor has had any other contract with the City terminated for cause at any time subsequent to the effective date of the Contract as set out in the Agreement; or

14.1.1.5 Contractor fails to utilize Ultra Low Sulfur Diesel Fuel, as required in Paragraph 3.9.1.1.

14.1.2 If an Event of Default occurs, City Engineer may, at his option and without prejudice to any other rights or remedies which the City may have, deliver a written notice to Contractor and Surety describing the Event of Default and giving the Contractor 10 days to cure the Event of Default. If after the cure period, Contractor has failed or refused to cure the Event of Default, then City Engineer may deliver a second written notice to Contractor giving notice of the termination of the Contract or of the termination of Contractor's performance under the Contract ("Notice of Termination"). If City Engineer issues a Notice of Termination, then City Engineer may, subject to any prior rights of Surety and any other rights of the City under the Contract or at law:

14.1.2.1 request that Surety complete the Work; or

14.1.2.2 take possession of the site and all materials, equipment, tools, and construction equipment and machinery on the site owned by Contractor; and

14.1.2.3 finish the Work by whatever reasonable method City Engineer may deem expedient.

14.1.3 After Contractor's receipt of a Notice of Termination, and except as otherwise directed in writing by City Engineer, Contractor shall:

14.1.3.1 stop the Work on the date and to the extent specified in the Notice of Termination;

14.1.3.2 place no further orders or subcontracts for Products or services;

14.1.3.3 terminate all orders and subcontracts to the extent that they relate to performance of work terminated;

14.1.3.4 assign to the City, in the manner, at the times, and to the extent directed by City Engineer, all rights, title, and interest of Contractor, under the terminated supply orders and subcontracts. The City may settle or pay claims arising out of termination of the orders and subcontracts;

14.1.3.5 settle all outstanding liabilities and all claims arising out of the termination of

supply orders and subcontracts with approval of City Engineer;

14.1.3.6 take action as may be necessary, or as City Engineer may direct, for protection and preservation of property related to the Work that is in possession of Contractor, and in which the City has or may acquire an interest; and

14.1.3.7 secure the Work in a safe state before leaving the site, providing any necessary safety measures, shoring, or other devices.

14.1.4 If the City terminates the Contract or terminates Contractor's performance under the Contract for any one or more of the reasons stated in Paragraph 14.1.1, Contractor may not receive any further payment until the Work is complete, subject to Paragraph 14.1.5.

14.1.5 If the unpaid balance of Contract Price exceeds the costs of finishing the Work, including liquidated damages and other amounts due under the Contract, the balance will be paid to Contractor. If the costs of finishing the Work exceed the unpaid balance, Contractor shall, within 10 days of receipt of written notice setting out the amount of the excess costs, pay the difference to the City. The amount to be paid to Contractor or the City will be certified by City Engineer in writing, and this obligation for payment shall survive termination of the Contract or termination of Contractor's performance under the Contract. Termination of the Contractor for cause shall not relieve the Surety from its obligation to complete the project.

14.2 *TERMINATION BY THE CITY FOR CONVENIENCE*

14.2.1 City Engineer may, without cause and without prejudice to other rights or remedies of the City, give Contractor and Surety a Notice of Termination with a seven days written notice.

14.2.2 After receipt of the Notice of Termination, and except as otherwise approved by City Engineer, Contractor shall conform to requirements of Paragraph 14.1.3.

14.2.3 After receipt of the Notice of Termination, Contractor shall submit to the City its termination Claim, in forms required by City Engineer. The Claim will be submitted to the City promptly, but no later than six months from the effective date of termination, unless one or more extensions are granted by City Engineer in writing. If Contractor fails to submit its termination Claim within the time allowed, in accordance with Paragraph 14.2.4, City Engineer will determine, on the basis of available information, the amount, if any, due to Contractor because of termination, and City Engineer's determination is final and binding on the Parties. The City will then pay to Contractor the amount so determined.

14.2.4 City Engineer will determine, on the basis of information available to City Engineer, the amount due, if any, to Contractor for the termination as follows:

14.2.4.1 Contract Price for all work performed in accordance with the Contract up to the date of termination determined in the manner prescribed for monthly payments in Article 9, except no retainage is withheld by the City either for payment determined by percentage of completion or for materials and equipment delivered to the site, in storage or in transit.

14.2.4.2 Reasonable termination expenses, including costs for settling and paying Subcontractor and Supplier claims arising out of termination of the Work, reasonable cost of preservation and protection of the City's property after termination, if required, and the cost of Claim preparation. Termination expenses do not include field or central office overhead, salaries of employees of Contractor, or litigation costs, including attorneys' fees.

No amount is allowed for anticipated profit or central office overhead on uncompleted work, or any cost or lost profit for other business of Contractor alleged to be damaged by the termination.

14.2.5 Contractor shall promptly remove from the site any construction equipment, tools, and temporary facilities, except the temporary facilities which City Engineer may wish to purchase and retain.

14.2.6 Contractor shall cooperate with City Engineer during the transition period.

14.2.7 The City will take possession of the Work and materials delivered to the site, in storage, or in transit, as of date or dates specified in the Notice of Termination, and is responsible for maintenance, utilities, security, and insurance, as stated in Notice of Termination.

14.3 *SUSPENSION BY THE CITY FOR CONVENIENCE*

14.3.1 City Engineer may, without cause, after giving Contractor and Surety 24-hour prior written notice, order Contractor to suspend, delay, or interrupt the Work in whole or in part for a period of time as City Engineer may determine.

14.3.2 An adjustment will be made in Contract Time equivalent to the time of suspension.

14.3.3 Adjustment will be made to Contract Price for increases in the cost of performance of the Work, including profit on increased cost of performance caused by suspension, delay, or interruption of the Work in accordance with Paragraph 7.3. No adjustment will be made to the extent that:

14.3.3.1 performance was, or would have been, suspended, delayed, or interrupted by another cause for which Contractor is responsible; or

14.3.3.2 adjustment is made or denied under another provision of the Contract.

14.4 *TERMINATION BY CONTRACTOR*

14.4.1 Contractor may terminate the Contract if the Work is stopped for a period of 30 days through no act or fault of Contractor, directly related to one of these events:

14.4.1.1 issuance of an order of a court or other public authority having jurisdiction;

14.4.1.2 act of government, such as a declaration of national emergency which makes material unavailable; or

14.4.1.3 if repeated suspensions, delays, or interruptions by the City as described in Paragraph 14.3 constitute, in the aggregate, more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less;

No termination will be effective for the above reasons if Contractor delivers written notice to City Engineer describing the reason for termination, giving the proposed termination date, and granting the City a reasonable opportunity to respond and cure any City default before termination is effective.

14.4.2 If the Contract is terminated pursuant to this Paragraph 14.4, Contractor shall comply with the requirements of Paragraphs 14.2.2 through 14.2.7.

END OF DOCUMENT

Document 00800

SUPPLEMENTARY CONDITIONS

The following Paragraphs amend and supplement the August 15, 2015 edition of General Conditions. Unaltered portions of General Conditions remain in effect.

ARTICLE 1 - GENERAL PROVISIONS:

1.1 *DEFINITIONS*:

1.1.9.1 The firm of N/A has been employed by the City as Construction Manager for the Work.

1.1.22.1 *Good Faith Efforts*. Steps taken to achieve an MBE, WBE, SBE, or PDBE goal or other requirements which, by their scope, intensity, and usefulness, demonstrate the bidder's responsiveness to fulfill the business opportunity objective, as well as the Contractor's responsibility to put forth measures to meet or exceed the MBE, WBE, SBE, or PDBE goal (Contract Goal). These steps apply from before a contract's award, through its duration, and after its conclusion, in the event the Contractor has been unsuccessful in meeting the Contract Goal. These efforts are required whether a Goal Oriented Contract or a Regulated Contract, as defined in the Office of Business Opportunity's Policy & Procedures Manual, available at http://www.houstontx.gov/obo.

ARTICLE 3 - THE CONTRACTOR

3.5 *LABOR*:

3.5.3.1.1 If the Original Contract Price is greater than One Million Dollars, Contractor shall make Good Faith Efforts to comply with the City ordinances regarding Minority Business Enterprises (MBE), Women Business Enterprises (WBE), Persons with Disabilities Business Enterprises (PDBE) and Small Business Enterprise (SBE) participation goals which are as follows:

.1 the MBE goal is 11 percent,

.2 the WBE goal is 7 percent, and

.3 the PDBE goal is 0 percent.

.4 The bidder may substitute SBE participation of no more than four percent of the MBE goal, the WBE goal, or portions of the MBE Goal and WBE Goal.

3.5.3.1.2 The MBE, WBE, PDBE, and SBE goals are specific to this Agreement. The Contractor shall make reasonable efforts to achieve these goals.

3.5.3.1.3 Failure by Contractor to comply with the goals for MBE, WBE, SBE, or PDBE is a material breach of the Agreement, which may result in termination of the Agreement, or such other remedy permitted as the City deems appropriate.

ARTICLE 8 - TIME

8.1 *PROGRESS AND COMPLETION: Add the following Paragraph 8.1.6.1.*

8.1.6.1 Contractor shall credit the City by Change Order for inspection services for overtime work or work performed on Sundays or Legal Holidays. The amount Contractor credits the City will be $50.00 per hour *actual costs* per inspector for inspection services.

ARTICLE 9 - PAYMENTS AND COMPLETION

9.1 *UNIT PRICE WORK*:

9.1 References to Unit Prices in individual Specification sections are not applicable to the Contract. Include payment for portions of the Work required by these sections in the Stipulated Price for the Contract.

9.12 *LIQUIDATED DAMAGES*: *Insert the following Paragraph 9.12.1.1.*

9.12.1.1 The amount of liquidated damages payable by Contractor or Surety for each and every day of delay beyond Contract Time, are $2,000.00 per day.

ARTICLE 11 - INSURANCE AND BONDS

11.2 INSURANCE TO BE PROVIDED BY CONTRACTOR

11.2.1.2 Contractor shall purchase for the duration of the Contract the insurance set out in Table 2 in addition to the minimum insurance coverage set out in section 11.2.1.

TABLE 2
ADDITIONAL REQUIRED COVERAGE
DEFENSE COSTS EXCLUDED FROM FACE AMOUNT OF POLICY.

(Coverage)	(Limit of Liability)
Property and Casualty Coverage: "All Causes of Loss" Builder's Risk Form for directing physical change to building or plant construction on the Work site and/or all land improvements including all work. (Including but not limited to earthquake, flood, boiler, and machinery including testing, damage to existing or adjoining property, time element coverage, collapse, soft costs (management, architecture, financial costs, pre-opening costs, etc.), transit coverage, off-site storage).	100% of Contract Price, including change orders

11.5 *MAINTENANCE BONDS:*

11.5.2 One-year Surface Correction Bond: Contractor shall provide, on the City standard form, an additional One-Year Bond in an amount equal to four percent of the Original Contract Price or cost of repair. Bond shall provide for Contractor's correction, replacement, or restoration of backfill or subsurface and surface work not in accordance with the Contract, within one year from the date the One-Year Maintenance Bond has expired.

END OF DOCUMENT

Document 00805

EQUAL EMPLOYMENT OPPORTUNITY PROGRAM REQUIREMENTS
(City of Houston Information Requirements
for the Successful Bidder on All Construction Contracts)

DOCUMENTS THAT MUST BE SIGNED AND RETURNED TO THE CITY OF HOUSTON PRIOR TO FINAL EXECUTION OF CONTRACT

Certification by Bidder Regarding Equal Employment Opportunity EEO-3

Total Work Force Composition of the Company,..... EEO-6
or in lieu thereof, a copy of the latest Equal Employment Opportunity Commission's EEO-1 form (This information is required only if the Contractor has a work force of 50 or more people and the Contract is $50,000 or more.)

Company's Equal Employment Opportunity Compliance Program EEO-7

INFORMATION THAT MUST BE SUPPLIED DURING THE COURSE OF THE WORK

Certification By Proposed Subcontractor Regarding
Equal Employment Opportunity EEO-26

Certification by Proposed Material Suppliers, Lessors,and
Professional Service Providers Regarding Equal Employment Opportunity..... EEO-29

PLEASE COMPLETE PAGES EEO-3 THROUGH EEO-7 AND MAIL TO:

City of Houston
Mayor's Office of Business Opportunity
Contract Compliance Section
611 Walker, 7th Floor
Houston, Texas 77002
Attention: Director

The remainder of the reports can be mailed at the appropriate time.

EQUAL EMPLOYMENT OPPORTUNITY PROGRAM REQUIREMENTS

The following are Equal Employment Opportunity requirements to be met and documents to be submitted to:

Mayor's Office of Business Opportunity
Contract Compliance Section
611 Walker, 7th Floor
Houston, Texas 77002

Under the conditions and terms of all City construction contracts, the prime contractor is responsible for all Equal Employment Opportunity compliance, including subcontractor compliance.

EQUAL EMPLOYMENT OPPORTUNITY FORMS (EEO Forms)

These forms are submitted by the prime contractors at the beginning of the Project and as requested:

- EEO Forms 3, 6, and 7, by prime contractors

This form is submitted by all subcontractors before they begin work on the project:

- EEO Form 26 by subcontractors

This form is submitted by all suppliers, lessors, or professional services providers before they begin work on the project:

- EEO Form 29

POSTING

The following poster should be clearly displayed on each job site, or in case of annual service agreements, in the Contractor's office:

Equal Employment Opportunity is the Law Poster

JOB SITE VISITS

Site visits will be made by a Contract Compliance Officer, who will make their presence known to the Project Manager, Supervisor, or Foreman, and will conduct interviews with employees on site.

PAYMENT AND EVALUATION

Upon completion of the Project, as part of the contract-awarding department's total clearance process, the Office of Business Opportunity's Contract Compliance Section must certify to the department that all EEO compliance requirements have been met.

CERTIFICATION BY BIDDER REGARDING
EQUAL EMPLOYMENT OPPORTUNITY

GENERAL

In accordance with Executive Order 11246 (30 F.R. 12319-25), the implementing rules and regulations thereof, and orders of the Secretary of Labor, a certification regarding Equal Opportunity is required of bidders or prospective contractors and their proposed subcontractors prior to the award of contracts or subcontracts.

CERTIFICATION OF BIDDER

Bidder's Name:_____

Address:_____

Telephone Number:_____ Fax :_____

Name of the Company's EEO Officer: _____

E-mail Address:_____

Web Page/URL Address:_____

IRS Employer Identification Number:_____

Work to be performed:_____

Project No:

1. Participation in a previous contract or subcontract.

   a. Bidder has participated in a previous contract or subcontract subject to the Equal Opportunity Clause. ☐ YES ☐NO

   b. Compliance reports were required to be filed in connection with such contract or subcontract. ☐YES ☐NO

   c. Bidder has filed all compliance reports required by Executive Orders 10925, 11114, 11246, or by regulations of the Equal Employment Opportunity Commission issued pursuant to Title VII of the Civil Rights Act of 1964. ☐ YES ☐NO

   d. If answer of Item c. is "No", please explain in detail on reverse side of this certification.

2. Dollar amount of bid:$

3. Anticipated performance period in days: _____

4. Expected total number of employees to perform the proposed construction: _____

5. Nonsegregated facilities.

   a. Notice to prospective federally-assisted construction contractors

      (1) A Certification of Nonsegregated Facilities, as required by the May 9, 1967, Order (32 F.R. 7439, May 19, 1967) on Elimination of Segregated Facilities, by the Secretary of Labor, must be submitted to the recipient prior to the award of a federally-assisted construction contract exceeding $10,000 which is not exempt from the provisions of the Equal Opportunity Clause.

      (2) Contractors receiving federally-assisted construction contract awards exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity Clause will be required to provide the forwarding of the following notice to prospective subcontractors for supplies and construction contracts where the subcontracts exceed $10,000 and are not exempt from the provisions of the Equal Opportunity Clause.

      The federally-assisted construction Contractor certifies that he/she does not maintain or provide any segregated facilities at any of his/her establishments, and does not permit employees to perform their services at any location, under his/her control, where segregated facilities are maintained. The federally-assisted construction Contractor certifies further that he/she will not maintain or provide segregated facilities at any of his/her establishments, and will not permit employees to perform their services at any location, under his/her control, where segregated facilities are maintained. The federally-assisted construction Contractor agrees that a breach of this certification is a violation of the Equal Opportunity Clause in this Contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms 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. The federally-assisted construction Contractor agrees that (except where he/she has obtained identical certifications from proposed Subcontractors for specific time periods) he/she will obtain identical certifications in duplicate from proposed Subcontractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity Clause, and that he/she will retain the duplicate of such certifications in his/her files. The Subcontractor will include the original in his/her bid package.

6. Race or ethnic group designation of bidder. Enter race or ethnic group in appropriate box:

☐ White ☐ Black ☐ Hispanic

☐ Pacific Islander, Asian ☐ American Indian, Aleut.

7. Gender of Owner **D** Male **D** Female

REMARKS: _____

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

_____
Company Officer (Please Type)

_____ _____
Signature Date

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

Total Work Force Composition of the Company

City of Houston, Affirmative Action Requirements for All Construction Contracts

	White		Black		Hispanic		Pacific Islander/ Asian		Alaska Native/ Amer Ind.		Total Persons		Total Minority		Total Female	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Officials and Administrators																
Professionals																
Paraprofessionals																
Technicians																
Protective Service Workers																
Sales Workers																
Office and Clerical																
Skilled Craft Workers																
Operatives (Semi-skilled)																
Laborers (Unskilled)																
Service / Maintenance Workers																
Others																
Total																

This report includes all of the company's permanent work force. For description of job categories, see Pages CC-27 through CC-29.

Check One: [ ] **Contractor** [ ] **Subcontractor**

COMPANY: _____ **DATE:** _____

EQUAL EMPLOYMENT OPPORTUNITY COMPLIANCE PROGRAM FOR

_____

Name of Company

The Company's Office of Business Opportunity Program shall consist of documented good faith efforts to comply with the goals, timetables, and objectives set forth in the following Affirmative Action steps:

A. City of Houston's Specific Equal Employment Opportunity Policy and Clause as contained in City Council Ordinance No. 78-1538, passed August 9, 1978.

B. Notice of Requirement for Office of Business Opportunity to ensure Equal Employment Opportunity (Executive Order 11246).

C. Standard Federal Equal Employment Opportunity Construction Contract Specifications (Executive Order 11246).

Project: _____

_____
Company Officer (Please Type)

_____ _____
Signature Date

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

SPECIAL PROVISIONS
SPECIFIC EQUAL EMPLOYMENT OPPORTUNITY POLICY

1. GENERAL

   a. Equal employment opportunity requirements not to discriminate and to take affirmative action to assure equal employment opportunity are required by Executive Order 11246, as amended. The requirements set forth in these Special Provisions shall constitute the specific affirmative action requirements for Project activities under this Contract and shall supplement the notice of requirement for affirmative action to ensure equal employment opportunity and standard federal equal employment opportunity construction contract specifications.
   b. The Contractor shall work with the City and the Federal Government in carrying out equal employment opportunity obligations and in their review of his/her activities under the Contract.
   c. The prime Contractor and all Subcontractors holding subcontracts of $10,000 or more shall comply with the following minimum specific requirement activities of equal employment opportunity. The Contractor shall include these requirements in every subcontract of $10,000 or more with such modification of language as is necessary to make them binding on the Subcontractor.

2. EQUAL EMPLOYMENT OPPORTUNITY POLICY

   The Contractor shall accept as his/her operating policy the following statement which is designed to further the provision of equal employment opportunity to all persons without regard to their race, age, color, religion, sex, or national origin, and to promote the full realization of equal employment opportunity through a positive continuing program:

   It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, color, sex, or national origin. Such action shall include: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship.

3. EQUAL EMPLOYMENT OPPORTUNITY OFFICER

   The Contractor shall designate and make known to the City contracting officers an equal employment opportunity officer (hereinafter referred to as the EEO Officer) who must be capable of effectively administering and promoting an active Contractor program of equal employment opportunity and who must be assigned adequate authority and responsibilities to do so.

4. DISSEMINATION OF POLICY

a. All members of the Contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action, or who are substantially involved in such action, will be made fully cognizant of, and will implement the Contractor's equal employment opportunity policy and contractual responsibilities to provide equal employment opportunity in each grade and classification of employment. To ensure that the above agreement will be met, the following actions shall be taken as a minimum:

(1) Periodic meetings of supervisory and personnel office employees shall be conducted before the start of work and then not less often than once every six months, at which time the Contractor's equal employment opportunity policy and its implementation will be reviewed and explained. The meetings shall be conducted by the EEO Officer or other knowledgeable company official.

(2) All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer, or other knowledgeable company official, covering all major aspects of the Contractor's equal employment opportunity obligations, within 30 days following their reporting for duty with the Contractor.

(3) The EEO Officer or appropriate company official shall instruct all employees engaged in the direct recruitment of employees for the Project relative to the methods followed by the Contractor in locating and hiring minorities and females.

b. In order to make the Contractor's equal employment opportunity policy known to all employees, prospective employees, and potential sources of employees, i.e., schools, employment agencies, labor unions (where appropriate), college placement officers, etc., the Contractor shall take the following actions:

(1) Notices and posters setting forth the Contractor's equal employment opportunity policy shall be placed in areas readily accessible to employees, applicants for employment, and potential employees.

(2) The Contractor's equal employment opportunity policy and the procedures to implement such policy shall be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.

5. RECRUITMENT

a. When advertising for employees, the Contractor shall include in all advertisements for employees the notation "An Equal Opportunity Employer". All such advertisements will be published in newspapers, or

other publications, having a large circulation among minority groups in the area from which the Project work force would normally be derived.

b. The Contractor shall, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee-referral sources likely to yield qualified minority-group applicants, including, but not limited to, State employment agencies, schools, colleges, minority-group organizations, and female recruitment agencies. To meet this requirement, the Contractor shall, through his/her EEO Officer, identify sources of potential minority and female employees, and establish with such identified sources procedures whereby such group applicants may be referred to the Contractor for employment consideration.

In the event the Contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, he/she is expected to observe the provisions of that agreement to the extent that the system permits the Contractor's compliance with equal employment opportunity Contract provisions. (The U. S. Department of Labor has held that where implementation of such agreements has the effect of discriminating against minorities or women, or obligates the Contractor to do the same, such implementation violates Executive Order 11246 as amended).

c. The Contractor shall encourage his/her present employees to refer female or minority-group applicants for employment by posting appropriate notices or bulletins in areas accessible to all such employees. In addition, information and procedures with regard to referring such applicants will be discussed with employees.

6. PERSONNEL ACTIONS

a. Wage, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff and termination, shall be taken without regard to race, color, religion, sex, national origin, or age. The following procedures shall be followed:

(1) The Contractor shall conduct periodic inspections of Project sites to ensure that working conditions and employee facilities do not indicate discriminatory treatment of Project-site personnel.

(2) The Contractor shall periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.

(3) The Contractor shall periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the Contractor shall promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.

(4) The Contractor shall promptly investigate all complaints of alleged discrimination made in connection with his/her obligations under this Contract, shall attempt to resolve such complaints, and shall take appropriate corrective action. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the Contractor shall inform every complainant of all avenues of appeal.

7. TRAINING AND PROMOTION

a. The Contractor shall assist in locating, qualifying, and increasing the skills of minority-group and women employees and applicants for employment.

b. Consistent with the Contractor's work force requirements and as permissible under Federal and State regulations, the Contractor shall make full use of training programs, i.e., apprenticeship and on-the-job training programs, for the geographical area of Contract performance.

c. The Contractor shall advise employees and applicants for employment of available training programs and entrance requirements for each.

d. The Contractor shall periodically review the training and promotion potential of minority-group and women employees and shall encourage eligible employees to apply for such training and promotion.

8. UNIONS

If the Contractor relies in whole or in part upon unions as a source of employees, he/she shall use his/her best efforts to obtain the cooperation of such unions to increase minority groups and women within the unions, and to effect referrals by such unions of minority and female employees. Actions by the Contractor, either directly or through a contractor's association acting as his/her agent, will include the procedures set forth below:

a. The Contractor shall use best efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minority-group members and women for membership in the unions and increasing the skills of minority-group employees and women so that they may qualify for higher-paying employment.

b. The Contractor shall use best efforts to incorporate an equal employment opportunity clause into all union agreements to the end that such unions will be contractually bound to refer applicants without regard to their race, color, religion, sex, national origin, or age.

c. The Contractor is to obtain information as to the referral practices and policies of the labor union, except that to the extent such information is within the exclusive possession of the labor union, and such labor union refuses to furnish such information to the Contractor, the Contractor shall so certify to the City and shall set forth what efforts have been made to obtain such information.

d. In the event the union is unable to provide the Contractor with a reasonable flow of minority and women referrals within the time limit set forth in the collective bargaining agreement, the Contractor shall, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, age, sex, or national origin, making full efforts to obtain qualified and/or qualifiable minority group persons and women. (The U. S. Department of Labor has held that it shall be no excuse that the union with which the Contractor has a collective bargaining agreement providing for exclusive referral failed to refer minority employees.) In the event the union referral practice prevents the Contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these special provisions, such Contractor shall immediately notify the City.

9. SUBCONTRACTING

a. The Contractor shall use his/her best efforts to solicit bids from and to utilize minority-group and female subcontractors or subcontractors with meaningful minority-group and/or female representation among their employees.

b. The Contractor shall use his/her best efforts to assure Subcontractors' compliance with their equal employment opportunity obligations.

10. RECORDS AND REPORTS

a. The Contractor shall keep such records as are necessary to determine compliance with the Contractor's equal employment opportunity obligations. The records kept by the Contractor will be designed to indicate:

(1) The number of minority and non-minority group members and women employed in each work classification on the Project.

(2) The progress and efforts being made in cooperation with unions to increase employment opportunities for minorities and women (applicable only to contractors who rely in whole or in part on unions as a source of their work force).

(3) The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minority and female employees.

(4) The progress and efforts being made in securing the services of female and minority subcontractors.

b. All records, including payrolls, must be retained for a period of three years following completion of the Contract work and shall be available at reasonable times and places for inspection by authorized representatives of the City and/or the appropriate federal agency.

CITY OF HOUSTON, TEXAS

EQUAL EMPLOYMENT OPPORTUNITY CLAUSE

Pursuant to City Council Ordinance No. 78-1538, passed August 9, 1978, all contracts entered into by the City of Houston involving the expenditure of $10,000 or more, shall incorporate the following Equal Employment Opportunity Clause:

1. The Contractor, Subcontractor, vendor, Supplier, or lessee shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, or age. The Contractor, Subcontractor, vendor, Supplier, or lessee shall take affirmative action to ensure that applicants are employed and that employees are treated during employment without regard to their race, religion, color, sex, national origin, or age. Such action will include, but not be limited to, the following: employment; upgrading; demotion or transfer; recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor, Subcontractor, vendor, Supplier, or lessee agrees to post in conspicuous places available to employees, and applicants for employment, notices to be provided by the City setting forth the provisions of this Equal Employment Opportunity Clause.

2. The Contractor, Subcontractor, vendor, Supplier, or lessee states that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex, national origin, or age.

3. The Contractor, Subcontractor, vendor, Supplier, or lessee shall send to each labor union or representatives of workers with which it has a collective bargaining agreement or other contract or understanding, a notice to be provided by the agency contracting officer advising the said labor union or workers' representative of the Contractor's and Subcontractor's commitments under Section 202 of Executive Order No. 11246, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

4. The Contractor, Subcontractor, vendor, Supplier, or lessee will comply with all provisions of Executive Order No. 11246 and the rules, regulations, and relevant orders of the Secretary of Labor or other Federal Agency responsible for enforcement of the equal opportunity and affirmative action provisions applicable, and shall likewise furnish all information and reports required by the Mayor and/or Contractor Compliance Officers for purposes of investigation to ascertain and effect compliance with this program.

5. The Contractor, Subcontractor, vendor, Supplier, or lessee shall furnish all information and reports required by Executive Order No. 11246, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and shall permit access to all books, records, and accounts by the appropriate City and Federal officials for purposes of investigation to ascertain compliance with such rules, regulations, and orders. Compliance reports filed at such times as directed shall contain information as to the employment practice policies, program, and work force statistics of the Contractor, Subcontractor, vendor, Supplier, or lessee.

6. In the event of a Contractor's, Subcontractor's, vendor's, Supplier's, or lessee's non-compliance with the non-discrimination clause of this Contract or with any of such rules, regulations, or orders, this Contract may be canceled, terminated, or suspended in whole or in part, and the Contractor, Subcontractor, vendor, Supplier, or lessee may be declared ineligible for further City contracts in accordance with procedures provided in Executive Order No. 11246, and such other sanctions may be imposed and remedies invoked as provided in said Executive Order, or by rule, regulation, or order of the Secretary of Labor, or as may otherwise be provided by law.

7. The Contractor shall include the provisions of paragraphs 1 through 8 of this Equal Employment Opportunity Clause in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order No. 11246 of September 24, 1965 so that such provisions will be binding upon each Subcontractor or vendor. The Contractor shall take such action with respect to any subcontractor or purchase order as the contracting agency may direct as a means of enforcing such provisions, including sanctions for noncompliance; provided, however, that in the event the Contractor becomes involved in, or is threatened with litigation with a Subcontractor or vendor as a result of such direction by the contracting agency, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

8. The Contractor shall file and shall cause each of his Subcontractors, if any, to file compliance reports with the City in the form and to the extent as may be prescribed by the Mayor's Office of Business Opportunity. Compliance reports filed at such times as directed shall contain information as to the practices, policies, programs, employment policies, and employment statistics of the Contractor and each Subcontractor.

NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION
TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY
(EXECUTIVE ORDER 11246)

1. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Opportunity Construction Contract Specifications" set forth herein.

2. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate work force in each trade on all construction work in the covered area, are as follows:

Timetable	Goals for Minority Participation for Each Trade	Goals for Female Participation for Each Trade
	26.2% - 27.3%	6.9%

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or Federally-assisted) performed in the covered area.

The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals established for the geographical area where the Contract resulting from this solicitation is to be performed. The hours of minority and female employment and training must be substantially uniform throughout the length of the Contract, and in each trade, and the Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the Contract, the Executive Order, and regulations in 41 CFR part 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs within 10 working days of award of any construction subcontract in excess of $10,000 at any tier for construction work under the Contract resulting from this solicitation. The notification shall list the name, address, and telephone number of the Subcontractor; employer identification number; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the Contract is to be performed.

4. As used in this Notice, and in the Contract resulting from this solicitation, the "covered area" is The Houston, Texas Standard Metropolitan Statistical Area.

STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY
CONSTRUCTION CONTRACT SPECIFICATIONS
(EXECUTIVE ORDER 11246)

1. As used in these specifications:

   a. "Covered area" means the geographical area described in the solicitation from which this Contract resulted;

   b. "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;

   c. "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U. S. Treasury Department Form 941.

   d. "Minority" includes:

      (i) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);

      (ii) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin regardless of race);

      (iii) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and

      (iv) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

2. Whenever the Contractor, or any Subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of $10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this Contract resulted.

3. If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U. S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for

those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or Subcontractors toward a goal in an approved Plan does not excuse any covered Contractor's or Subcontractor's failure to take good efforts to achieve the Plan goals and timetables.

4. The Contractor shall implement the specific affirmative action standards provided in Paragraphs 7a through p of these specifications. The goals set forth in the solicitation from which this Contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. The Contractor is expected to make substantially uniform progress toward its goals in each craft during the period specified.

5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement to refer either minorities or women, shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.

6. In order for the non-working training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U. S. Department of Labor.

7. The Contractor shall take specific 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. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:

    a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which Contractor's employees are assigned to work. The Contractor, where possible, shall assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.

b. Establish and maintain a current list of minority and female recruitment sources; provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.

c. Maintain a current file of the names, addresses, and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source, or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefor, along with whatever additional actions the Contractor may have taken.

d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

e. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 7b above.

f. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.

g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination, or other employment decisions, including specific review of these items with on-site supervisory personnel such as superintendents, general foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of

these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

h. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other contractors and subcontractors with whom the Contractor does or anticipates doing business.

i. Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students, and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer, and vacation employment to minority and female youth both on the site and in other areas of a Contractor's work force.

k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.

l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare, through appropriate training, etc., for such opportunities.

m. Ensure that seniority practices, job classifications, work assignments, and other personnel practices do not have a discriminatory effect by continually monitoring all personnel and employment-related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.

n. Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

p. Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

8. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (7a through p). The efforts of a contractor association, joint contractor union, contractor-community, or other similar group of which the Contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under 7a through p of these Specifications provided that the Contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female work force participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, 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. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is under utilized).

10. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

11. The Contractor shall not enter into any subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

12. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination, and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

13. The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in Paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the

Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.B.

14. The Contractor shall designate a responsible official to monitor all employment-related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government, and to keep records. Records shall at least include for each employee the name, address, telephone number, construction trade, union affiliation, if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily-understandable and retrievable form; however to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

15. 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 (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

DESCRIPTION OF JOB CATEGORIES

Officials, Managers, and Administrators

Occupations requiring administrative personnel who set board policies, exercise overall responsibility for the execution of these policies, or provide specialized consultation on a regional, district, area basis, or direct individual departments or special phases of a firm's operations.

Includes: Officials, executives, middle management, plant managers, department managers, superintendents, salaried foremen who are members of management, purchasing agents, buyers, bureau chiefs, directors, deputy directors, wardens, examiners, sheriffs, police and fire chiefs, and kindred workers.

Professionals

Occupations which require specialized and theoretical knowledge which is usually acquired through college or experience of such kind and amount as to provide a comparable background.

Includes: Accountants, auditors, airplane pilots and navigators, architects, artists, chemists, designers, dieticians, editors, engineers, lawyers, librarians, mathematicians, natural scientists, registered professional nurses, personnel and labor relations workers, physical scientists, teachers, social workers, doctors, psychologists, economists, systems analysts, employment and vocational rehabilitation counselors, instructors, police and fire captains and lieutenants, and kindred workers.

Paraprofessionals

Occupations in which workers perform some of the duties of a professional or technician in a supportive role, which usually requires less formal training and/or experience normally required for professional or technical status. Such positions may fall within an identified pattern of a "New Careers" concept.

Includes: Library assistants, medical aides, child support workers, police auxiliary, welfare service aides, recreation assistants, homemakers aides, home health aides, and kindred workers.

Technicians

Occupations requiring a combination of basic scientific knowledge and manual skill which can be obtained through about two (2) years of post high school education, such as is offered in many technical institutes and junior colleges, or through equivalent on-the-job training.

Includes: Computer programmers and operators, draftsmen, engineering aides, junior engineers, mathematical aides, licensed practical or vocational nurses, photographers, radio operators, scientific assistants, surveyors, technical illustrators, technicians (medical, dental, electronics, physical sciences), police and fire sergeants, and kindred workers.

Protective Service Workers

Occupations in which workers are entrusted with public safety, security, and protection from destructive forces.

Includes: Police patrol officers, fire fighters, guards, deputy sheriffs, bailiffs, correctional officers, detectives, marshals, harbor patrol officers, and kindred workers.

Sales Workers

Occupations engaging wholly or primarily in direct selling.

Includes: Advertising agents and salespersons, insurance agents and brokers, real estate agents and brokers, stock and bond salespersons, demonstrators, salespersons and sales clerks, grocery clerks, cashiers, and kindred workers.

Office and Clerical

Occupations in which workers are responsible for internal and external communications, recording and retrieval of data and/or information and other paper work required in an office predominantly non-manual, though some manual work not directly involved with altering or transporting the products is included.

Includes: Bookkeepers, cashiers, collectors (bills and accounts), messengers and office helpers, office machine operators, shipping and receiving clerks, stenographers, typists and secretaries, telegraph and telephone operators, court transcribers, hearing reporters, statistical clerks, dispatchers, license distributors, payroll clerks, and kindred workers.

Skilled Craft Workers

Occupations in which workers perform jobs which require special manual skill through on-the-job training and experience, or through apprenticeship or other formal training programs. These workers exercise considerable independent judgment and usually receive an extensive period of training.

Includes: The building trades, hourly paid foremen and leadmen who are not members of management, mechanics and repairmen, skilled machining occupations, compositors and typesetters, electricians, engravers, job setters

(metal), motion picture projectionists, pattern and model makers, stationary engineers, tailors, heavy equipment operators, carpenters, and kindred workers.

Operatives (semi-skilled)

Workers who operate machine or processing equipment or perform other factory-type duties of intermediate skill level which can be mastered in a few weeks and require only limited training.

Includes: Apprentices (auto mechanics), plumbers, bricklayers, carpenters, electricians, mechanics, building trades, metal workers, machinists, printing trades, operatives, attendants (auto service and parking), blasters, chauffeurs, deliverymen, dressmakers and seamstresses (except factory), dryers, furnacemen, heaters (metal), laundry and dry cleaning operatives, milliners, miners, motormen, oilers, greasers, etc. (except auto), painters (except construction and maintenance), photographic process workers, stationary firemen, truck and tractor drivers, weavers (textile), welders and flame cutters, and kindred workers.

Laborers (unskilled)

Workers in manual occupations which generally require no special training. These workers perform elementary duties that may be learned in a few days and require the application of little or no independent judgment.

Includes: Garage workers, car washers and greasers, gardeners (except farm) and groundskeepers, longshoremen and stevedores, lumbermen, craftsmen, and wood choppers, laborers performing lifting, digging, mixing, loading, and pulling operations, and kindred workers.

Service/Maintenance Workers

Occupations in which workers perform duties which result in or contribute to the comfort, convenience, hygiene or safety for the general public or which contribute to the upkeep and care of buildings, facilities or grounds, or public property. Workers in this group may operate machinery.

Includes: Chauffeurs, laundry and dry cleaning operatives, truck drivers, trash collectors, custodial personnel, gardeners and groundskeepers, construction laborers, attendants (hospital and other institutions), professional and personal service, counter and fountain workers, elevator operators, firemen and fire protection, guards, watchmen and doorkeepers, stewards, porters, waiters, and kindred workers.

CERTIFICATION BY PROPOSED SUBCONTRACTOR REGARDING EQUAL EMPLOYMENT OPPORTUNITY

_____
Name of Prime Contractor

_____
Address

GENERAL

In accordance with Executive Order 11246 (30 F.R. 12319-25), the implementing rules and regulations thereof, and orders of the Secretary of Labor, a certification regarding Equal Opportunity is required of bidders or prospective contractors and their proposed subcontractors prior to the award of contracts or subcontracts.

SUBCONTRACTOR'S CERTIFICATION

Subcontractor's Name: _____

Address: _____

IRS Employer Identification Number: _____

Job Description : _____

1. Participation in a previous contract or subcontract.

   a. Subcontractor has participated in a previous contract or subcontract subject to the Equal Opportunity Clause. ____YES_____NO

   b. Compliance reports were required to be filed in connection with such contract or subcontract. ____YES_____NO

   c. Subcontractor has filed all compliance reports required by Executive Orders 10925, 11114, 11246, or by regulations of the Equal Employment Opportunity Commission issued pursuant to Title VII of the Civil Rights Act of 1964. ____YES_____NO

   d. If answer of Item c. is "No", please explain in detail on reverse side of this certification.

2. Dollar amount of proposed subcontract: $ _____

3. Anticipated performance period in days:

4. Expected total number of employees to perform the proposed subcontract: _____

5. Nonsegregated facilities.

   a. Notice to prospective federally-assisted construction contractors
      (1) A Certification of Nonsegregated Facilities, as required by the May 9, 1967, order (32 F.R. 7439, May 19, 1967) on Elimination of Segregated Facilities, by the Secretary of Labor, must be submitted to the Contractor prior to the award of a subcontract exceeding $10,000 which is not exempt from the provisions of the Equal Opportunity Clause.
      (2) Contractors receiving subcontract awards exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity Clause will be required to provide for the forwarding of this notice to prospective subcontractors for supplies and construction contracts where the subcontracts exceed $10,000 and are not exempt from the provisions of the Equal Opportunity clause.

   b. Certification of non-segregated facilities

      The federally-assisted construction contractor certified that he/she does not maintain or provide any segregated facilities at any of his/her establishments, and does not permit employees to perform their services at any location, under his/her control, where segregated facilities are maintained. The federally-assisted construction Contractor certifies further that he/she will not maintain or provide any segregated facilities at any of his/her establishments, and will not permit employees to perform their services at any location, under his/her control, where segregated facilities are maintained. The federally-assisted construction Contractor agrees that a breach of this certification is a violation of the Equal Opportunity Clause in this Contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms 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. The federally-assisted construction Contractor agrees that (except where he/she has obtained identical certifications from proposed Subcontractors for specific time periods) he/she will obtain identical certifications in duplicate from proposed Subcontractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity Clause, and that he/she will retain the duplicate of such certifications in his/her files. The Contractor will include the original in his/her Bid Package.

6. Race or ethnic group designation of bidder. Enter race or ethnic group in appropriate box:

D White D Black D Hispanic

D Pacific Islander, Asian D American Indian, Aleut.

7. Gender

D Male D Female

REMARKS: _

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

_____
Company Officer (Please Type)

_____ _____
Signature Date

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

Certification by Proposed Material Suppliers, Lessors, and Professional Service Providers Regarding Equal Employment Opportunity

Company Name:_____ $_____
(Supplier, Lessor, Professional Service Provider) (Amount of Contract)

Company Address: _____

Company Telephone Number:_____Fax:_____

E-mail Address: _____

Web Page/URL Address:_____

Company Tax Identification Number: _____

Project No.: [*WBS/CIP/AIP/File No.*]_____

Project Name: [*Legal Project Name*]_____

In accordance with the City of Houston Ordinance 78-1538, Supplier/Lessor/Professional Service Provider represents to be an equal opportunity employer and agrees to abide by the terms of the Ordinance. This certification is required of all Suppliers/Lessors/Professional Service Providers (herein Supplier) with contracts in the amount of $10,000.00 or more.

[ ] Yes [ ] No Supplier agrees not to discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, or age.

[ ] Yes [ ] No Supplier agrees that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex, national origin, or age.

[ ] Yes [ ] No Supplier will comply with all provisions of Executive Order No. 11246 and rules, regulations and applicable orders of the Department of Labor or other Federal Agency responsible for enforcement of applicable equal opportunity and affirmative action provisions and will likewise furnish all information and reports required by the Mayor or Contract Compliance Officers for the purpose of investigation to ascertain and effect compliance with the City of Houston's Office of Affirmative Action and Contract Compliance.

[ ] Yes [ ] No The Supplier shall file and cause their sub-tier contractors to file compliance reports with the City in the form and to the extent as may be prescribed by the Mayor or Contract Compliance Officers. Compliance reports filed at such times as directed shall contain information including, but not limited to, the practices, policies, programs, and employment policies.

I hereby certify that the above information is true and correct.

_____ _____
COMPANY OFFICER (Signature) DATE

_____
NAME AND TITLE (Print or type)

END OF DOCUMENT

Document 00808

REQUIREMENTS FOR THE CITY OF HOUSTON PROGRAM FOR MINORITY, WOMEN, AND SMALL BUSINESS ENTERPRISES AND PERSONS WITH DISABILITIES ENTERPRISES (PDBE)

CONSTRUCTION CONTRACTS

I. GENERAL

A. CITY AUTHORITIES

1. The "OBO Director" is the City of Houston's Office of Business Opportunity Director, or his or her designee.
City of Houston
611 Walker Street, 7th Floor
Houston, Texas 77002

2. The "Contracting Department" for this Project is the City of Houston Department specified in Document 00520 – Agreement.

3. The "Project Manager" is for this Project specified in Document 00550 – Contract Approval Notification.

II. REOCCURRING REPORTS THAT MUST BE SUBMITTED DURING THE COURSE OF THE CONTRACT:

A. MWSBE MONTHLY REPORT PROCESS

The Contractor shall complete the MWSBE Monthly Utilization Report in the Contract Compliance and Monitoring System (available at https://houston.mwdbe.com/).

B. The Contractor shall comply with further, applicable instructions regarding reporting and compliance as provided in Sections III.E and III.I below.

III. BUSINESS ENTERPRISE PROGRAM REQUIREMENTS:

A. PURPOSE

This Document facilitates implementation of City of Houston, Tex. Code of Ordinances Chapter 15, Article V, § 15-81 et seq., relating to MWSBE contract participation, and Code of Ordinances Chapter 15, Article VI, § 15-90 et seq., relating to PDBE contract participation (collectively, the "Business Enterprise Program or "MWSBE"). City of Houston, Tex. Ordinance 2013-0428, May 8, 2013.

B. POLICY

It is the policy of the City to encourage the full participation of Minority and Women-owned Business Enterprises, Small Business Enterprises, and Persons with Disabilities Business Enterprises in all phases of its procurement activities and to afford them a full and fair opportunity to compete for City contracts at all levels.

C. POLICY ELEMENTS

1. The Contractor agrees to ensure that MWSBE firms have a full and fair opportunity to participate in the performance of City contracts. In this regard the Contractor shall make all reasonable Good Faith Efforts to meet the Contract Goals for this Contract.

2. The Contractor and any Subcontractor shall not discriminate on the basis of race, color, religion, national origin, or sex in the performance of City contracts.

3. Contractor's performance in meeting the Participation Plan Percentage will be monitored during the construction phase of the Contract by the OBO Director and Contracting Department.

D. PERCENTAGE GOALS

The MWSBE goals and PDBE goals, if any, for the Work are specified in Document 00800 – Supplementary Conditions Goals.

E. CONTRACTOR RESPONSIBILITIES

1. Prior to Award:

The Bidder shall submit MWSBE documents in accordance with the requirements of Document 00410 – Bid Form Part A.

a. In accordance with the Code of Ordinances and the OBO Good Faith Efforts Policy (Attachment A), the Department shall approve an Apparent Low Bidder's MWSBE Participation Plan–Document 00470 (the "Bidder's Plan" or "Plan") within 3 business days of the Bid Opening only if the Department representative determines that Bidder's Plan meets the advertised Contract Goal and is administratively complete.

b. If the Department cannot approve the Bidder's Plan, it shall forward the Plan to the OBO Director, who shall review the Bidder's Plan, and if applicable, the Bidder's Document 00471 (Record of Good Faith Efforts) and Document 00472 (Pre-Award Deviation Request) and determine whether the Bidder has made Good Faith Efforts to meet the Contract Goals within 10 business days of the Bid Opening.

c. If the OBO Director determines that the Bidder has failed to provide a valid participation plan or make Good Faith Efforts or if the Bidder fails to provide documents and associated information required by this Document 00808 or reasonably requested in writing by the OBO Director, the OBO Director may declare the Bidder to be non-responsible.

d. If the OBO Director determines that the Bidder has made Good Faith Efforts, the Director may approve the Bidder's Contract Goal Deviation request. Thereafter, the Bidder/Contractor shall be bound by the Plan, as approved by the OBO Director.

e. The Contractor shall:

(1) ensure that all MWSBE firms listed in the Plan are certified by the Office of Business Opportunity prior to bid date. Qualified, non-certified firms may obtain priority consideration for certification if no more than two firms are certified with the same capability as the non-certified firm.

(2) execute written contracts with all certified Subcontractors and Suppliers. All such contracts must be executed and sent to the OBO Director and Contracting Department within 30 days after the date of the Notice to Proceed and must include provisions set forth in Articles 3 and 5 of Document 00700 - General Conditions.

(3) designate an MWSBE liaison officer who will administer the Contractor's MWSBE program and who shall document and maintain records of Good Faith Efforts to subcontract with MWSBE Subcontractors and Suppliers.

2. After Award:

a. The Contractor shall submit MWSBE Monthly Utilization Reports, requested in Article II above.

b. The Contractor shall complete and submit to the OBO Director a Post-Award Deviation Request–Document 00572 ("Post-Award Deviation Request") if the Contractor reasonably believes that it will not achieve the Business Enterprise Program Participation Plan Percentage documented in the Plan. The Contractors shall also submit to the OBO Director, with a Copy to the Contracting Department, a Record of Post-Award Good Faith Efforts (Document 00571) for each Certified Firm that the Contractor does not use in accordance with the Approved Plan before the Contractor uses another firm to perform the work.

c. The Contractor shall conform to the Plan unless the OBO Director grants a Post-Award Deviation Request. The OBO Director shall approve or reject a Deviation Request within 5 business days of receipt of the Deviation Request.

d. The OBO Director shall grant a Post-Award Deviation Request if

(1) for a reason beyond the Contractor's control, the Contractor is unable to use the certified MWSBE firm in the Plan to perform the specified work. In such cases, the Contractor shall use and document Good Faith Efforts to find a similarly qualified, certified MWSBE firm to perform such specified work; or

(2) the Contractor reasonably believes that, due to a change of scope, execution of the work in accordance with the directions from the Contracting Department is unlikely to meet the terms of the Plan. In such cases, the Contractor shall use and document Good Faith efforts to achieve a reasonable amount of MWSBE participation on the remaining work on the Contract.

(3) The OBO Director shall not unreasonably withhold approval of a Post-Award Deviation Request.

e. After the Date of Substantial Completion, the OBO Director shall evaluate the Contractor's Good Faith Efforts towards meeting the Plan, as it may amended.

f. If the Contractor fails to conform to the Plan and fails to submit a Post-Award Deviation Request or provide documents and associated information required by the Good Faith Efforts Policy or reasonably requested in writing by the OBO Director, the OBO Director may impose sanctions in accordance with Article VI of this Document 00808.

F. ELIGIBILITY OF MWSBE FIRMS FOR SUBCONTRACTING

1. To ensure that the City's Business Enterprise Program benefits only those firms that are owned and controlled by a minority person(s), a woman (women),a person(s) with a disability, or a small business enterprise, the Office of Business Opportunity will certify the eligibility of MWSBE and PDBE Contractors, Subcontractors, and Suppliers. Contact the Office of Business Opportunity Certification Section at 832-393-0600 for information regarding certification.

2. The Office of Business Opportunity maintains a Certified Minority, Women and Small Business Enterprises and Disabilities Business Enterprises Directory on the City's website. This Directory also lists federally-designated Disadvantaged Business Enterprises (DBEs).

NOTE: MWSBE firms, even if certified by another agency, may not qualify for Contract Goals unless certified by the Office of Business Opportunity prior to acceptance of the Participation Plan.

G. DETERMINATION OF MWSBE PARTICIPATION

MWSBE participation shall be counted toward meeting the Contract Goals in response to the following:

1. Once a firm is certified as a MWSBE firm, the total dollar value of the subcontract awarded to the MWSBE firm is counted toward the Contract Goals (See Sections III.G.4 and III.G.5 below). Safety and Participation goals do not count as a single goal concerning MWSBE/DBE requirements.

2. When the Contractor or Subcontractor is in a joint venture with one or more MWSBE firms, the OBO Director shall determine the percent of participation resulting from such joint venture to be counted toward the Contract Goals.

3. Contractor may count toward its Contract Goals only those MWSBE Subcontractors/ Suppliers performing a Commercially Usefully Function.
   a. **COMMERCIALLY USEFUL FUNCTION** means a discrete task or group of tasks, the responsibility for performance of which shall be discharged by the MWSBE firm by using its own forces or by actively supervising on-site the execution of the tasks by another entity for whose work the MWSBE firm is responsible. In determining whether a certified firm is performing a commercially useful function, factors including but not limited to the following shall be considered: (1) whether the firm has the skill and expertise to perform the work for which it is being utilized and possesses all necessary licenses; (2) whether the firm is in the business of performing, managing, or supervising the work for which it has been certified and is being utilized; and

(3) whether it is performing a real and actual service that is a distinct and verifiable element of the work called for in a contract. Without limiting the generality of the foregoing, a MWSBE will not be considered to be performing a commercially useful function, if it subcontracts to non-MWSBE firms or to other MWSBE firms, more than 50 percent of a contract being counted toward the applicable Contract Goals, unless such subcontracting in excess of 50 percent has been expressly approved by the OBO Director in a Goal or Plan Deviation Request (Document 00472 or Document 00572) (either pre-bid or post award).

b. The OBO Director shall approve a Plan Deviation Request if the Contractor demonstrates that the industry standard for the type of work involved is to subcontract over 50 percent of the work.

4. A MWSBE firm cannot subcontract more than 50 percent of the work for which it is responsible to perform unless the OBO Director grants a Deviation Approval.

5. The Contractor may count 100 percent of MWSBE Manufacturer Supplier's participation and 60 percent of MWSBE Non-Manufacturer Supplier's participation toward its Contract Goals. Such MWSBE Supplier contracts shall not exceed 50 percent of contract's goals.

6. The OBO Policy and Procedures Manual, as amended, shall apply to the Contract for other determinations regarding counting MWSBE participation not explicitly provided for in the Contract.

H. CONTRACTOR COMPLIANCE

To ensure compliance with MWSBE requirements, the OBO Director and Contracting Department will monitor Contractor's efforts regarding MWSBE Subcontractors/Suppliers during the performance of this Contract. This may be accomplished through the following: job site visits, reviewing of records and reports, and interviews of randomly selected personnel.

I. RECORDS AND REPORTS

1. In accordance with II.A of this Document, the Contractor shall submit an initial report outlining MWSBE participation, 40 days after the Notice to Proceed date, and on or before the 15th day of each month thereafter until all MWSBE subcontracting or material supply activity is completed. Each report shall cover the preceding month's activity. The Contractor shall use the MWSBE Contract Compliance and Monitoring System (B2G Now) to meet this requirement.

2. Contractor shall maintain the following records for review upon request by the OBO Director or Contracting Department:

   a. Copies of executed Subcontractor agreements and purchase orders;
   b. Documentation of payments and other transactions with MWSBE Subcontractors/ Suppliers;
   c. Appropriate explanations of any changes or replacements of MWSBE Subcontractors/Suppliers;

NOTE: All replacement MWSBE Subcontractors/Suppliers must be certified by the Office of Business Opportunity.

   d. Any other records required by the OBO Director or Contracting Department.

3. If a Participation Plan Percentage is not being met, the monthly report shall include a narrative description of the progress being made in MWSBE participation. If sufficient MWSBE Subcontractors or Suppliers to meet the Participation Plan Percentage are being utilized, they should be identified by name and the dollar amount paid to date for work performed or materials furnished by each MWSBE during the monthly period. Reports are required when no activity has occurred in a monthly period.

4. Contractor shall retain all such records for a period of four years following completion of the Work and shall be available at reasonable times and places for inspection by authorized representatives of the City including the City Controller.

IV. SANCTIONS:

A. SUSPENSION PERIOD AND WAIVER

Pursuant to Section 15-86 of the Code of Ordinances, the OBO Director is authorized to suspend for a period of up to, but not to exceed, five years, any Contractor who has failed to make Good Faith Efforts.

B. GUIDELINES FOR IMPOSITION OF SANCTIONS

1. General:

a. The OBO Director shall not impose any sanction except upon evidence of specific conduct on the part of a MWSBE or Contractor that is inconsistent with or in direct contravention of specific applicable requirements for Good Faith Efforts.

b. Imposition and enforcement of suspensions shall be consistent with applicable state law.

2. Severity of Sanctions:

a. In determining the length of any suspension, the OBO Director shall consider the following factors:

(1) Whether the failure to comply with applicable requirements involved intentional conduct or, alternatively, may be reasonably concluded to have resulted from a misunderstanding on the part of the Contractor or MWSBE of the duties imposed on them by Article V of Chapter 15 of the Code of Ordinances and these procedures;

(2) The number of specific incidences of failure by Contractor or MWSBE to comply;

(3) Whether the Contractor or MWSBE has been previously suspended;

(4) Whether the Contractor or MWSBE has failed or refused to provide the OBO Director with any information requested by the Director or required to be submitted to the Director pursuant to law or these procedures;

(5) Whether the Contractor or MWSBE has materially misrepresented any applicable facts in any filing or communication to the OBO Director; and

(6) Whether any subsequent restructuring of the subject business or other action has been undertaken to cure the deficiencies in meeting applicable requirements.

b. Suspensions may be for any length of time not to exceed five years. Suspensions in excess of one year shall be reserved for cases involving intentional or fraudulent misrepresentation or concealment of material facts, multiple acts in contravention of applicable requirements, cases where the Contractor or MWSBE has been previously suspended, or other similarly egregious conduct.

C. DELEGATION

A decision to implement a suspension may be taken after notice and an opportunity for a hearing by an impartial person(s) designated by the OBO Director as the hearing officer.

The hearing officer(s) shall not have participated in the actions or investigations giving rise to the suspension hearing.

D. NOTICE

1. Prior to imposing any suspension, the OBO Director shall deliver written notice to the Contractor or MWSBE setting forth the grounds for the proposed suspension and setting a date, time, and place to appear before the hearing officer(s) for a hearing on the matter.

2. Any notice required or permitted to be given hereunder to any Contractor or MWSBE may be given either by personal delivery or by certified United States mail, postage prepaid, return receipt requested, addressed to their most recent address as specified in the records of the Office of Business Opportunity or in the Contract if no address is on file with the Office of Business Opportunity.

E. HEARING PROCEDURES

Proceedings before a hearing officer shall be conducted informally and in accordance with the OBO Policy and Procedures Manual, as amended, provided that each party may be represented by counsel and may present evidence and cross-examine witnesses. The City shall have the burden to prove by a preponderance of evidence that the Contractor's or MWSBE firm's actions constitute misconduct or failure to make Good Faith Efforts. The decision shall be reduced to writing and notice provided to the Contractor or MWSBE.

F. APPEALS

Appeals authorized pursuant to Section 15-86(b) of the Code of Ordinances shall be conducted by the OBO Director. Pursuant to Section 15-86(b), The contractor may appeal the OBO Director's decision in accordance with Section 15-23 of the Code of Ordinances and OBO Policy and Procedures.

ATTACHMENT A

City of Houston
Office of Business Opportunity
Good Faith Efforts Policy

General Policy.

Good Faith Efforts are steps taken to achieve an Contract Goal or other requirements which, by their scope, intensity and usefulness demonstrates the bidder's responsiveness to fulfill the business opportunity objective prior to the award of a contract, as well as the contractor's responsibility to put forth measures to meet or exceed the Contract Goal throughout the duration of the contract.

Good Faith Efforts are required to be made and demonstrated by an apparent successful bidder on goal oriented contracts or proposer on a regulated contract prior to award of a contract. Good Faith Efforts are required on professional services and construction contracts and on procurement of goods and non-professional service contracts with goals. If a bidder, when submitting a participation plan at the time of bid or proposal submission, anticipates it cannot or will not meet the Contract Goal prior to the award, the bidder must demonstrate to Office of Business Opportunity ("OBO") it has made Good Faith Efforts to meet the Contract Goal, to be eligible for the contract award.

Good Faith Efforts shall be evaluated on a case-by-case basis in making a determination whether a bidder or contractor is in compliance with this policy. The efforts employed by a bidder or contractor should be those that one could reasonably expect a bidder or contractor to take if the bidder were actively and aggressively attempting to obtain MWSBE participation sufficient to meet the Contract Goal. Efforts taken that are mere formalities or other perfunctory acts shall not be considered Good Faith Efforts to meet Contract Goals.

The factors provided herein are representative of the types of actions OBO will consider in determining whether the bidder or contractor made Good Faith Efforts to obtain MWSBE participation to meet the Contract Goal. The factors prescribed below are not intended to be a mandatory checklist, nor is it intended to be exhaustive or exclusive. OBO may consider other factors or types of efforts that may be relevant in appropriate cases.

If a contractor fails to submit Good Faith Efforts documentation as provided in this Policy, it waives the right to appeal OBO decisions related to this Policy. OBO will review all the efforts made by the contractor, including the quality and quantity of those efforts.

Pre–Award.

A bidder must submit a participation plan (Document 00470) to OBO at the time the bidder submits the bid. If the participation by certified MWSBE subcontractors documented on the participation plan ("participation") is less than the Contract Goal, a bidder should submit a Record of Good Faith Efforts (Document 00471) with the bid. A bidder should also submit a request for a deviation (Document 00472) if the bidder, having used Good Faith Efforts, reasonably believes that it cannot meet the Contract Goal or a commercially useful deviation.

In making a determination that the bidder has made a good faith effort to meet the Contract Goals, OBO shall consider specific documentation concerning the steps taken to obtain MWSBE participation, with a consideration of, by way of illustration and not limitation, whether the bidder demonstrated a genuine effort to comply with the following factors:

1. Attended any pre-bid or pre-proposal meetings scheduled by the City Department;

2. Followed up with MWSBEs that attended the pre-bid or pre-proposal meetings to discuss subcontracting and supplier opportunities and contacted MWSBEs listed in the City's online directory;

3. Conducted outreach with minority and women focused organizations and associations far in advance of solicitation due date (no less than 10 business days);

4. Identified and designated portions of the work to be performed by MWSBEs to increase the likelihood of meeting the Contract Goals (including where appropriate breaking down the contract into reasonably sized subcontracts to ensure participation);

5. Advertised subcontracting opportunities in news media focused towards minority and women persons far in advance of solicitation due date;

6. Provided MWSBEs with a point of contact that was knowledgeable about the project and possessed decision-making authority to answer questions from interested MWSBEs;

7. Provided a reasonable number of MWSBEs certified with timely written notices via email, mail, and/or fax and/or with documented contact regarding the subcontracting/supplier opportunities. A "reasonable number of MWSBEs" shall be based on the number of MWSBEs available in the directory;

8. Solicited the MWSBEs within a reasonable amount of time (no less than seven business days) before bid submission, as well as followed up with the MWSBEs solicited to determine if they were interested in submitting a bid or proposal or participating on a team.

9. Provided interested MWSBEs certified to perform the solicited work with prompt access to the plans, specifications, scope of work and requirements of the contract;

10. Negotiated in good faith with interested MWSBEs, and not rejecting MWSBEs as unqualified without sound reasons based on a thorough investigation of their capabilities;

11. Entered into a formal contract, or signing enforceable letters of intent with MWSBEs;

12. Provided an explanation to any MWSBE whose bid or price quotation is rejected, unless another MWSBE is accepted for the same work, as follows:
    a. Where price competitiveness is not the reason for rejection, a written rejection notice including the reason for rejection will be sent to the rejected MWSBE firm;
    b. Where price competitiveness is the reason for rejection, a meeting must be held with the price-rejected MWSBE, if requested, to discuss the rejection;

13. Made efforts to assist interested MWSBEs in obtaining bonding, lines of credit, insurance required for the contract, and documenting MWSBE denied by bona fide surety agents;

14. Ensured that the conditions and requirements for subcontracts are commensurate with industry standards and would not cause an economic hardship on MWSBEs, such as unnecessary insurance or coupling bid bonds with retainage;

15. Incorporated efforts not attempted earlier or on previous bids that appear more likely to lead to attaining the Contract Goal. Past performance on similar contracts with similar scopes will also be taken in consideration when determining Good Faith Efforts. A bidder that continues to make same efforts without any significant change in the level of participation may not be making Good Faith Efforts.

Post–Award.

The contractor must sign the approved participation plan (Document 00470 or Document 00570) prior to starting work on the Project. A contractor should submit a request for deviation (Document 00572) from OBO if the contractor, having made Good Faith Efforts, reasonably believes that it will not achieve the Participation Plan Percentage documented in the approved participation plan. Unless OBO approves a deviation, a contractor must submit to OBO a Participation Summary (Document 00660) prior to City Council's consideration of any close-out, term extension, or change order. If participation is less than anticipated in the approved participation plan, the contractor must submit a Record of Good Faith Efforts (Document 00571) along with the Participation Summary. A contractor that fails to submit a deviation request and Good Faith Efforts documentation waives the right to appeal OBO decisions related to this Policy.

If the contractor is awarded the contract and fails to achieve the established Participation Plan Percentage, the contractor must demonstrate to OBO its efforts to meet the Participation Plan Percentage and failure to do so based on circumstances that the contractor could not reasonably control. In determining whether the contractor made Good Faith Efforts to ensure full participation and achievement of the Participation Plan Percentage, OBO shall consider the following factors:

1. Whether the contractor designated an MWSBE liaison officer to administer the Contractor's MWSBE programs and to be responsible for maintenance of records of Good Faith Efforts.

2. Whether the contractor furnished prompt MWSBE Utilization Reports in a timely and accurate manner through the online Contract Monitoring System or via hard copy.

3. Whether the contractor responded to efforts to resolve disputes with MWSBEs, and genuinely attempted to resolve these issues.

4. Whether the contractor disclosed payment discrepancies timely and within the monthly reporting period;

5. Whether the contractor complied with the participation plan, unless the contractor received a deviation from the OBO Director and whether upon approval, the contractor made Good Faith Efforts to replace a removed MWSBE with another certified firm;

6. Whether the contractor furnished prompt written responses to written inquiries from the Director or any employee of OBO regarding the MWSBE's performance or information germane to the MWSBE's certification;

7. Whether the contractor ensured that at all times during the performance of any contract or subcontract the MWSBE firm is engaging in a commercially useful function as that term is defined in Chapter 15 of the City of Houston Code of Ordinances;

8. Whether the contractor provided the OBO information, or other material, that was factually accurate and free of material misrepresentation; and

9. Whether the contractor furnished prompt responses to requests for information, books and records needed to verify compliance from the department administering the Contract, the City Attorney and the City Controller;

10. Whether the contractor attended all meetings and mediation hearings as requested by the Director or his/her designee; and

11. How the contractor may be affected by change orders, with consideration given to the size of the change orders.

Change Orders.

The requirement to make Good Faith Efforts to achieve the approved Participation Plan Percentage is applicable to change orders. Contractors should make Good Faith Efforts to ensure that the Participation Plan Percentage remains substantially the same after the issuance of change orders. If a contractor cannot maintain substantially the same level of participation provided in the latest approved Participation Plan (Document 00470 or Document 00570) due to a change order, the contractor shall submit to the OBO Director and Contracting Department a Document 00571 (Post-Award Record of Good Faith Efforts) and Document 00572 (Post-Award Plan Deviation Request) in a timely manner that does not cause disruption to the project. In addition to other relevant factors, in evaluating whether Good Faith Efforts were made by the contractor to meet the Participation Plan Percentage despite change orders, the OBO Director shall consider the contractor's efforts to timely and efficiently deliver the project.

END OF DOCUMENT

Document 00820

WAGE SCALE AND PAYROLL REQUIREMENTS FOR ENGINEERING CONSTRUCTION

Wage Scale Requirements

1.1 Contractor and its Subcontractors must pay the general prevailing wage rates for building construction for each craft or type of worker or mechanic employed in the execution of any building construction or repair under the Contract in accordance with Chapter 2258 of the Texas Government Code and City of Houston, Texas Ordinance Nos. 85-2070, 2000-1114, 2001-152, 2006-91 and 2006-168, and 2009- 247 all as amended from time to time. City Council has determined the prevailing wage rate in the locality in which the work is being performed, which is set forth in Exhibit "A".

1.2 This prevailing wage rate does not prohibit the payment of more than the rates stated.

1.3 In bidding, Contractor warrants and represents that it has carefully examined the classifications for each craft or type of worker needed to execute the Contract and determined that such classifications in Exhibit "A" include all necessary categories to perform the work under the Contract.

1.4 The wage scale for engineering construction is to be applied to all site work greater than five feet from an exterior wall of new building under construction or from an exterior wall of an existing building.

1.5 If Contractor believes that an additional classification for a particular craft or type of worker is necessary to perform work under the Contract, it must submit with its bid a request to the Contract Compliance Division of the Office Of Business Opportunity ("OBO") to use an additional labor classification not listed in Exhibit "A" and specify the proposed new classification. OBO shall determine whether a proposed classification is already covered in Exhibit "A", and, if it is, specify which classification is appropriate. OBO's decision is conclusive. If OBO decides that a new classification is necessary, it will determine the appropriate prevailing wage rate for any resurveyed, amended, new, or additional craft or type of worker not covered by Exhibit "A". Such determination must be decided in accordance with procedures established by OBO, and in compliance with Chapter 2258 of the Texas Government Code and City of Houston, Texas Ordinance Nos. 85-2070, 2000-1114, 2001-152, 2006-91, 2006-168 and 2009-247 subject to City Council approval.

1.6 Contractor must not use any labor classification not covered by Exhibit "A" until such classification is established and approved for use by OBO.

1.7 A Contractor or Subcontractor who violates Chapter 2258 of the Texas Government Code must pay to the City, $60 per each worker employed for each calendar day or part of the day that the worker is paid less than the wage rates set forth in Exhibit "A".

1.8 The City may withhold money required to be withheld under Chapter 2258 of the Texas Government Code from the final payment to Contractor or earlier payments if City Council makes a determination that there is good cause to believe that Contractor has not complied with these provisions and Chapter 2258 of the Government Code, in which case the City may withhold the money at any time subsequent to the finding by City Council.

1.9 Contractor and Subcontractors must keep records specifying:

(1) the name and classification of each worker employed under the Contract; and

(2) the actual per diem wages paid to each worker, and the applicable hourly rate.

The records must be open at all reasonable hours for inspection by the officers and agents of the City.

1.10 The hourly cost of salary for non-exempt workers for labor in excess of 40 hours per worker per week, shall be calculated at 1.5 times the worker's base pay, plus 1.0 times fringe benefits, for the applicable craft and level.

Certified Payroll Requirements

2.1 Employees are paid weekly and payrolls are submitted weekly using the City of Houston's electronic payroll submission module, unless the prime Contractor has been instructed to do otherwise by the Office of Business Opportunity. When no work is done after a Contractor has started work, the Contractor is required to submit a weekly compliance statement indicating no work was performed. The payrolls must reflect the exact work and classification of the workers, the exact amount that they were paid. Workers must be paid the contracted amount (prevailing wage rates). The Contractor will be penalized $60.00 a day for each employee who is underpaid per Texas Government Code §2258-023 for all contracts.

2.2 Payrolls must be submitted electronically & indicate whether the worker worked inside or outside the building area when both wage rates are applicable to the contract.

2.3 Payrolls must be submitted each week until all work by the contractor is complete and the electronic payroll submission is marked as final in the system.

2.4 Payrolls must cover a seven day period from the start of the work week and must be consecutive seven day periods until all work is complete.

2.5 Payrolls must have employees' names, addresses, last four digits of the social security numbers, and job classifications. The job classifications must be the same as the classifications on the prevailing wage rate schedule.

2.6 A payroll deduction authorization form must be submitted for each employee for any deductions other than Federal and FICA taxes.

2.7 Employees must be paid overtime (time and a half) for all hours worked over 40 hours a week on both federally and City-funded contracts.

2.8 The Contractor has the responsibility to comply with all Internal Revenue Service rules and regulations. Contractors who submit certified payrolls with **Owner Operators (truckers)** must submit a signed tax liability statement from Owner Operator acknowledging their responsibility for Federal Income Tax and FICA reporting obligations.

2.9 If the Contractor wants to use the apprentice wage rates for an employee, the apprenticeship certificates must be submitted to the Office of Business Opportunity in advance of the employee working on the project and appearing on the payroll. You must comply with the listed number of journeymen to apprentices as listed.

2.10 A poster of the Prevailing Wage Rate Schedule should be clearly displayed on each job site from the time the project starts until the work is completed, or in case of annual service agreements, in the Contractor's office.

2.11 The Contractor shall submit the "Certificate from Contractor Appointing Officer or Employee to Supervise Payment of Employees" (Exhibit "B") to the Monitoring Authority listed in Document 00495 prior to final execution of the contract.

2.12 During the course of the work, ALL Subcontractors shall submit the "Certificate from Subcontractor Appointing Officer or Employee to Supervise Payment of Employees" (Exhibit "C") to the Monitoring Authority listed in Document 00495.

2.13 Upon completion of the Project, as part of the contract-awarding department's total clearance process, the Office of Business Opportunity's Contract Compliance Section must review whether the Wage Rate and Payroll Requirements were met and report the results to the department.

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EXHIBIT "A"

LABOR CLASSIFICATIONS AND PREVAILING WAGE RATES FOR ENGINEERING CONSTRUCTION 2015

CLASSIFICATION	RATE	CLASSIFICATION	RATE
Asphalt Distributor Operator	$14.06	Milling Machine Operator - Fine Grade	$13.53
Asphalt Paving Machine Operator	$14.32	Mixer Operator	$10.33
Asphalt Raker	$12.36	Motor Grader Operator- Rough	$14.23
Asphalt. Shoveler	$11.68	Motor Grader Operator	$15.69
Broom or Sweeper Operator	$12.68	Oiler	$12.12
Bulldozer Operator	$11.81	Painter-Structures	$18.62
Carpenter- Rough	$12.49	Pavement Marking Machine Operator	$11.18
Concrete Finisher- Paving	$12.98	Pile Driverman	$14.95
Concrete Finisher- Structures	$12.98	Pipe Layer	$12.12
Concrete Paving Curbing Machine Operator	$11.71	Reinforcing Steel Setter - Paving	$15.15
Concrete Paving Finishing Machine Operator	$13.07	Reinforcing Steel Setter - Structure	$14.39
Concrete Paving Joint Sealer Operator	$11.00	Roller Operator, Pneumatic - Self-propelled	$11.57
Concrete Paving. Saw Operator	$13.99	Roller Operator, Steel Wheel, Flat Wheel/Tamping	$11.57
Concrete Paving Spreader Operator.	$10.44	Roller Operator, Steel Wheel, Plant Mix Pavement	$11.92
Concrete Rubber . . .	$9.00	Scraper Operator	$13.47
Crane Clamshell Backhoe Derrick, Dragline, Shovel Operator	$12.71	Servicer	$13.97
Crusher and Screening Plant Operator	$11.29	Sign Installer - PGM	$8.54
Electrician * 3 Journeyman 2 Apprentice Allowed	$27.11	Slip Form Machine Operator	$11.07
Flagger	$10.33	Spreader Box Operator	$13.58
Form Builder/Setter- Structures	$12.23	Structural Steel Worker	$14.39
Form Liner- Paving and Curb	$12.34	Tractor Operator - Crawler Type	$13.68
Form Setter- Paving and Curb	$12.34	Tractor Operator- Pneumatic	$10.07
Foundation Drill Operator - Crawler Mounted	$17.43	Transit Mixer Truck Driver	$11.00
Foundation Drill Operator - Truck Mounted	$15.89	Truck Driver, Lowboy-float	$16.03
Front Loader Operator	$13.17	Truck Driver, Single-Axle - Heavy	$11.46
Laborer Common	$11.02	Truck Driver, Single-Axle - Light	$11.48
Laborer- Utility	$11.73	Truck Driver, Tandem Axle Semi-Trailer	$12.27
Manhole Builder	$9.00	Work Zone Barricade Servicer	$11.67
Mechanic	$16.96	eceive rate prescribed for craft performing operation to which welding is incidental	

* Apprentices- must be in an approved USDOL Program and cannot exceed ratios

Engineering Prevailing Wages Classification Definitions

Asphalt Distributor Operator
Drives distributor truck, sets spray bars and operates valves and levers to control distribution of bituminous material for highway surfacing. May oil, grease or otherwise service and make adjustments to equipment as needed. Performs other related duties.

Asphalt Paving Machine Operator
Operates paving machine that spreads and levels asphaltic concrete on highway subgrade. Controls movement of machine, raises and lowers screed, regulates width of screed. May, oil, grease, service and make adjustments to equipment as needed. Performs other related duties.

Asphalt Raker
Distributes asphaltic materials evenly over road surface by raking and brushing material to correct thickness; directs Laborers when to add or take away material to fill low spots or to reduce high spots. Performs other related duties.

Asphalt Shoveler
A general term used on construction work covering many unskilled classifications requiring work of a physical nature. A laborer works with all crews doing everything from pick and shovel work to cleaning up lumber with hammer, shoveling and placing concrete, uses air tools, cleans concrete joints and fills joints with sealing compound from bucket or with hose and nozzle from a central source, applies coating of oil to inside face of forms, may help set and strip forms, unloads and transports reinforcing steel, cures newly poured concrete, helps lower pipe into ditch for pipelayers, builds fences, works with dirt crew keeping construction layout stakes out of the way of dirt moving equipment.

Broom or Sweeper Operator
Operates a self-propelled machine to sweep and clean roadway surfaces. May oil grease, service and make adjustments to equipment as needed. Performs other related duties.

Bulldozer Operator
Operates a crawler tractor with a bulldozer mounted in front of chassis to level, distribute and push earth or other material. May operate a ripper attachment to break up rock or other hard material. May use a push block on front of tractor to push load scrapers. May oil, grease, or otherwise service and make minor repairs to equipment as needed. Performs other related duties.

Carpenter, Rough
Works from plans to build, assemble, fit together, align, plum, and set in place forms for molding concrete structures. Forms may be wood, steel, aluminum, fiberglass or any other type of material. Checks form while concrete is placed. May install miscellaneous materials integral to concrete structures. May set precast concrete elements. Prepares for slipforming traffic rail and median barrier. May install permanent metal deck forms. May work with power tools Performs other related duties.

Concrete Finisher, Paving
Finishes the exposed surfaces of fresh concrete paving, median barrier and every element of concrete structures to the final grade and contour structures to the final grade and contour with the use of straight edges and steel trowels. Operates bridge deck finishing machine. Finishes concrete curbs and gutters. Finishes exposed surface of concrete after forms have been removed by patching imperfections with fresh concrete, rubbing surface with abrasive stone, and directing others in removing excess or defective concrete with power tools. Performs other related duties.

Concrete Finisher, Structures
A worker semi-skilled in concrete finishing who assists Concrete finisher by performing specific or general duties of lesser skill and keeping Concrete Finisher supplied with materials, tools, and supplies; cleaning working area an equipment; and holding materials and tools. Performs other related duties.

Concrete Paving Curbing Machine Operator
Operates self - propelled machine(s) which may or may not travel on concrete paving forms, spreading and leveling fresh concrete to grade by use of augers and screeds. May oil, grease or otherwise service and make adjustments to equipment as necessary. Performs other related duties.

Concrete Paving Finishing Machine Operator
Operates self - propelled machine(s) which may or may not travel on concrete paving forms, spreading and leveling fresh

concrete to grade by use of augers and screeds. May oil, grease or otherwise service and make adjustments to equipment as necessary. Performs other related duties.

Concrete Paving Joint Sealer Operator
Cleans and seals joints requiring a hot or cold sealing compound in concrete paving, sidewalks, driveway and approach slabs. May oil, grease or make necessary repairs adjustments to equipment as needed. Performs other related duties.

Concrete Paving Saw Operator
Operates a water-cooled power saw with either or an abrasive blade to saw expansion and contraction joints in concrete paving. May also be used to saw asphaltic pavements. May oil grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Concrete Paving Spreader Operator
Operates self - propelled machine(s) which may or may not travel on concrete paving forms, spreading and leveling fresh concrete to grade by use of augers and screeds. May oil, grease or otherwise service and make adjustments to equipment as necessary. Performs other related duties.

Concrete Rubber
Finishes the exposed surface of concrete masonry after the forms have been removed by patching holes and broken corners with fresh concrete, rubbing surface with abrasive stone to remove rough spots, and removing high spots and defective concrete with hand chisel and hammer or pneumatic chisel and powered abrasive stone. Performs other related duties.

Crane, Clamshell, Backhoe, Derrick, Dragline, Shovel Operator
A worker who operates a lattice boom type crane can hoist and move materials, raise and lower heavy weights and perform other related operations. May be crawler type or rubber tired. May include placement of rock riprap, clamshell, dragline, pipe and pile driving operations. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Crusher and Screed Plant Operator
Operates a crusher or screening plant through which rock is run to break it into crushed stone for construction or to control flow of materials not needed. May include minor repairs and may service and make necessary adjustments to equipment as needed. Performs other related duties.

Electrician *3 Journeyman 2 Apprentice
Plans and directs the layout of metal electrical conduit, installs wiring systems, switch-panels, buss bars, works on overhead distribution systems and underground distribution systems. Performs other related duties.

Flagger
A worker who directs traffic in or around a construction site. May use signs or devices to direct traffic. May help assemble, position and clean devices or equipment used to direct traffic. Must be able to effectively communicate with the public. May require certain level of training by TXDOT specifications. Performs other related duties.

Form Builder/Setter, Structures
Fits together, aligns and sets to grade metal and wooden forms for placement of concrete. Forms may be wood, steel, aluminum, fiberglass or any other type of material. Checks forms while concrete is placed. May install miscellaneous materials integral to concrete structures. May set precast concrete elements. Prepares for slipforming traffic rail and median barrier. May install permanent metal deck forms. May work with power tools. Performs other related duties.

Form Liner, Paving & Curb
Fits together, panels align and sets to grade metal and wooden forms for placement of concrete. Works with survey crew to set stringline for panels or moles. Performs other related duties.

Form Setter, Paving & Curb
Fits together, align and set to grade metal and wooden forms for placement of concrete paving and curbs. Works with survey crew to set stringline for paving, curb and gutter curb. Performs other related duties.

Foundation Drill Operator, Crawler Mounted
Operates a hole-drilling machine that is crawler mounted. May include geotechnical operations such as soils nails, rock nails, tiebacks, anchors and jet grouting. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Foundation Drill Operator, Truck Mounted
Operates a hole drilling machine that is mounted on the rear of a rubber tired vehicle or truck. May include soils nails, rock nails, tiebacks, anchors and jet grouting. Drive truck from location to location or may have laborer who drives truck. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Front End Loader Operator
Operates a rubber tired, skid steer or crawler type tractor with an attached scoop type bucket on front end. Machine is used to load materials from stockpiles, excavation, charging batch plants, loading and unloading trucks. May be used with attachments in lieu of the bucket. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Laborer, Common
A general term used on construction work covering many unskilled classifications requiring work of a physical nature. A laborer works with all crews doing everything from pick and shovel work to cleaning up lumber with hammer, shoveling and placing concrete, uses air tools, cleans concrete joints and fills joints with sealing compound from bucket or with hose and nozzle from a central source, applies coating of oil to inside face of forms, may help set and strip forms, unloads and transports reinforcing steel, cures newly poured concrete, helps lower pipe into ditch for pipelayers, builds fences, works with dirt crew keeping construction layout stakes out of the way of dirt moving equipment.

Laborer, Utility
Performs a variety of manual duties, usually working in a utility capacity by working on multiple projects and tasks where demands require workmen with varied experience and ability to work without close direction. Unloads and transports reinforcing steel. May occasionally place and tie reinforcing steel. Directs common laborers in pouring concrete. Erects shoring and bracing. Assists in installation of pipe. Installs, operate and maintains dewatering systems. May assist equipment operators in positioning machines, verifying grades and signaling operators. Directs truck drivers and scraper operators to dumping positions to maintain grades as directed. Uses power tools and air tools. May work as lead man in a labor crew. His performance of a wide variety of construction jobs distinguishes him from a helper assigned to a specific craft. Installs and maintains erosion control. Is more or less a general utility construction worker. May be second step in learning a skill, and may later become a helper in a specific classification. Performs other related duties.

Manhole Builder
Constructs a means of permanent access to water and sewer lines for maintenance purposes. This work consists of laying brick or concrete slab at bottom of ditch up to an approximate grade line near the surface of the ground. Brick or block is normally laid to form a nearly circular manhole. Brick or block is laid in by eyesight and is normally to a plumb line. Chipped or culled brick can be used quite often is. No effort may be made to keep mortar off the face of the brick and joints are not pointed. May apply coating of concrete to interior and exterior surface. Performs other related duties.

Mechanic
Assembles, set up, adjusts and maintains and repairs all types of construction equipment and trucks. He may perform the duties of a welder in repair of equipment. Performs other related duties.

Milling Machine Operator, Fine Grade
Operates a power-driven milling machine that planes material of the to roadbed and discharges the material into a hauling unit or a windrow. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Mixer Operator
Performs a variety of manual duties, usually working in a utility capacity by working on multiple projects and tasks where demands require workmen with varied experience and ability to work without close direction. Unloads and transports reinforcing steel. May occasionally place and tie reinforcing steel. Directs common laborers in pouring concrete. Erects shoring and bracing. Assists in installation of pipe. Installs, operate and maintains dewatering systems. May assist equipment operators in positioning machines, verifying grades and signaling operators. Directs truck drivers and scraper operators to dumping positions to maintain grades as directed. Uses power tools and air tools. May work as lead man in a labor crew. His performance of a wide variety of construction jobs distinguishes him from a helper assigned to a specific craft. Installs and maintains erosion control. Is more or less a general utility construction worker. May be second step in learning a skill, and may later become a helper in a specific classification. Performs other related duties.

Motor Grader Operator, Rough
Operates a motor grader. Equipment is used to grade excavation and embankment and to lay asphalt, base and other materials. May blade haul roads and do other general motor grader work, but does not perform finish grade work to close

specification tolerances. This operator may be a learner in the first phase of learning the skills of motor grader work. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Motor Grader Operator
Operates a motor grader. Equipment is used to grade excavation and embankment and to lay asphalt, base and other materials. May blade haul roads and do other general motor grader work, but does not perform finish grade work to close specification tolerances. This operator may be a learner in the first phase of learning the skills of motor grader work. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Oiler
A learner or semi-skilled worker who under the direction of the watch engineer. May oil and grease or otherwise service all engines and necessary equipment as needed. He may clean and paint engine room as needed. Performs other related duties.

Painter, Structures
Paints and stains structural steel and concrete surfaces of bridges, retaining walls, or other structures. Directs cleaning and abrasive blasting of surfaces prior to painting or staining. Performs other related duties.

Pavement Marking Machine Operator
Operates machine used in laying paint stripes or markers on all types of paving. Loads machine with appropriate materials and may walk or ride on machine. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Piledriverman
Sets in place, aligns, plumbs directs driving of timber, concrete, steel, pipe and any other type of piling. Sets, drives and pulls steel, concrete and other types of sheet piling. Rigs pile and leads and bracing. Signals operator. Splices piles before and after driving. Directs pile cutoff. May direct jetting or drilling equipment in connection with installing piles to grade. Performs other related duties.

Pipelayer
Installs concrete, clay, steel, ductile iron, plastic, corrugated pipe and any other type of pipe for storm drainage, water lines, gas lines and sanitary sewer lines. Lays underground communication and electrical ducts. May install and set electrical ground boxes, hand holes, manholes, inlets and other structures. Caulks joints, makes threaded and flanged connections. Installs valves and other accessories. Performs other related duties.

Reinforcing Steel Setter, Paving
Works from plans to lay out and install reinforcing steel within forms or in mats of concrete paving. May direct unloading of material. Determines rigging required to complete work. Gives direction to reinforcing steel worker (helper) or common or utility laborers. May install miscellaneous materials integral to concrete structure or paving. May work with power tools. Performs other related duties.

Reinforcing Steel Setter, Structure
Works from plans to lay out and install reinforcing steel within forms or in mats of concrete paving. May direct unloading of material. Determines rigging required to complete work. Gives direction to reinforcing steel worker (helper) or common or utility laborers. May install miscellaneous materials integral to concrete structure or paving. May work with power tools. Performs other related duties.

Roller Operator, Pneumatic, Self-Propelled
Operates a self-propelled machine with either steel wheels pneumatic tires, which is used to compact and smooth all bituminous materials. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Roller Operator, Steel Wheel, Flat Wheel/Tamping
Operates a self-propelled machine with either steel wheels or pneumatic tires which is used to compact earth fills, subgrade, flexible base and all other types of materials except bituminous. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Roller Operator, Steel Wheel, Plant Mix Pavement
Operates a self-propelled machine with either steel wheels pneumatic tires, which is used to compact and smooth all bituminous materials. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Scraper Operator
Operates a self-contained wheeled tractor scraper both self loading or assisted by crawler tractors or other scrapers. Used to excavate and transport earth or other materials. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Servicer
Drives a truck, which carries various fuels, oils, greases and filters. Must have knowledge of and is responsible for the correct oiling and greasing and changing of filters on equipment according to the manufacturers' specifications. Uses compressed air grease guns, wrenches and other tools. May make adjustments to clutches, brakes and other mechanical items. Keeps record of service preventive maintenance records. May have laborer assisting him. May require CDL if driving truck on public highways. Performs other related duties.

Sign Installer (PGM)
Sets forms, reinforcing steel, anchor bolts and pours concrete for Sign foundations. Fabricates and erects pipe and angle Frameworks by bolting, welding or other means prior to installation of signs that are normally prefabricated. Works from plans in location and drilling holes for proper location and alignment of signs. May direct hoisting of signs into place. Fastens signs to framework by bolting and other means. Locates and sets lighting brackets. May perform other work associated with signing projects. Supervises sign erector helper. Performs other related duties.

Slip Form Machine Operator
Cleans and seals joints requiring a hot or cold sealing compound in concrete paving, sidewalks, driveway and approach slabs. May oil, grease or make necessary repairs adjustments to equipment as needed. Performs other related duties.

Spreader Box operator
Operates spreader box by adjusting hopper and strike off blade so that the gravel, stone or other material may be spread to a specific depth on road surface during seal coat and surface treatment operations. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Structural Steel Worker
Works from plans to lay out and install reinforcing steel within forms or in mats of concrete paving. May direct unloading of material. Determines rigging required to complete work. Gives direction to reinforcing steel worker (helper) or common or utility laborers. May install miscellaneous materials integral to concrete structure or paving. May work with power tools. Performs other related duties.

Tractor operator, Crawler Type
Operates a crawler tractor with a bulldozer mounted in front of chassis to level, distribute and push earth or other material. May operate a ripper attachment to break up rock or other hard material. May use a push block on front of tractor to push load scrapers. May oil, grease, or otherwise service and make minor repairs to equipment as needed. Performs other related duties.

Tractor Operator, Pneumatic
Operates a gasoline or diesel powered agricultural tractor that tows compaction rollers, plow, disc. water tanks, scrapers and other similar operations. May use other miscellaneous attachments. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Traveling Mixer Operator
Drives a gasoline or diesel truck upon which is mounted a concrete mixer. Operates concrete mixer and dumps concrete on the grade, into forms or into concrete pumps or buckets. Cleans mixer drum. May require CDL license for on highway use. May service and make necessary adjustments for proper operation of equipment. Performs other related duties.

Truck driver, lowboy-Float
Drives a heavy-duty diesel powered truck to which is attached a trailer upon which heavy equipment is hauled. Driver is often required to operate heavy equipment to load or unload the lowboy. May require CDL license for on highway use. May service and make necessary adjustments for proper operation of equipment. Performs other related duties.

Truck driver, Single Axle, Heavy
Drive a light capacity truck for transporting loads of construction material. The truck is of single rear axle type, may have various kinds of beds attached, such as dump, flat bed, tank, etc. May require CDL license for driving on highway. May services and make necessary adjustments for proper operation equipment. Performs other related duties.

Truck driver, Single Axle-Light
Drive a light capacity truck for transporting loads of construction material. The truck is of single rear axle type, may have

various kinds of beds attached, such as dump, flat bed, tank, etc. May require CDL license for driving on highway. May services and make necessary adjustments for proper operation equipment. Performs other related duties.

Truck Driver, Tandem Axle, Semi-Trailer
Drives a diesel-powered tractor pulling a semi trailer hauling materials. Hauls dirt, rock, aggregates or other material. May require CDL license for driving on highway. May service and make necessary adjustments for proper operation of equipment. Performs other related duties.

Work Zone Barricade Servicer
Fabricates, erects and maintains temporary traffic control devices, including arrow boards, signs, barricades, channelizing devices, barrels and all message boards. May operates a truck during traffic control operations.

WELDERS - Receives rate for craft being performed to which welding is incidental.

EXHIBIT "B"

CERTIFICATE FROM CONTRACTOR APPOINTING OFFICER OR EMPLOYEE TO SUPERVISE PAYMENT OF EMPLOYEES

Project Name _____

_____

Project WBS#:_____Date_____

(I) (We) hereby certify that (I am) (we are) the **Prime Contractor** for _____

_____
(specify type of job)

in connection with construction of the above-mentioned Project, and that (I) (we) have appointed_____, whose signature appears below, to supervise the payment of (my) (our) employees beginning_____, 20___; that he/she is in a position to have full knowledge of the facts set forth in the payroll documents and in the statement of compliance required by the Copeland Act and the City of Houston, which he/she is to execute with (my) (our) full authority and approval until such time as (I) (we) submit to the City of Houston a new certificate appointing some other person for the purposes hereinabove stated.

_____ Phone:_____
(Identifying Signature of Appointee)

Attest: _____
(Name of Firm or Corporation)

By:_____ By:_____
(Signature) (Signature)

_____ _____
(Title) (Title)

NOTE: This certificate must be executed by an authorized officer of a corporation or by a member of a partnership, and shall be executed prior to and be submitted with the first payroll. Should the appointee be changed, a new certificate must accompany the first payroll for which the new appointee executes a statement of compliance required by the Copeland Act and the City of Houston.

EXHIBIT "C"

CERTIFICATE FROM SUBCONTRACTOR APPOINTING OFFICER OR EMPLOYEE TO SUPERVISE PAYMENT OF EMPLOYEES

Project Name _____

_____

Project WBS#:_____Date_____

(I) (We) hereby certify that (I am) (we are) the **Sub Contractor** for _____

_____
(specify type of job)

in connection with construction of the above-mentioned Project, and that (I) (we) have appointed_____, whose signature appears below, to supervise the payment of (my) (our) employees beginning_____, 20___; that he/she is in a position to have full knowledge of the facts set forth in the payroll documents and in the statement of compliance required by the Copeland Act and the City of Houston, which he/she is to execute with (my) (our) full authority and approval until such time as (I) (we) submit to the City of Houston a new certificate appointing some other person for the purposes hereinabove stated.

_____ Phone:_____
(Identifying Signature of Appointee)

Attest: _____
(Name of Firm or Corporation)

By:_____ By:_____
(Signature) (Signature)

_____ _____
(Title) (Title)

NOTE: This certificate must be executed by an authorized officer of a corporation or by a member of a partnership, and shall be executed prior to and be submitted with the first payroll. Should the appointee be changed, a new certificate must accompany the first payroll for which the new appointee executes a statement of compliance required by the Copeland Act and the City of Houston.

END OF DOCUMENT

Document 00821

WAGE SCALE AND PAYROLL REQUIREMENTS FOR BUILDING CONSTRUCTION

Wage Scale Requirements

1.1 Contractor and its Subcontractors must pay the general prevailing wage rates for building construction for each craft or type of worker or mechanic employed in the execution of any building construction or repair under the Contract in accordance with Chapter 2258 of the Texas Government Code and City of Houston, Texas Ordinance Nos. 85-2070, 2000-1114, 2001-152, 2006-91 and 2006-168, and 2009-247 all as amended from time to time. City Council has determined the prevailing wage rate in the locality in which the work is being performed, which is set forth in Exhibit "A".

1.2 This prevailing wage rate does not prohibit the payment of more than the rates stated.

1.3 In bidding, Contractor warrants and represents that it has carefully examined the classifications for each craft or type of worker needed to execute the Contract and determined that such classifications in Exhibit "A" include all necessary categories to perform the work under the Contract.

1.4 The wage scale for building construction is to be applied to work on a building including an area within 5 feet of the exterior wall.

1.5 If Contractor believes that an additional classification for a particular craft or type of worker is necessary to perform work under the Contract, it must submit with its bid a request to the Contract Compliance Division of the Office of Business Opportunity ("OBO") to use an additional labor classification not listed in Exhibit "A" and specify the proposed new classification. OBO shall determine whether a proposed classification is already covered in Exhibit "A", and, if it is, specify which classification is appropriate. OBO's decision is conclusive. If OBO decides that a new classification is necessary, it will determine the appropriate prevailing wage rate for any resurveyed, amended, new, or additional craft or type of worker not covered by Exhibit "A". Such determination must be decided in accordance with procedures established by OBO, and in compliance with Chapter 2258 of the Texas Government Code and City of Houston, Texas Ordinance Nos. 85-2070, 2000-1114, 2001-152, 2006-91, 2006-168, and 2009-247 subject to City Council approval.

1.6 Contractor must not use any labor classification not covered by Exhibit "A" until such classification is established and approved for use by OBO.

1.7 A Contractor or Subcontractor who violates Chapter 2258 of the Texas Government Code must pay to the City, $60 per each worker employed for each calendar day or part of the day that the worker is paid less than the wage rates set forth in Exhibit "A".

1.8 The City may withhold money required to be withheld under Chapter 2258 of the Texas Government Code from the final payment to Contractor or earlier payments if City Council makes a determination that there is good cause to believe that Contractor has not complied with these provisions and Chapter 2258 of the Government Code, in which case the City may withhold the money at any time subsequent to the finding by City Council.

1.9 Contractor and Subcontractors must keep records specifying:

(1) the name and classification of each worker employed under the Contract; and

(2) the actual per diem wages paid to each worker, and the applicable hourly rate.

The records must be open at all reasonable hours for inspection by the officers and agents of the City.

1.10 The hourly cost of salary for non-exempt workers for labor in excess of 40 hours per worker per week, shall be calculated at 1.5 times the worker's base pay, plus 1.0 times fringe benefits, for the applicable craft and level.

Certified Payroll Requirements

2.1 Employees are paid weekly and payrolls are submitted weekly using the City of Houston's electronic payroll submission module, unless the prime Contractor has been instructed to do otherwise by the Office of Business Opportunity. When no work is done after a Contractor has started work, the Contractor is required to submit a weekly compliance statement indicating no work was performed. The payrolls must reflect the exact work and classification of the workers, the exact amount that they were paid. Workers must be paid the contracted amount (prevailing wage rates). The Contractor will be penalized $60.00 a day for each employee who is underpaid per Texas Government Code §2258-023 for all contracts.

2.2 Payrolls must be submitted electronically & indicate whether the worker worked inside or outside the building area when both wage rates are applicable to the project.

2.3 Payrolls must be submitted each week until all work by the contractor is complete and the electronic payroll submission is marked as final in the system.

2.4 Payrolls must cover a seven day period from the start of the work week and must be consecutive seven day periods until all work is complete.

2.5 Payrolls must have employees' names, addresses, last four digits of the social security numbers, and job classifications. The job classifications must be the same as the classifications on the prevailing wage rate schedule.

2.6 A payroll deduction authorization form must be submitted for each employee for

any deductions other than Federal and FICA taxes and court ordered child support.

2.7 Employees must be paid overtime (time and a half) for all hours worked over 40 hours a week on both federally and City-funded contracts.

2.8 The Contractor has the responsibility to comply with all Internal Revenue Service rules and regulations. Contractors who submit certified payrolls with **Owner Operators (truckers)** must submit a signed tax liability statement from each Owner Operator acknowledging their responsibility for Federal Income Tax and FICA reporting obligations.

2.9 If the Contractor wants to use the apprentice wage rates for an employee, the apprenticeship certificates must be submitted to the Office of Business Opportunity in advance of the employee working on the project and appearing on the payroll. Contractor must comply with posted number of journeymen to apprentices or helpers as listed on the wage rate.

2.10 A poster of the Prevailing Wage Rate Schedule should be clearly displayed on each job site from the time the project starts until the work is completed, or in case of annual service agreements, in the Contractor's office.

2.11 The Contractor shall submit the "Certificate from Contractor Appointing Officer or Employee to Supervise Payment of Employees" (Exhibit "B") to the Monitoring Authority listed in Document 00495 prior to final execution of the contract.

2.12 During the course of the work, Subcontractors shall submit the "Certificate from Subcontractor Appointing Officer or Employee to Supervise Payment of Employees" (Exhibit "C") to the Monitoring Authority listed in Document 00495.

2.13 Upon completion of the Project, as part of the contract-awarding department's total clearance process, the Office of Business Opportunity's Contract Compliance Section must review whether the Wage Rate and Payroll Requirements were met and report the results to the department.

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EXHIBIT "A"

CITY OF HOUSTON, TEXAS
LABOR CLASSIFICATIONS AND PREVAILING WAGE RATES
FOR BUILDING CONSTRUCTION 2015

Worker Classification	Ratio	Base Rate	Fringe Benefit	Wage Total
Asbestos Worker/Insulator *	Ratio 1/1 - Apprentice	$20.75	$9.85	$30.60
Asbestos Abatement Worker (ceilings, walls ,floors only)	Ratio 1/3 – Helpers $9.10	$14.00	$0.00	$14.00
Boilermaker *	Ratio 5/1 - Apprentice	$23.14	$21.55	$44.69
Brick Layer * (see Mason Tender Brick)	Ratio 1/3 – Mason Tender Brick	$18.87	$0.00	$18.87
Carpenter * (including acoustical ceiling work)	Ratio 2/1 - Apprentice	$21.97	$7.98	$29.95
Cement Mason/Concrete Finisher *	Ratio 1/3 Mason Tender	$13.93	$0.00	$13.93
Drywall Finisher/Taper *	Ratio 1/3 – Helpers $8.54	$16.27	$3.66	$19.93
Drywall Hanger, * incl. metal studs installation	Ratio 1/3 – Helpers $9.46	$17.44	$3.93	$21.37
Electrician *	Ratio 3/2 - Apprentice	$27.65	$7.70	$35.35
Elevator Mechanic *	Ratio 1/1 - Apprentice	$38.00	$26.79	$64.79
Formbuilder/ Formsetter *	Ratio 1/3 – Helpers $7.67	$12.77	$0.00	$12.77
Glazier *	Ratio 1/3 – Helper $11.51	$14.92	$2.78	$17.70
Insulator * (Batt and Foam)	Ratio 1/3 – Helper $6.50	$14.87	$0.73	$15.60
Ironworker *(Reinforcing)	Ratio 1/3 – Helper $7.83	$12.14	$0.00	$12.14
Ironworker *(Structural)	Ratio 1/3 – Helper $10.19	$22.02	$6.35	$28.37
Lather *	Ratio 1/3 – Helper $13.38	$19.73	$0.00	$19.73
Painter * (Brush, Roller, and Spray)	Ratio 1/3 – Helper $7.42	$17.24	$4.41	$21.65
Pipe Fitter ***(HVAC Pipe only)**	Ratio 1/1 - Apprentice	$29.63	$10.31	$39.94
Pipe Fitter ***(Excluding HVAC)**	Ratio 1/3 – Apprentice $12.40	$29.39	$10.31	$39.70
Plasterer *	Ratio 1/3 Plaster Tenders	$19.42	$1.00	$20.42
Plumber *	Ratio 3/2 - Apprentice	$30.29	$9.50	$39.79
Roofer *	Ratio 1/3 – Helper $7.85	$15.40	$0.00	$15.40
Sheet Metal Worker *(incl. HVAC duct and system install.)	Ratio 2/1 - Apprentice	$25.37	$12.39	$37.76
Sprinkler Fitter * (Fire sprinklers)	Ratio 1/1 – Apprentice	$26.36	$16.52	$42.88
Tile Finisher *	Ratio 1/3 – Helper $8.08	$12.00	$0.43	$12.43
Tile Setter *	Ratio 1/3 – Helper $10.91	$16.17	$0.00	$16.17
Truck Driver		$14.18	$0.00	$14.18
Laborers:				
Common Laborer		$9.29	$0.00	$9.29
Mason Tender (Bricklayer's Helper)		$10.13	$0.00	$10.13
Mason Tender (Cement /Concrete Finisher's Helper)		$9.86	$0.00	$9.86
Pipe Layer		$12.35	$0.00	$12.35
Plaster Tender (Plasterer's helper)		$12.90	$2.51	$15.41
Power Equipment Operator:				
Asphalt Paver		$13.50	$0.25	$13.75
Backhoe – Power Equipment Operator		$12.54	$0.00	$12.54
Crane – Power Equipment Operator		$34.85	$9.85	$44.70
Forklift – Power Equipment Operator		$16.00	$0.00	$16.00
Slab and Wall Saw – Power Equipment Operator		$15.54	$3.83	$19.37
Welders - Receive rate prescribed for craft performing operation in which welding is incidental				

*** When Apprentices are shown, Helpers cannot be utilized. See Definitions for allowable journeymen to apprentice /helpers.**

Building Construction Prevailing Wages Classification Definitions

Asbestos Worker/Insulator * - Ratio 1Journeyman /1 Apprentice (1 Journeyman / 1 Apprentice) (Including application of all insulating materials, protective coverings, coatings and finishing to all type of mechanical systems). Applies insulating material to exposed surfaces of structures, such as air ducts, hot and cold pipes, storage tanks, and cold storage rooms: Reads blueprints and selects required insulation material (in sheet, tubular, or roll form), such as fiberglass, foam rubber, styrofoam, cork, or urethane, based on material's heat retaining or excluding characteristics. Brushes adhesives on or attaches metal adhesive-backed pins to flat surfaces as necessary to facilitate application of insulation material. Measures and cuts insulation material to specified size and shape for covering flat or round surfaces, using tape measure, knife, or scissors. Fits, wraps, or attaches required insulation material around or to structure, following blueprint specifications. Covers or seals insulation with preformed plastic covers, canvas strips, sealant, or tape to secure insulation to structure, according to type of insulation used and structure covered, using staple gun, trowel, paintbrush, or caulking gun.

Asbestos Abatement Worker * (Ceilings, Floors, & Walls only) Ratio 1 Journeyman /3 Helpers
Removes asbestos from ceilings, walls, beams, boilers, and other structures, following hazardous waste handling guidelines: Assembles scaffolding and seals off work area, using plastic sheeting and duct tape. Positions mobile decontamination unit or portable showers at entrance of work area. Builds connecting walkway between mobile unit or portable showers and work area, using hand tools, lumber, nails, plastic sheeting, and duct tape. Positions portable air evacuation and filtration system inside work area. Sprays chemical solution over asbestos covered surfaces, using tank with attached hose and nozzle, to soften asbestos. Cuts and scrapes asbestos from surfaces, using knife and scraper. Shovels asbestos into plastic disposal bags and seals bags, using duct tape. Cleans work area of loose asbestos, using vacuum, broom, and dustpan. Places asbestos in disposal bags and seals bags, using duct tape. Dismantles scaffolding and temporary walkway, using hand tools, and places plastic sheeting and disposal bags into transport bags. Seals bags, using duct tape, and loads bags into truck.

Boilermaker * - Ratio 5 Journeymen /1 Apprentice
Assembles, analyzes defects in, and repairs boilers, pressure vessels, tanks, and vats in field, following blueprints and using hand tools and portable power tools and equipment: Locates and marks reference points for columns or plates on foundation, using master straightedge, squares, transit, and measuring tape, and applying knowledge of geometry. Attaches rigging or signals crane operator to lift parts to specified position. Aligns structures or plate sections to assemble boiler frame, tanks, or vats, using plumb bobs, levels, wedges, dogs, or turnbuckles. Hammers, flame cuts, files, or grinds irregular edges of sections or structural parts to facilitate fitting edges together. Bolts or arc-welds structures and sections together. Positions drums and headers into supports and bolts or welds supports to frame. Aligns water tubes and connects and expands ends to drums and headers, using tube expander. Bells, beads with power hammer, or welds tube ends to ensure leak proof joints. Bolts or welds casing sections, uptakes, stacks, baffles, and such fabricated parts as chutes, air heaters, fan stands, feeding tube, catwalks, ladders, coal hoppers, and safety hatch to frame, using wrench. Installs manholes, hand holes, valves, gauges, and feed water connection in drums to complete assembly of water tube boilers. Assists in testing assembled vessels by pumping water or gas under specified pressure into vessel and observing instruments for evidence of leakage. Repairs boilers or tanks in field by unbolting or flame cutting defective sections or tubes, straightening plates, using torch or jacks, installing new tubes, fitting

and welding new sections and replacing worn lugs on bolts. May rivet and caulk sections of vessels, using pneumatic riveting and caulking hammers.

Bricklayer * (See Mason Tender) - Ratio 1Journeyman /3 Mason Tender Brick
Lays building materials, such as brick, structural tile, and concrete cinder, glass, gypsum, and terra cotta block (except stone) to construct or repair walls, partitions, arches, sewers, and other structures: Measures distance from reference points and marks guidelines on working surface to lay out work. Spreads soft bed (layer) of mortar that serves as base and binder for block, using trowel. Applies mortar to end of block and positions block in mortar bed. Taps block with trowel to level, align, and embed in mortar, allowing specified thickness of joint. Removes excess mortar from face of block, using trowel. Finishes mortar between brick with pointing tool or trowel. Breaks bricks to fit spaces too small for whole brick, using edge of trowel or brick hammer. Determines vertical and horizontal alignment of courses, using plumb bob, gauge line (tightly stretched cord), and level. Fastens brick or terra cotta veneer to face of structures, with tie wires embedded in mortar between bricks, or in anchor holes in veneer brick. May weld metal parts to steel structural members. May apply plaster to walls and ceiling, using trowel, to complete repair work.

Carpenter * (Including Acoustical Ceiling Work) - Ratio 2 Journeymen /1 Apprentice
Constructs, erects, installs, and repairs structures and fixtures of wood, plywood, and wallboard, using carpenter's hand tools and power tools, and conforming to local building codes: Studies blueprints, sketches, or building plans for information pertaining to type of material required, such as lumber or fiberboard, and dimensions of structure or fixture to be fabricated. Selects specified type of lumber or other materials. Prepares layout, using rule, framing square, and calipers. Marks cutting and assembly lines on materials, using pencil, chalk, and marking gauge. Shapes materials to prescribed measurements, using saws, chisels, and planes. Assembles cut and shaped materials and fastens them together with nails, dowel pins, or glue. Verifies trueness of structure with plumb bob and carpenter's level. Erects framework for structures and lays subflooring. Builds stairs and lays out and installs partitions and cabinetwork. Covers sub floor with building paper to keep out moisture and lays hardwood, parquet, and wood-strip-block floors by nailing floors to sub floor or cementing them to mastic or asphalt base. Applies shock-absorbing, sound-deadening, and decorative paneling to ceilings and walls. Fits and installs prefabricated window frames, doors, doorframes, weather stripping, interior and exterior trim, and finish hardware, such as locks, letter drops, and kick plates. Constructs forms and chutes for pouring concrete. Erects scaffolding and ladders for assembling structures above ground level. May weld metal parts to steel structural members.

Cement Mason/Concrete Finisher *(Mason Tender Cement/Concrete) - Ratio 1 Journeyman /3 Mason Tender Cement
Finisher; concrete floater Smooths and finishes surfaces of poured concrete floors, walls, sidewalks, or curbs to specified textures, using hand tools or power tools, including floats, trowels, and screeds: Signals concrete deliverer to position truck to facilitate pouring concrete. Moves discharge chute of truck to direct concrete into forms. Spreads concrete into inaccessible sections of forms, using rake or shovel. Levels concrete to specified depth and workable consistency, using hand held screed and floats to bring water to surface and produce soft topping. Smooths, and shapes surfaces of freshly poured concrete, using straightedge and float or power screed. Finishes concrete surfaces, using power trowel, or wets and rubs concrete with abrasive stone to impart finish. Removes rough or defective spots from concrete surfaces, using power grinder or chisel and hammer, and patches holes with fresh concrete or epoxy compound. Molds expansion joints and edges, using edging tools, jointers, and straightedge. May sprinkle colored stone chips, powdered steel, or coloring powder on concrete to produce prescribed finish. May produce rough concrete surface, using broom. May mix cement, using hoe or concrete-mixing machine. May direct sub

grade work, mixing of concrete, and setting of forms.

Drywall Finisher/Taper - Ratio 1Journeyman /3 Helpers
Wallboard and plasterboard; sheetrock taper; taper and bedder; taper and floater. Seals joints between plasterboard or other wallboards to prepare wall surface for painting or papering; Mixes sealing compound by hand or with portable electric mixer, and spreads compound over joints between boards, using trowel, broad knife, or spatula. Presses paper tape over joint to embed tape into compound and seal joint, or tapes joint, using mechanical applicator that spreads compound and embeds tape in one operation. Spreads and smooth's cementing material over tape, using trowel or floating machine to blend joint with wall surface. Sands rough spots after cement has dried. Fills cracks and holes in walls and ceiling with sealing compound. Installs metal molding at corners in lieu of sealant and tape. Usually works as member of crew. May apply texturing compound and primer to walls and ceiling preparatory to final finishing, using brushes, roller, or spray gun. May countersink nails or screws below surface of wall prior to applying sealing compound, using hammer or screwdriver.

Drywall Hanger - Ratio 1 Journeyman /3 Helpers
Dry-wall installer; gypsum dry-wall systems installer. Plans gypsum drywall installations, erects metal framing and furring channels for fastening drywall, and installs drywall to cover walls, ceilings, soffits, shafts, and movable partitions in residential, commercial, and industrial buildings: Reads blueprints and other specifications to determine method of installation, work procedures, and material, tool, and work aid requirements. Lays out reference lines and points for use in computing location and position of metal framing and furring channels and marks position for erecting metalwork, using chalk line. Measures, marks, and cuts metal runners, studs, and furring channels to specified size, using tape measure, straightedge and hand and portable power cutting tools. Secures metal framing to walls and furring channels to ceilings, using hand and portable power tools.
Measures and marks cutting lines on drywall, using square, tape measure, and marking devices. Scribes cutting lines on drywall, using straightedge and utility knife and breaks board along cut lines. Fits and fastens board into specified position on wall, using screws, hand tools, portable power tools, or adhesive. Cuts openings into board for electrical outlets, vents, or fixtures, using keyhole saw or other cutting tools. Measures, cuts, assembles, and installs metal framing and decorative trim for windows, doorways, and vents. Fits, aligns, and hangs doors and installs hardware, such as locks and kick plates (Includes Installing Metal Studs).

Electrician * Ratio 3 Journeymen /2 Apprentice
Plans layout, installs, and repairs wiring, electrical fixtures, apparatus, and control equipment: Plans new or modified installations to minimize waste of materials, provide access for future maintenance, and avoid unsightly, hazardous, and unreliable wiring, consistent with specifications and local electrical codes. Prepares sketches showing location of wiring and equipment, or follows diagrams or blueprints, ensuring that concealed wiring is installed before completion of future walls, ceilings, and flooring. Measures, cuts, bends, threads, assembles, and installs electrical conduit, using tools, such as hacksaw, pipe threader, and conduit bender. Pulls wiring through conduit. Splices wires by stripping insulation from terminal leads, using knife or pliers, twisting or soldering wires together, and applying tape or terminal caps. Connects wiring to lighting fixtures and power equipment, using hand tools. Installs control and distribution apparatus, such as switches, relays, and circuit-breaker panels, fastening in place with screws or bolts, using hand tools and power tools. Connects power cables to equipment, such as electric range or motor, and installs grounding leads. Tests continuity of circuit to ensure electrical compatibility and safety of components, using testing instruments, such as ohmmeter, battery and buzzer, and oscilloscope. Observes functioning of installed equipment or system to detect hazards and need for adjustments, relocation,

or replacement (Including Pulling Wire and Low Voltage Wiring and Installation of Fire Alarms, Security Systems, Telephones, and Computers).

Elevator Mechanic * - Ratio 1 Journeyman /1 Apprentice
FOOTNOTES: a. - Employer contributes 8% of basic hourly rate for over 5 years' service and 6% of basic hourly rate for 6 months to 5 years' service as Vacation Pay Credit. Paid Holidays: New Year's Day; Memorial Day; Independence Day Labor Day; Thanksgiving Day; Friday after Thanksgiving Day; Christmas Day.

Erector; elevator installer; elevator mechanic. Assembles and installs electric and hydraulic freight and passenger elevators, escalators, and dumbwaiters, determining layout and electrical connections from blueprints: Studies blueprints and lays out location of framework, counterbalance rails, motor pump, cylinder, and plunger foundations. Drills holes in concrete or structural steel members with portable electric drill. Secures anchor bolts or welds brackets to support rails and framework, and verifies alignment with plumb bob and level. Cuts prefabricated sections of framework, rails, and other elevator components to specified dimensions, using acetylene torch, power saw, and disk grinder. Installs cables, counterweights, pumps, motor foundations, escalator drives, guide rails, elevator cars, and control panels, using hand tools. Connects electrical wiring to control panels and electric motors. Installs safety and control devices. Positions electric motor and equipment on top of elevator shaft, using hoists and cable slings.

Formbuilder/Formsetter - Ratio 1Journeyman /3 Helpers
Constructs built-in-place or prefabricated wooden forms, according to specifications, for molding concrete structures: Studies blueprints and diagrams to determine type and dimension of forms to be constructed. Saws lumber to blueprint dimensions, using handsaw or power saw, and nails lumber together to make form panels. Erects built-in-place forms or assembles and installs prefabricated forms on construction site according to blueprint specifications, using hand tools, plumb rule, and level. Inserts spreaders and tie rods between opposite faces of form to maintain specified dimensions. Anchors and braces forms to fixed objects, using nails, bolts, anchor rods, steel cables, planks, and timbers.

Glazier - Ratio 1 Journeyman /3 Helpers
Installs glass in windows, skylights, store fronts, and display cases, or on surfaces, such as building fronts, interior walls, ceilings, and tabletops: Marks outline or pattern on glass, and cuts glass, using glasscutter. Breaks off excess glass by hand or with notched tool. Fastens glass panes into wood sash with glaziers points, and spreads and smoothes putty around edge of panes with knife to seal joints. Installs mirrors or structural glass on building fronts, walls, ceilings, or tables, using mastic, screws, or decorative molding. Bolts metal hinges, handles, locks, and other hardware to prefabricated glass doors. Sets glass doors into frame and fits hinges. May install metal window and doorframes into which glass panels are to be fitted. May press plastic adhesive film to glass or spray glass with tinting solution to prevent light glare. May install stained glass windows.

Insulator (Batt and Foam) - Ratio 1 Journeyman /3 Helpers
Applies batt and form insulation to walls, ceilings and other surfaces according to manufacturers specifications and blue print instructions. May use sealants such as cement plaster or asphalt compound to seal insulation; may spread concrete over floor slabs to form wearing floor: brushes adhesives, cuts insulating materials to specified shape to cover surfaces; uses tape or other sealants to adhere insulation to surfaces. May use staple gun, towel, paintbrushes and caulking guns.

Ironworker (Reinforcing) - Ratio 1 Journeyman/3 Helpers
Positions and secures steel bars in concrete forms to reinforce concrete; places rods in forms, spacing and fastening together with wire and pliers. Cuts bars using hacksaw, bar cutters or acetylene torch. Bends steel rods with hand tools or rod bending machine; reinforces concrete with wire mesh; welds reinforcing bars together.

Ironworker (Structural) - Ratio 1 Journeyman /3 Helpers
Erector; ironworker; steel erector; structural-iron erector; structural-iron worker; structural steel erector. Performs any combination of following duties to raise, place, and unite girders, columns, and other structural-steel members to form completed structures or structure frameworks, working as member of crew: Sets up hoisting equipment for raising and placing structural-steel members. Fastens steel members to cable of hoist, using chain, cable, or rope. Signals worker operating hoisting equipment to lift and place steel member. Guides member, using tab line (rope) or rides on member in order to guide it into position. Pulls, pushes, or pries steel members into approximate position while member is supported by hoisting device. Forces members into final position, using turnbuckles, crowbars, jacks, and hand tools. Aligns rivet holes in member with corresponding holes in previously placed member by driving drift pins or handle of wrench through holes. Verifies vertical and horizontal alignment of members, using plumb bob and level.

Lather - Ratio 1 Journeyman /3 Helpers
Fastens wooden, metal, or rockboard lath to walls, ceilings, and partitions of buildings to provide supporting base for plaster, fireproofing, or acoustical material, using hand tools and portable power tools: Erects horizontal metal framework to which laths are fastened, using nails, bolts, and studgun. Drills holes in floor and ceiling, using portable electric tool, and drives ends of wooden or metal studs into holes to provide anchor for furring or rockboard lath. Wires horizontal strips to furring to stiffen framework. Cuts lath to fit openings and projections, using hand tools or portable power tools. Wires, nails, clips, or staples lath to framework, ceiling joists, and flat concrete surfaces. Bends metal lath to fit corners, or attaches preformed corner reinforcements. Wires plasterer's channels to overhead structural framework to provide support for plaster or acoustical ceiling tile.

Painter (Brush, Roller, and Spray) - Ratio 1Journeyman /3 Helpers
Applies coats of paint, varnish, stain, enamel, or lacquer to decorate and protect interior or exterior surfaces, trimmings, and fixtures of buildings and other structures: Reads work order or receives instructions from supervisor or homeowner regarding painting. Smoothes surfaces, using sandpaper, brushes, or steel wool, and removes old paint from surfaces, using paint remover, scraper, wire brush, or blowtorch to prepare surfaces for painting. Fills nail holes, cracks, and joints with caulk, putty, plaster, or other filler, using caulking gun and putty knife. Selects premixed paints, or mixes required portions of pigment, oil, and thinning and drying substances to prepare paint that matches specified colors. Removes fixtures, such as pictures and electric switchcovers, from walls prior to painting, using screwdriver. Spreads dropcloths over floors and room furnishings, and covers surfaces, such as baseboards, doorframes, and windows with masking tape and paper to protect surfaces during painting. Paints surfaces, using brushes, spray gun, or paint rollers. Simulates wood grain, marble, brick, or tile effects. Applies paint with cloth, brush, sponge, or fingers to create special effects. Erects scaffolding or sets up ladders to perform tasks above ground level.

Pipe fitter * (HVAC Pipe Only) - Ratio 1Journeymen /1 Apprentice (See Schedule included)
Lays out, assembles, installs, and maintains pipe systems, pipe supports, and related hydraulic and pneumatic equipment for steam, hot water, heating, cooling, lubricating, sprinkling, and industrial production and processing systems, applying knowledge of system operation, and following

blueprints: Selects type and size of pipe, and related materials and equipment, such as supports, hangers, and hydraulic cylinders, according to specifications. Inspects work site to determine presence of obstructions and to ascertain that holes cut for pipe will not cause structural weakness. Plans installation or repair to avoid obstructions and to avoid interfering with activities of other workers. Cuts pipe, using saws, pipe cutter, hammer and chisel, cutting torch, and pipe cutting machine. Threads pipe, using pipe threading machine. Bends pipe, using pipe bending tools and pipe bending machine. Assembles and installs variety of metal and nonmetal pipes, tubes, and fittings, including iron, steel, copper, and plastic. Connects pipes, using threaded, caulked, soldered, brazed, fused, or cemented joints, and hand tools. Secures pipes to structure with brackets, clamps, and hangers, using hand tools and power tools. Installs and maintains hydraulic and pneumatic components of machines and equipment, such as pumps and cylinders, using hand tools. Installs and maintains refrigeration and air conditioning systems, including compressors, pumps, meters, pneumatic and hydraulic controls, and piping, using hand tools and power tools, and following specifications and blueprints. Increases pressure in pipe system and observes connected pressure gauge to test system for leaks.

Pipe Fitter * (Excluding HVAC Pipe) – Ratio 1Journeymen /3 Helpers
Lays out, assembles, installs, and maintains pipe systems, pipe supports, and related hydraulic and pneumatic equipment for steam, hot water, heating, cooling, lubricating, sprinkling, and industrial production and processing systems, applying knowledge of system operation, and following blueprints: Selects type and size of pipe, and related materials and equipment, such as supports, hangers, and hydraulic cylinders, according to specifications. Inspects work site to determine presence of obstructions and to ascertain that holes cut for pipe will not cause structural weakness. Plans installation or repair to avoid obstructions and to avoid interfering with activities of other workers. Cuts pipe, using saws, pipe cutter, hammer and chisel, cutting torch, and pipe cutting machine. Threads pipe, using pipe-threading machine. Bends pipe, using pipe bending tools and pipe bending machine. Assembles and installs variety of metal and nonmetal pipes, tubes, and fittings, including iron, steel, copper, and plastic. Connects pipes, using threaded, caulked, soldered, brazed, fused, or cemented joints, and hand tools. Secures pipes to structure with brackets, clamps, and hangers, using hand tools and power tools. Installs and maintains hydraulic and pneumatic components of machines and equipment, such as pumps and cylinders, using hand tools. Installs and maintains refrigeration and air conditioning systems, including compressors, pumps, meters, pneumatic and hydraulic controls, and piping, using hand tools and power tools, and following specifications and blueprints. Increases pressure in pipe system and observes connected pressure gauge to test system for leaks. May weld pipe supports to structural steel members. May observe production machines in assigned area of manufacturing facility to detect machinery malfunctions. May operate machinery to verify repair. May modify programs of automated machinery, such as robots and conveyors, to change motion and speed of machine, using teach pendant, control panel, or keyboard and display screen of robot controller and programmable controller. May be designated Steam Fitter (construction) when installing piping systems that must withstand high pressure

Plasterer * See Plaster Tender - Ratio 1 Journeyman /3 Plaster Tenders
Applies coats of plaster to interior walls, ceilings, and partitions of buildings, to produce finished surface, according to blueprints, architect's drawings, or oral instructions, using hand tools and portable power tools: Directs workers to mix plaster to desired consistency and to erect scaffolds. Spreads plaster over lath or masonry base, using trowel, and smoothes plaster with darby and float to attain uniform thickness. Applies scratch, brown, or finish coats of plaster to wood, metal, or board lath successively. Roughens undercoat with scratcher (wire or metal scraper) to provide bond for succeeding coats of plaster.

Plumber * (Excluding HVAC Pipe) - Ratio 3 Journeymen /2 Apprentice
Assembles, installs, and repairs pipes, fittings, and fixtures of heating, water, and drainage systems, according to specifications and plumbing codes: Studies building plans and working drawings to determine work aids required and sequence of installations. Inspects structure to ascertain obstructions to be avoided to prevent weakening of structure resulting from installation of pipe. Locates and marks position of pipe and pipe connections and passage holes for pipes in walls and floors, using ruler, spirit level, and plumb bob. Cuts openings in walls and floors to accommodate pipe and pipe fittings, using hand tools and power tools. Cuts and threads pipe, using pipe cutters, cutting torch, and pipe-threading machine. Bends pipe to required angle by use of pipe-bending machine or by placing pipe over block and bending it by hand. Assembles and installs valves, pipe fittings, and pipes composed of metals, such as iron, steel, brass, and lead, and nonmetals, such as glass, vitrified clay, and plastic, using hand tools and power tools. Joins pipes by use of screws, bolts, fittings, solder, plastic solvent, and caulks joints. Fills pipe system with water or air and reads pressure gauges to determine whether system is leaking. Installs and repairs plumbing fixtures, such as sinks, commodes, bathtubs, water heaters, hot water tanks, garbage disposal units, dishwashers, and water softeners. Repairs and maintains plumbing by replacing washers in leaky faucets, mending burst pipes, and opening clogged drains.

Roofer - Ratio 1 Journeyman/3 Helpers
Covers roofs with roofing materials other than sheet metal, such as composition shingles or sheets, wood shingles, or asphalt and gravel, to waterproof roofs: Cuts roofing paper to size, using knife, and nails or staples it to roof in overlapping strips to form base for roofing materials. Installs gutters and downs spouts. Aligns roofing material with edge of roof, and overlaps successive layers, gauging distance of overlap with chalk line, gauge on shingling hatchet, or by lines on shingles. Fastens composition shingles or sheets to roof with asphalt, cement, or nails. Punches holes in slate, tile, terra cotta, or wooden shingles, using punch and hammer. Cuts strips of flashing and fits them into angles formed by walls, vents, and intersecting roof surfaces. When applying asphalt or tar and gravel to roof, mops or pours hot asphalt or tar onto roof base. Applies alternate layers of hot asphalt or tar and roofing paper until roof covering is as specified. Applies gravel or pebbles over top layer, using rake or stiff bristled broom.

Sheet metal worker * Ratio 2 Journeymen /1 Apprentice (Including Setting HVAC Duct & System Installs)
Fabricates, assembles, installs and repairs sheet metal products, including sheet metal roof (also see Roofer). Operates soldering and welding equipment to join together sheet metal parts. Seals seams and joints with sealant. Installs roof sheets, trims, flashing, gutters down spouts and other related items. Performs other related duties.

Sprinkler Fitter (Fire) * - Ratio 1 Journeyman /1 Apprentice
Lays out, assembles, installs, and maintains pipe systems, pipe supports, and related hydraulic and pneumatic equipment for steam, hot water, heating, cooling, lubricating, sprinkling, and industrial production and processing systems, applying knowledge of system operation, and following blueprints: Selects type and size of pipe, and related materials and equipment, such as supports, hangers, and hydraulic cylinders, according to specifications. Inspects work site to determine presence of obstructions and to ascertain that holes cut for pipe will not cause structural weakness. Plans installation or repair to avoid obstructions and to avoid interfering with activities of other workers. Cuts pipe, using saws, pipe cutter, hammer and chisel, cutting torch, and pipe cutting machine. Threads pipe, using pipe-threading machine. Bends pipe, using pipe bending tools and pipe bending machine. Assembles and installs variety of metal and nonmetal pipes, tubes, and fittings, including iron, steel, copper, and plastic. Connects pipes, using threaded, caulked, soldered, brazed, fused, or cemented joints, and hand tools. Secures pipes to structure with

brackets, clamps, and hangers, using hand tools and power tools. Installs and maintains hydraulic and pneumatic components of machines and equipment, such as pumps and cylinders, using hand tools. Installs and maintains refrigeration and air conditioning systems, including compressors, pumps, meters, pneumatic and hydraulic controls, and piping, using hand tools and power tools, and following specifications and blueprints. Increases pressure in pipe system and observes connected pressure gauge to test system for leaks. May weld pipe supports to structural steel members. May observe production machines in assigned area of manufacturing facility to detect machinery malfunctions.
May operate machinery to verify repair. May modify programs of automated machinery, such as robots and conveyors, to change motion and speed of machine, using teach pendant, control panel, or keyboard and display screen of robot controller and programmable controller.

Tile Finisher - Ratio 1 Journeyman /3 Helpers
Supplies and mixes construction materials for TILE SETTER (construction) 861.381-054, applies grout, and cleans installed tile: Moves tiles, tile setting tools, and work devices from storage area to installation site manually or using wheelbarrow. Mixes mortar and grout according to standard formulas and request from TILE SETTER (construction), using bucket, water hose, spatula, and portable mixer. Supplies TILE SETTER (construction) with mortar, using wheelbarrow and shovel. Applies grout between joints of installed tile, using grouting trowel. Removes excess grout from tile joints with wet sponge and scrapes corners and crevices with trowel. Wipes surface of tile after grout has set to remove grout residue and polish tile, using nonabrasive materials. Cleans installation site, mixing and storage areas, and installation machines, tools, and equipment, using water and various cleaning tools. Stores tile setting materials, machines, tools, and equipment. May apply caulk, sealers, acid, steam, or related agents to caulk, seal, or clean installed tile, using various application devices and equipment. May modify mixing, grouting, grinding, and cleaning procedures according to type of installation or material used. May assist TILE SETTER (construction) to position and secure metal lath, wire mesh, or felt paper prior to installation of tile. May cut marked tiles to size, using power saw or tile cutter.

Tile Setter - Ratio 1 Journeyman /3 Helpers
Applies tile to walls, floors, ceilings, and promenade roof decks, following design specifications: Examines blueprints, measures and marks surfaces to be covered, and lays out work. Measures and cuts metal lath to size for walls and ceilings with tin snips. Tacks lath to wall and ceiling surfaces with staple gun or hammer. Spreads plaster base over lath with trowel and levels plaster to specified thickness, using screed. Spreads concrete on sub floor, with trowel and levels it with screed.
Spreads mastic or other adhesive base on roof deck, using serrated spreader to form base for promenade tile. Cuts and shapes tile with tile cutters and biters. Positions tile and taps it with trowel handle to affix tile to plaster or adhesive base.

Truck Driver
Drives truck with capacity of more than 3 tons, to transport materials to and from specified destinations: Drives truck to destination, applying knowledge of commercial driving regulations and area roads. Prepares receipts for load picked up. Collects payment for goods delivered and for delivery charges. May maintain truck log, according to state and federal regulations. May maintain telephone or radio contact with supervisor to receive delivery instructions. May load and unload truck. May inspect truck equipment and supplies, such as tires, lights, brakes, gas, oil, and water. May perform emergency roadside repairs, such as changing tires, installing light bulbs, tire chains, and spark plugs. May position blocks and tie rope around items to secure cargo during transit.

Laborers

Common Laborer
Performs any combination of the following tasks in erecting, repairing and wrecking buildings; dig, spread and level dirt and gravel; lift carry and hold building materials, tools and supplies; clean tools, equipment, materials and work areas; mix, pour and spread concrete, asphalt, gravel and other materials; join, wrap and seal sections of pipe; routine non-machine tasks such as removing forms from set concrete, filling expansion joints with asphalt, and placing culverts in trench. May also signal construction equipment operators; measure distances from grade stakes, drive stakes and stretch lines; bolt, nail align and block up under forms; mix and finish poured concrete, erect scaffolding; spread paint or coating to seal surfaces; caulking compounds to seal surfaces; remove projections from concrete, and mount pipe hangers.

Mason Tender Brick (Bricklayer's Helper)

Mason Tender Cement (Concrete Mason's / Concrete Finisher's Helper)

Pipe layer
Lay pipe for storm or sanitation sewers, drains, and water mains. Perform any combination of the following tasks: grade trenches or culverts, position pipe, or seal joints.

Plaster Tender (Plaster's Helper)
Tends machine that pumps plaster or stucco through spray gun for application to ceilings, walls, and partitions of buildings: Starts and stops machine on signals from PLASTERER (construction). Fills hopper of machine with plaster. Turns valves to regulate pump and compressor. Assists in erecting scaffolds.

Power Equipment Operator:

Asphalt Paver (operator)
Operator; bituminous-paving-machine operator; blacktop-paver operator; blacktop spreader; mechanical-spreader operator; paving-machine operator, asphalt or bituminous. Operates machine that spreads and levels hot-mix bituminous paving material on sub grade of highways and streets: Bolts extensions to screed to adjust width, using wrenches. Lights burners to heat screed. Starts engine and controls paving machine to push dump truck and maintain constant flow of asphalt into hopper. Observes distribution of paving material along screed and controls direction of screed to eliminate voids at curbs and joints. Turns valves to regulate temperature of asphalt flowing from hopper when asphalt begins to harden on screed.

Backhoe (operator)
Operates power-driven machine, equipped with movable shovel, to excavate or move coal, dirt, rock, sand, and other materials: Receives written or oral instructions from supervisor regarding material to move or excavate. Pushes levers and depresses pedals to move machine, to lower and push shovel into stockpiled material, to lower and dig shovel into surface of ground, and to lift, swing, and dump contents of shovel into truck, car, or onto conveyor, hopper, or stockpile. Observes markings on ground, hand signals, or grade stakes to remove material, when operating machine at excavation site.

Crane (operator)
Operates electric-, diesel-, gasoline-, or steam-powered guy-derrick or stiff-leg derrick (mast

supported by fixed legs or tripod), to move products, equipment, or materials to and from quarries, storage areas, and processes, or to load and unload trucks or railroad cars: Pushes and pulls levers and depresses pedals to raise, lower, and rotate boom and to raise and lower load line in response to signals.

Forklift (operator)
Drives gasoline-, liquefied gas-, or electric-powered industrial truck equipped with lifting devices, such as forklift, boom, scoop, lift beam and swivel-hook, fork-grapple, clamps, elevating platform, or trailer hitch, to push, pull, lift, stack, tier, or move products, equipment, or materials in warehouse, storage yard, or factory: Moves levers and presses pedals to drive truck and control movement of lifting apparatus. Positions forks, lifting platform, or other lifting device under, over, or around loaded pallets, skids, boxes, products, or materials or hooks tow trucks to trailer hitch, and transports load to designated area. Unloads and stacks material by raising and lowering lifting device.

Slab & Wall Saw (See Related Power Equipment Operator Above)
Use associated power equipment operators already defined.

Apprentices
Apprentices may be used in any of the crafts listed above where noted, if they are currently certified in a program recognized by the Bureau of Apprenticeship and Training, U.S. Department of Labor, providing the proper ratio between journeyman and apprentice is observed. Apprentice certification certificates must be supplied with the first weekly payroll upon which the apprentice's name appears.

Helper (65% of the journeyman classification)
(Must not exceed 3 helpers to 1 journeyman)
A Helper is a semi-skilled worker (rather than a skilled journeyman) who works under the direction of and assists a journeyman. Under the journeyman's direction and supervision, the helper performs a variety of duties to assist the journeyman such as preparing, carrying, and furnishing equipment, supplies and maintaining them in order; cleaning and preparing work areas; lifting, positioning, and holding materials or tools; and other related semi-skilled tasks as directed by the journeyman. A helper may use the tools of the trade at and under the direction of the journeyman. The particular duties performed by a helper vary according to area practice. The journeyman must work in close proximity to the location of the helpers work area. The helpers wage rate shall be calculated at no less than 65% of the prevailing wage for that journeyman's classification.

Helper who assists more than one journeyman craft should be listed with the notation indicating each journeyman craft classification they assist.

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

Pipe fitters * Apprentice Schedule (Excluding HVAC Pipe)

Journeyma	Indentured Apprentice	Apprentice Applicant	Total
1	1	0	1 to 1
3	2	1	3 to 3
5	3	2	5 to 5
8	4	3	8 to 7
12	5	4	12 to 9
16	6	5	16 to 11
20	7	6	20 to 13
25	8	7	25 to 15
30	9	8	30 to 17
40	10	9	40 to 19
50	11	10	50 to 21

NOTE: Continue after 50 Journeyman — ONE (1) Indentured Apprentice and one (1) Apprentice Applicant for every ten (10) Journeyman

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*** When Apprentices are shown, Helpers cannot be utilized**

APPRENTICES (see definitions)

Registered Apprenticeship Ratios

For All Apprentices

Apprentice duties consist but are not limited to reading blue prints, lay out, fabrication, installation, and assembly. Other duties are the setting up and operation of fabrication machines, using hand tools, power tools, lifting/handling devices, sealing if necessary according to their particular craft. Apprentices also are trained in the preparation process of a job that include but not limited to staging, planning, distribution, and sectioning of materials. Apprentices may be used in any of the crafts listed where noted on the Prevailing Wage Rate Schedule, if they are currently certified in a program recognized by the Bureau of Apprenticeship and Training, U.S. Department of Labor, providing the proper ratio between journeyman and apprentice is observed. Apprentice certification certificates must be supplied with the first weekly payroll upon which the apprentice's name appears. Helpers or Laborers cannot be utilized when Apprentices are shown

Asbestos Worker / Insulator

City of Houston allows the use of 1 Journeyman and 1 Apprentice, the Apprentice can be used with the first Journeyman. No other Apprentices can be added until the 2th Journeyman is added. All Apprentices are to be under the direct supervision of a Journeyman.
1 Journeyman w/ 1 Apprentice
2 Journeymen w/ 2 Apprentices

Boilermakers

City of Houston allows the use of 5 Journeymen and 1 Apprentice, the Apprentice can be used with the first Journeyman. No other Apprentices can be added until the 6th Journeyman is added. All Apprentices are to be under the direct supervision of a Journeyman.
1-5 Journeymen w/ 1 Apprentice
6-10 Journeymen w/ 2 Apprentices

Carpenter

City of Houston allows the use of 2 Journeymen and 1 Apprentice, the Apprentice can be used with the first Journeyman. No other Apprentices can be added until the 4th Journeyman is added. All Apprentices are to be under the direct supervision of a Journeyman.
1-2 Journeymen w/ 1 Apprentice
3-4 Journeymen w/ 2 Apprentices
5-6 Journeymen w/ 3 Apprentices

Electrician

City of Houston allows the use of 3 Journeymen and 2 Apprentices, the Apprentice can be used with the first Journeyman. No other Apprentices can be added until the 3rd Journeyman is added. All Apprentices are to be under the direct supervision of a Journeyman. All Journeymen and Apprentices must hold a current license from the State of Texas.

1 Journeyman w/ 1 Apprentice
2 Journeymen w/ 1 Apprentice
3 Journeymen w/ 2 Apprentices
4 Journeymen w/ 3 Apprentices
5 Journeymen w/ 3 Apprentices
6 Journeymen w/ 4 Apprentices
7 Journeymen w/ 4 Apprentices
8 Journeymen w/ 4 Apprentices
9 Journeymen w/ 4 Apprentices
10 Journeymen w/ 5 Apprentices

Plumbers

City of Houston allows the use of 3 Journeymen and 2 Apprentices, the Apprentice can be used with the first Journeyman. No other Apprentices can be added until the 3rd Journeyman is added. All Apprentices are to be under the direct supervision of a Journeyman. All Journeymen and Apprentices must hold a current license from the State of Texas.

1 Journeyman w/ 1 Apprentice
2 Journeymen w/ 1 Apprentice
3 Journeymen w/ 2 Apprentices
4 Journeymen w/ 3 Apprentices
5 Journeymen w/ 3 Apprentices
6 Journeymen w/ 4 Apprentices
7 Journeymen w/ 4 Apprentices
8 Journeymen w/ 4 Apprentices
9 Journeymen w/ 4 Apprentices
10 Journeymen w/ 5 Apprentices

Sprinkler Fitter

City of Houston allows the use of 1 Journeyman and 1 Apprentice, the Apprentice can be used with the first Journeyman. No other Apprentices can be added until the 2th Journeyman is added. All Apprentices are to be under the direct supervision of a Journeyman.

1 Journeyman w/ 1 Apprentice
2 Journeymen w/ 2 Apprentices
Sheetmetal Worker

City of Houston allows the use of 2 Journeymen and 1 Apprentice, the Apprentice can be used with the first Journeyman. No other Apprentices can be added until the 4th Journeyman is added. All Apprentices are to be under the direct supervision of a Journeyman.

1-2 Journeymen w/ 1 Apprentice
3-4 Journeymen w/ 2 Apprentices
5-6 Journeymen w/ 3 Apprentices

Pipefitter

City of Houston allows the use of 1 Journeymen and 1 Apprentice, the Apprentice can be used with the first Journeyman. No other Apprentices can be added until the 4th Journeyman is added. All Apprentices are to be under the direct supervision of a Journeyman.

1 Journeyman w/ 1 Apprentice
2 Journeymen w/ 1 Apprentice
3 Journeymen w/ 2 Apprentices
4 Journeymen w/ 3 Apprentices
5 Journeymen w/ 3 Apprentices
6 Journeymen w/ 4 Apprentices
7 Journeymen w/ 4 Apprentices
8 Journeymen w/ 4 Apprentices
9 Journeymen w/ 4 Apprentices
10 Journeymen w/ 5 Apprentices

HELPER (see definitions)

(Must not exceed 3 helpers to 1 journeyman)
A Helper is a semi-skilled laborer (rather than a skilled journeyman) who works under the direction of and assists a journeyman. Under the journeyman's direction and supervision, the helper

performs a variety of duties to assist the journeyman such as preparing, carrying, and furnishing equipment, supplies and maintaining them in order; cleaning and preparing work areas; lifting, positioning, and holding materials or tools; and other related semi-skilled tasks as directed by the journeyman. A helper may use the tools of the trade at and under the direction of the journeyman. The particular duties performed by a helper vary according to area practice. The journeyman must work in close proximity to the location of the helpers work area. The helper's wage rate shall be calculated at no less than 65% of the prevailing wage for that journeyman's classification. Helper who assists more than one journeyman craft should be listed with the notation indicating each journeyman craft classification they assist.

Welders
Receive rate prescribed for craft performing operation is which welding is incidental

Pipefitters * Apprentice Schedule (Excluding HVAC Pipe)

NOTE: Continue after 50 Journeyman - ONE (1) Indentured Apprentice and one (1) Apprentice Applicant for every ten (10) Journeyman

	Indentured	Apprentice	
Journeyman	Apprentice	Applicant	Total
1	1	0	1 to 1
3	2	1	3to 3
5	3	2	5 to 5
8	4	3	8 to 7
12	5	4	12 to 9
16	6	5	16 to 11
20	7	6	20 to 13
25	8	7	25 to 15
30	9	8	30 to 17
40	10	9	40 to 19
50	11	10	50 to 21

When Apprentices are shown, Helpers cannot be utilized

If there are questions as to the classification of a worker, contact the Contract Compliance Officer in writing with a description of the work to be performed. After review the Contract Compliance Officer will respond in writing with the classification and wage rate to be paid the worker in question.

Fringe Benefits

If the worker is not receiving fringe benefits, they must be paid in cash if noted on the prevailing wage schedule along with the base rate. The term wages means the basic hourly rate of pay; any contribution irrevocably made by a contractor or subcontractor to a trustee or to a third person pursuant to a bona fide fringe benefit fund, plan, or program; and the rate of costs to the

contractor or subcontractor which may be reasonably anticipated in providing bona fide fringe benefits to laborers and mechanics pursuant to an enforceable commitment to carry out a financially responsible plan of program, which was communicated in writing to the laborers and mechanics affected. The fringe benefits enumerated in the Davis-Bacon Act include medical or hospital care, pensions on retirement or death, compensation for injuries or illness resulting from occupational activity, or insurance to provide any of the foregoing; unemployment benefits; life insurance, disability insurance, sickness insurance, or accident insurance; vacation or holiday pay; defraying costs of apprenticeship or other similar programs; or other bona fide fringe benefits. Fringe benefits do not include benefits required by other Federal, State, or local law. The prevailing wages (including fringe benefits) as adopted for this contract are based upon a survey performed under the Davis-Bacon Act. Thus determinations in regard to fringe benefits, to the extent practicable, will be based upon the standards set forth in the following federal regulations.

Title 29, Code of Federal Regulations, Part 4
Labor Standards for Federal Service Contracts

(29 CFR 4.169-4.171)

29 CFR 4.170 - Furnishing fringe benefits or equivalents.

(a) General. Fringe benefits required under the Act shall be furnished, separate from and in addition to the specified monetary wages, by the contractor or subcontractor to the employees engaged in performance of the contract, as specified in the determination of the Secretary or his authorized representative and prescribed in the contract documents. Section 2(a)(2) of the Act provides that the obligation to furnish the specified benefits "may be discharged by furnishing any equivalent combinations of fringe benefits or by making equivalent or differential payments in cash under rules and regulations established by the Secretary." The governing rules and regulations for furnishing such equivalents are set forth in Sec. 4.177 of this subpart. An employer cannot offset an amount of monetary wages paid in excess of the wages required under the determination in order to satisfy his fringe benefit obligations under the Act, and must keep appropriate records separately showing amounts paid for wages and amounts paid for fringe benefits.
(b) Meeting the requirement, in general. The various fringe benefits listed in the Act and in Sec. 4.162(a) are illustrative of those which may be found to be prevailing for service employees in a particular locality. The benefits which an employer will be required to furnish employees performing on a particular contract will be specified in the contract documents. A contractor may dispose of certain of the fringe benefit obligations which may be required by an applicable fringe benefit determination, such as pension, retirement, or health insurance, by irrevocably paying the specified contributions for fringe benefits to an independent trustee or other third person pursuant to an existing "bona fide" fund, plan, or program on behalf of employees engaged in work subject to the Act's provisions. Where such a plan or fund does not exist, a contractor must discharge his obligation relating to fringe benefits by furnishing either an equivalent combination of "bona fide" fringe benefits or by making equivalent payments in cash to the employee, in accordance with the regulations in Sec. 4.177.

29 CFR 4.171 – "Bona fide" fringe benefits.

(a) To be considered a ``bona fide" fringe benefit for purposes of the Act, a fringe benefit plan, fund, or program must constitute a legally enforceable obligation, which meets the following criteria:

(1) The provisions of a plan, fund, or program adopted by the contractor, or by contract as a result of collective bargaining, must be specified in writing, and must be communicated in writing to the affected employees. Contributions must be made pursuant to the terms of such plan, fund, or program. The plan may be either contractor-financed or a joint contractor employee contributory plan. For example, employer contributions to Individual Retirement Accounts (IRAs) approved by IRS are permissible. However, any contributions made by employees must be voluntary, and if such contributions are made through payroll deductions, such deductions must be made in accordance with Sec. 4.168. No contribution toward fringe benefits made by the employees themselves, or fringe benefits provided from monies deducted from the employee's wages may be included or used by an employer in satisfying any part of any fringe benefit obligation under the Act.

(2) The primary purpose of the plan must be to provide systematically for the payment of benefits to employees on account of death, disability, advanced age, retirement, illness, medical expenses, hospitalization, supplemental unemployment benefits, and the like.

(3) The plan must contain a definite formula for determining the amount to be contributed by the contractor and a definite formula for determining the benefits for each of the employees participating in the plan.

(4) Except as provided in paragraph (b), the contractor's contributions must be paid irrevocably to a trustee or third person pursuant to an insurance agreement, trust or other funded arrangement. The trustee must assume the usual fiduciary responsibilities imposed upon trustees by applicable law. The trust or fund must be set up in such a way that the contractor will not be able to recapture any of the contributions paid in nor in any way divert the funds to its own use or benefit.

(5) Benefit plans or trusts of the types listed in 26 U.S.C. 401(a) which are disapproved by the Internal Revenue Service as not satisfying the requirements of section 401(a) of the Internal Revenue Code or which do not meet the requirements of the Employee Retirement Income Security Act of 1974, 29 U.S.C. 1001, et seq. and regulations thereunder, are not deemed to be ``bona fide" plans for purposes of the Service Contract Act.

(6) It should also be noted that such plans must meet certain other criteria as set forth in Sec. 778.215 of 29 CFR part 778 in order for any contributions to be excluded from computation of the regular rate of pay for overtime purposes under the Fair Labor Standards Act (Secs. 4.180-4.182).

(b)(1) Unfunded self-insured fringe benefit plans (other than fringe benefits such as vacations and holidays which by their nature are normally unfunded) under which contractors allegedly make "out of pocket" payments to provide benefits as expenses may arise, rather than making irrevocable contributions to a trust or other funded arrangement as required under Sec. 4.171(a)(4), are not normally considered "bona fide" plans or equivalent benefits for purposes of the Act.

(2) A contractor may request approval by the Administrator of an unfunded self-insured plan in order to allow credit for payments under the plan to meet the fringe benefit requirements of the Act. In considering whether such a plan is bona fide, the Administrator will consider such factors as whether it could be reasonably anticipated to provide the prescribed benefits, whether it represents a legally enforceable commitment to provide such benefits, whether it is carried out under a financially responsible program, and whether the plan has been communicated to the employees in writing. The Administrator in his/her discretion may

direct that assets be set aside and preserved in an escrow account or that other protections be afforded to meet the plan's future obligation.

(c) No benefit required by any other Federal law or by any State or local law, such as unemployment compensation, workers' compensation, or social security, is a fringe benefit for purposes of the Act.

(d) The furnishing to an employee of board, lodging, or other facilities under the circumstances described in Sec. 4.167, the cost or value of which is creditable toward the monetary wages specified under the Act, may not be used to offset any fringe benefit obligations, as such items and facilities are not fringe benefits or equivalent benefits for purposes of the Act.

(e) The furnishing of facilities which are primarily for the benefit or convenience of the contractor or the cost of which is properly a business expense of the contractor is not the furnishing of a "bona fide" fringe benefit or equivalent benefit or the payment of wages. This would be true of such items, for example, as relocation expenses, travel and transportation expenses incident to employment, incentive or suggestion awards, and recruitment bonuses, as well as tools and other materials and services incidental to the employer's performance of the contract and the carrying on of his business, and the cost of furnishing, laundering, and maintaining uniforms and/or related apparel or equipment where employees are required by the contractor, by the contractor's Government contract, by law, or by the nature of the work to wear such items. See also Sec. 4.168.

(f) Contributions by contractors for such items as social functions or parties for employees, flowers, cards, or gifts on employee birthdays, anniversaries, etc. (sunshine funds), employee rest or recreation rooms, paid coffee breaks, magazine subscriptions, and professional association or club dues, may not be used to offset any wages or fringe benefits specified in the contract, as such items are not ``bona fide" wages or fringe benefits or equivalent benefits for purposes of the Act.

EXHIBIT "B"

CERTIFICATE FROM CONTRACTOR APPOINTING OFFICER OR EMPLOYEE TO SUPERVISE PAYMENT OF EMPLOYEES

Project Name _____

_____

Project WBS#:_____Date_____

(I) (We) hereby certify that (I am) (we are) the **Prime Contractor** for _____

_____
(specify type of job)

in connection with construction of the above-mentioned Project, and that (I) (we) have appointed_____, whose signature appears below, to supervise the payment of (my) (our) employees beginning_____, 20___; that he/she is in a position to have full knowledge of the facts set forth in the payroll documents and in the statement of compliance required by the Copeland Act and the City of Houston, which he/she is to execute with (my) (our) full authority and approval until such time as (I) (we) submit to the City of Houston a new certificate appointing some other person for the purposes hereinabove stated.

_____ Phone:_____
(Identifying Signature of Appointee)

Attest: _____
(Name of Firm or Corporation)

By:_____ By:_____
(Signature) (Signature)

_____ _____
(Title) (Title)

NOTE: This certificate must be executed by an authorized officer of a corporation or by a member of a partnership, and shall be executed prior to and be submitted with the first payroll. Should the appointee be changed, a new certificate must accompany the first payroll for which the new appointee executes a statement of compliance required by the Copeland Act and the City of Houston.

EXHIBIT "C"

CERTIFICATE FROM SUBCONTRACTOR APPOINTING OFFICER OR EMPLOYEE TO SUPERVISE PAYMENT OF EMPLOYEES

Project Name _____

_____

Project WBS#:_____Date_____

(I) (We) hereby certify that (I am) (we are) the **Sub Contractor** for _____

_____
(specify type of job)

in connection with construction of the above-mentioned Project, and that (I) (we) have appointed_____, whose signature appears below, to supervise the payment of (my) (our) employees beginning_____, 20___; that he/she is in a position to have full knowledge of the facts set forth in the payroll documents and in the statement of compliance required by the Copeland Act and the City of Houston, which he/she is to execute with (my) (our) full authority and approval until such time as (I) (we) submit to the City of Houston a new certificate appointing some other person for the purposes hereinabove stated.

_____ Phone:_____
(Identifying Signature of Appointee)

Attest: _____
(Name of Firm or Corporation)

By:_____ By:_____
(Signature) (Signature)

_____ _____
(Title) (Title)

NOTE: This certificate must be executed by an authorized officer of a corporation or by a member of a partnership, and shall be executed prior to and be submitted with the first payroll. Should the appointee be changed, a new certificate must accompany the first payroll for which the new appointee executes a statement of compliance required by the Copeland Act and the City of Houston.

END OF DOCUMENT

Document 00830

TRENCH SAFETY GEOTECHNICAL INFORMATION

1.0 DOCUMENT INCLUDES

A. Trench Safety Geotechnical Information: Geotechnical information obtained for use in design of the trench safety system is included as an attachment to this document.

2.0 RELATED DOCUMENTS

A. Section 02260 - Trench Safety Systems.

END OF DOCUMENT

City of Houston
Pay or Play Program Requirements

I. Pay or Play Program Overview

A. Purpose

The Pay or Play Program was established with Ordinance 2007-534 on July 1, 2007 and is governed by Executive Order 1-7. The Pay or Play Program (POP Program) creates a more level playing field and enhances fairness in the bid process between competing contractors that choose to offer health benefits to their workforce and those who do not. The program also recognizes and accounts for the fact that there are cost associated with health care of the uninsured citizens of the Houston and Harris County area.

B. Program Elements

1. **Covered contracts**:

I.) Advertised after July 1, 2007 or which is executed on or after the effective date of this Executive Order.
II.) Contracts valued at or above $100,000.00 (contract) and $200,000.00 (sub-contract) including contingencies, amendments, supplemental terms and/or change orders.
III.) Professional Service, Construction, and Service type contracts.

2. **Contracts not covered**:

I.) Any contract in which the primary purpose is procurement of property, goods, supplies, and or equipment.
II.) An inter-governmental contract, inter-governmental agreement or purchasing cooperative.

3. **Covered employees:** This program applies to employees of a covered contractor or subcontractor, including contract labor, who are over age 18, work at least 30 hours per week and work any amount of time under a covered city contract or subcontract.

4. **Pay or Play Option:**

I.) "Pays" by contributing $1.00 per covered employee per regular hour for work performed under the contract with the City; or
II.) "Plays" by providing health benefits to covered employees. Health benefits must meet or exceed the following standards:

- The **employer will contribute no less than $150 per covered employee per month** toward the total premium cost.
- The **employee contribution, if any amount, will be no greater than 50% of the monthly premium cost and no more than $150 per month.**

Note: (1)A contractor is deemed to have complied with section 5.4 of E.O. 1-7 with respect to a covered employee who is not provided health benefits if the employee refuses the benefits and the employee's contribution to the premium is no more than $40 per month. (2) If applicable the contractor has the option to both Pay and Play.

5. **Exemptions/Waivers**: The City of Houston will award a contract to a contractor that neither Pays nor Plays only if the contractor has received an approved waiver (Form POP-4 requested by City departments only).

6. **Administration**: Contractor performance in meeting Pay or Play program requirements will be managed by the contracting department. The Office of Business Opportunity (OBO) has administrative oversight of the program, including audit responsibilities (department compliance). Questions about the program should be referred to the Department POP Liaison an updated contact list is available on http://www.houstontx.gov/obo/popforms.html or call Gracie Orr with the Office of Business Opportunity at 832-393-0633.

II. Documentation and Reporting Requirements

A. Document that must be signed and returned to administering department with the bid/proposal.

1.) City of Houston Pay or Play Program Acknowledgment Form (Form POP-1) acknowledges bidder/proposers' knowledge of the program and its requirements, and the intention to comply.

B. Documents that must be signed and returned to administering department within a period designated by the department's Contract Administrator, upon notification of low bidder or successful proposer status:

1.) Certification of Compliance with Pay or Play Program (Form POP-2)

Note - Contractors that opt to "play" must provide proof of coverage, including document from insurance provider, and names of covered employees.

2.) List of Subcontractors (Form POP-3)

Note- Review the affidavit statement at the bottom of this form for further important POP Compliance information.

C. Contractors reporting requirements:

1.) Contractors that opt to Pay
Provide monthly reports to administering department, detailing names of employees, hours worked, exemptions (if any) and amount owed. (Form POP-5)

2.) Contractors that opt to Play
Provide periodic reports to the contract administrator showing proof of coverage (insurance premium invoice or insurance card) reporting schedule will be determined by administering department based on length of contract. (Form POP-7)

3.) Employee Waiver Request
Contractor may request POP program waiver by submitting the request on POP-8 if the employee is less than 18 years old, employee has other health coverage such as through spouse or parents, or Medicare/Medicaid.

Note proof of coverage must be provided in the form of a copy of the employee's insurance card. (Remove social security numbers if applicable)

4.) Contractors shall submit an initial report with the second invoice to the department. Payments based on monthly reports are due to the contracting department with submission of the following month's invoice. Payments may be made out to the City of Houston preferably via cashier check or business check.

III. Compliance and Enforcement

The Office of Business Opportunity will audit program compliance. Contractors willfully violating or misrepresenting POP program compliance will be subject to corrective and/or punitive action, including but not limited to the assessment of fines and penalties and/or debarment. The Pay or Play Program Requirements Form and all other POP Forms are available for downloading from the City of Houston's Website at http://www.houstontx.gov/obo/popforms.html

Document 00931

REQUEST FOR INFORMATION

1. PROJECT No.: R-000265-0079-4
2. RFI No.: _____
3. PROJECT NAME: Keegans Bayou and Greenridge WWTP Improvements
4. CONTRACTOR: [Contractor Name]
5. CONTRACT No.: _____
6. SPECIFICATION Nos.: _____
7. DRAWING Nos.: _____
8. RESPONSE CODE: [_] CRITICAL [_] ROUTINE 9.DATE RESPONSE REQUIRED: _____
10. INFORMATION REQUIRED:

11. _____ _____
CONTRACTOR (Signature) TITLE DATE

12. RESPONSE:

13. _____ _____
PROJECT MANAGER (Signature) DATE

14. If Contractor believes the response given in Item 12 requires an adjustment in Contract Price or Contract Time, Contractor shall submit a timely proposal so as not to delay Contractor's Work in accordance with General Conditions, Article 7 - Changes in the Work.

END OF DOCUMENT

Section 01110

SUMMARY OF WORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Summary of the Work including work by the City, City-furnished Products, work sequence, proposed work under this Contract, Contractor use of Premises, special conditions for substantial completion and City occupancy.

B. A pre-bid site visit for this project will be scheduled with a date to be determined.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

Work covered by this contract is for the construction of the Keegan's Bayou and Greenridge Wastewater Treatment Plants (WWTPs) Improvements as described in this section. The full and complete project scope of work is described by the contract documents consisting of technical specifications, drawings and other documents included as part of the bid package. The exclusion of any scope of work items from this summary does not relieve the Contractor from fulfilling his obligation under this Contract.

A. Base Bid Items Covered by this Contract:

Keegan's Bayou WWTP

1. Item No. 1: Mobilization at Keegan's Bayou WWTP by the Contractor to initiate project start-up.

2. Item No. 2: Demolition of existing grit removal equipment and structures as shown on the contract drawings and as specified including but not limited to the following:

a) Site Preparation – Storm Water Pollution Control setup by the Contractor.

b) Protection of existing structures including the verification of dimensions, extents, depths and locations of existing structures, buried piping and utilities using record documents as starting point of verification. Notify Engineer and City of any conflicts.

c) Partial demolition of existing structures including the repair of concrete surfaces damaged as a result of or as part of the demolition work including but not limited to the following:

(1) Repair of Bypass channel, headworks area and grit channel cracks including a full epoxy coating of all existing and proposed channel walls and floors in the aforementioned areas.

(2) Addition of flowable fill beneath existing Grit Chamber.

d) Removal of existing equipment including gates, pipes, pumps, classifiers, miscellaneous metals and associated items.

e) Retrofit existing 50 MGD capacity mechanical vortex grit chamber with new equipment including, but not limited to gear motor, gear head, propeller drive tube, axial flow propeller, flooded suction grit removal pump and auxiliary equipment as specified.

(1) Demolition by the Contractor as shown in the Contract Documents, including, but not limited to:

(a) The existing Grit Pump Station.

(b) The existing Grit Cyclone/Classifier Station.

(c) Portions of the existing Grit Removal Chamber.

(2) Installation of equipment as shown on the drawings.

f) Construct new 50 MGD grit chamber with new gear motor, gear head, propeller drive tube, axial flow propeller, flooded suction grit removal pump and auxiliary equipment as specified.

g) Installation of two 500-gpm top mounted vacuum, or self-priming grit pumps with provisions to inject non-potable water into the grit chamber without interrupting pumping.

h) Installation of two classifier grit handling systems to clean and dewater grit.

i) Performance testing of new grit removal system.

j) Retrofit of existing clarifier influent gates with electric motor operator and associated appurtenances.

k) Installation of bollards.

l) Startup and Training as by the Contractor as shown in the Contract Documents.

3. Item No. 3: Supply and installation of fully functional electrically operated actuators at the existing clarifier influent gates, including all electrical work.

4. Item No. 4: Removal and disposal of 300 tons of sludge and settled debris within existing process units and existing grit chamber.

5. Item No. 5: Installation of Trench Safety System.

6. Item No. 6: SCADA System Improvements. Rehabilitation and replacement including but not limited to:

a) Circuit tracing and identification of existing control signal wiring and terminations for replacement PLC control systems. Operational verification of existing field devices for replacement PLC control systems.

b) Replacement of, and modifications to, existing PLC based SCADA control systems at Clarifier Building, Blower Building No. 2, and the Sludge Dewatering Building.

c) Replacement of selected field devices.

d) Field installation and connections to controls for the new Grit Removal System.

e) Extension of existing facility fiber optic network loop from Liquids Building to the new grit removal system.

f) Upgrade to the existing network communications switch at Blower Building #2. Provision of new network communication connections to Blower control retrofits.

g) Provisions for new operator workstation monitors at liquids building and the solids building. Replacement of existing network communication switch at Liquids Building.

h) Automation of (4) new motor operated lift gate actuators at the existing clarifier influent flow splitter box.

i) Demolition of unused and abandoned PLC control systems and associated auxiliaries for the previously demolished centrifuge dewatering system.

j) Participation in control system testing, calibration, commissioning, and operator training.

7. Item No. 7: SCADA Control Systems Engineering Services, including coordination, supervision, and analysis to verify existing control signals to be reconnected to replacement PLC control systems or demolished. PLC configuration and software programming, integration of manufacturer control systems, reassignment of network IP address for all plant network devices, additions and modifications to SCADA graphical user interface. Coordination and supervision of control system testing, calibration, software debugging, calibration, commissioning, and operator training.

8. Item No. 8: Electrical, Power Panels, Conduit support Racks, wiring and conduits associated with Dewatering Building. Work includes replacement of electrical circuits/conduits to the existing pumps.

9. Item No. 9: Provide manufacturer's replacement control retrofits for six (6) existing digester blower systems, including new control panels, PLCs, touch screen interfaces, replacement field devices, wiring, engineering, software programming, testing, start-up, training, and demonstration services.

Greenridge WWTP

10. Item No. 10: Mobilization at Greenridge WWTP by the Contractor to initiate project start-up.

11. Item No. 11: Demolition and improvements including but not limited to the following:

    a) Site Preparation - Storm Water Pollution Control setup by the Contractor.

    b) Protection of existing structures including the verification of dimensions, extents, depths and locations of existing structures, buried piping and utilities using record documents as starting point of verification. Notify Engineer and City of any conflicts.

    c) Demolition by the Contractor, as shown in the Contract Documents, including, but not limited to:

        (1) The existing Sodium Bisulfate Storage Area.

        (2) Two existing building slabs and abandoned tank.

        (3) The existing Blower Building.

    d) Retrofit of existing clarifier influent gates with electric motor operator and associated appurtenances.

    e) Aeration Basin Improvements: Replacement improvements including but not limited to the automation of existing Mechanical Surface Aerators including motor replacement, addition of dissolved oxygen probes and sensors, variable frequency drives, and PLC control panel to operate and control the aerators speed.

    f) Blower Building Improvements. Construction of a new blower building, three blowers, bridge crane, electrical equipment, piping and all associated civil, mechanical, structural, electrical and instrumentation improvements.

    g) Digester Improvements: Removal of temporary influent piping to digester and replacement with new permanent piping; modifications to air piping to tie-in new blower piping.

    h) Chlorination/Dechlorination Improvements: Miscellaneous chlorination/dechlorination system improvements including, but not limited to:

        (1) New sodium bisulfite containment basin including but not limited to slab, walls, tanks, FRP building, pumps, magnetic level gauge, FRP grating, piping, controls and related appurtenances.

        (2) New mixer at chlorine mixing chamber including associated structural improvements.

        (3) Removal and replacement of mix-point and pre-dechlorination analyzers.

    i) Scum Removal System Improvements: Provide new static scum screen including but not limited to slab, platform, grating, and railing with modifications to the existing scum piping. Additionally, replacement of

the existing pumps, pump control system, and scum pump mixing assembly.

j) Civil Site Improvements: All civil improvements related to above items included site paving and grading, yard piping, manholes, and associated pipe connections.

k) Detention Mitigation Improvements: Provide re-grading of Swales including but not limited to inlet, manhole and piping replacement to insure proper detention and drainage of the system.

l) Installation of bollards

m) Startup and Training as shown in the Contract Documents.

12. Item No. 12: Removal and disposal of 1,500 tons of sludge and settled debris within existing process units.

13. Item No. 13: Installation of Trench Safety System.

14. Item No. 14: Storm sewer outfall investigation and replacement.

15. Item No. 15: SCADA System Improvements. Rehabilitation and replacement improvements including but not limited to:

a) Provisions for new PLC based control system RTU0240E – New Blower Building.

b) Modifications to existing PLC based control system –Chlorine Control Building.

c) Extension of existing facility fiber optic network loop from Operations & Maintenance Building to New Blower Building including provisions for a new network switch and associated patch panels, fiber converters, and local Ethernet cabling.

d) Participation in control system testing, calibration, commissioning, and operator training.

e) Provisions for new and replacement field devices as follows:

(1) Three (3) motor operated lift gate actuators at existing clarifier influent flow splitter box.

(2) Eight (8) variable speed aeration motor drives

(3) Four (4) dissolved oxygen sensor stations

(4) Three (3) digester air blower motor drives

(5) Two (2) clarifier scum transfer pump systems

(6) Two (2) bisulfate storage tank level sensors

(7) Two (2) bisulfate pump delivery rate controls

16. Item No. 16: SCADA Control Systems Engineering Services, including coordination, supervision, and analysis to verify existing control signals to be reconnected to replacement PLC control systems or demolished. PLC configuration and software programming, integration of manufacturer control systems, reassignment of network IP address for all plant network devices, additions and modifications to SCADA graphical user interface. Coordination and supervision of control system testing, calibration, software debugging, calibration, commissioning, and operator training.

B. Extra Unit Work Covered by this Contract:

Extra Unit Work, as defined in this Section, shall be included in the Total Project Cost. Work items included as "Extra Unit Work" are to be used only if necessary and performed only after receiving approval of the Engineer. No compensation will be received for any work item classified as "Extra Unit Work" unless the work items were actually used on the job after approval from the Engineer. Compensation will be received on a unit price basis relative to the work performed as defined in Section 00410 – Bid Form. Extra Unit Work items include the following:

1. Item No. 17: Removal of additional sludge/settled debris above the base bid amount.

2. Item Nos. 18-19: Extra excavation that is required to complete work in addition to excavation included in Base Unit Price work.

3. Item Nos. 20-21: Extra backfill that is required to complete work in addition to backfill included in Base Lump Sum work.

4. Item No. 22: Extra asphalt removal that is required to complete the work in addition to the asphalt removal included in Base Lump Sum work.

5. Item No. 23: Extra 7" thick reinforced concrete pavement that is required to complete the work in addition to the 7" thick reinforced concrete pavement included in Base Lump Sum work.

6. Item No. 24: Extra 4" thick concrete with/without form that is required to complete work in addition to 4" thick concrete included in Base Lump Sum work.

7. Item No. 25: Extra bollards that are required to complete the work in addition to the bollards included in Base Lump Sum work.

8. Item No. 26: Extra reinforcing steel in place that is required to complete work in addition to reinforcing steel included in Base Lump Sum work.

9. Item No. 27: Extra class "A" concrete with or without form that is required to complete work in addition to class "A" concrete included in Base Lump Sum work.

10. Item No. 28: Additional crack repairs in concrete slabs and walls that is required to complete the work in addition to the crack repairs included in the Base Lump Sum work.

11. Item Nos. 29-34: Extra electrical conduits that are required to complete work in addition to conduit included in Base Lump Sum work.

12. Item No. 35-41: Extra electrical conductors that are required to complete work in addition to conductors included in Base Lump Sum work.

13. Item No. 42: Extra twisted shielded instrument cables that are required to complete work in addition to what is included in Base Lump Sum work.

14. Item No. 43: Extra duct bank trenching, rebar, concrete encasement and backfill for a duct bank where the top of the conduit is 36" below grade in addition to duct bank included in Base Lump Sum work to complete work. The cross sectional area of the concrete encasement shall be four square feet.

15. Item No. 44: Extra Programming for PLC control and instrumentation systems as requested by the owner in addition to programming included in Base Lump Sum work.

16. Item Nos. 45-58: Extra Instrumentation components as requested by the owner in addition to controls and instrumentation work included in Base Lump Sum work.

17. Item No. 59: Extra Ladder Trays that are required to complete work in addition to those included in Base Lump Sum work.

18. Item No. 60: Extra Field Technician Services: Qualified controls & instrumentation technician field services as directed that is required to complete work in addition to those included in Base Lump Sum work.

19. Item No. 61: Extra 6" Ductile Iron Piping including excavation and restoration that are required to complete work in addition to those included in Base Lump Sum work.

20. Item No. 62: Installation of new 2" underground conduits from Clarifier Building to new Grit Chamber in the event that existing conduits are discovered to be unusable. This extra unit price includes utility location and horizontal boring costs as required for to install the new conduits.

21. Item No. 63 : Provision for additional days of portable electric power generation to the main switchgear at Greenridge WWTP for the convenience of COH and at the direction of the owner. This extra unit price includes fuel for operation of these extra days of generator operation. This extra unit price item is in addition to the provision for portable power generation required to complete the base lump sum work. This extra unit price does not include re-mobilization of generators and assumes generators are already on-site, connected, and operating.

C. CASH ALLOWANCES

1.03 CASH ALLOWANCES

Include the following specific Cash Allowances in Contract Price under provision of General Conditions Paragraph 3.11:

1. Item No. 64: City of Houston Building Permit for Keegan's Bayou WWTP and Greenridge WWTP. Cash allowance for the actual cost of the permit fees associated with the building and demolition permits required by the City of Houston.

2. Item No. 65: Street Cut Permit for Greenridge WWTP – Cash allowance for the actual cost of the permit fees associated with the Street Cut permit required by the City of Houston.

3. Item No. 66: Utility Reimbursement – Cash allowance for the actual cost of a temporary utility connection, installation and overhead wire.

1.04 ALTERNATES – Not Used

1.05 CITY-FURNISHED PRODUCTS

A. Items Furnished by the City for installation and final connection by Contractor:
   1. Dumpsters
      a. Grit Removal
      b. Scum Removal

B. Contractor's Responsibilities

1. Arrange and pay for Product delivery to the site.

2. Receive and unload Products at the site; jointly with the City, inspect for completeness or damage.

3. Handle, store, install and finish Products.

4. Repair or replace damaged items.

1.06 WORK SEQUENCE

A. Contractor shall construct work in phases during the construction period. Contractor shall coordinate construction schedule and operations with the City of Houston. Contractor shall submit a detailed Construction Sequencing Plan, in accordance with Section 01325 – Construction Schedule, which describes the method of construction associated with ensuring uninterrupted/continual plant operations during construction activities. Contractor shall submit Construction Sequencing Plan per Section 01330 – Submittal Procedures. Refer to Section 01312 - Coordination and Meetings.

B. Construction Sequencing Plan shall be staged so that service/flow through the WWTP is not disrupted during construction in a way that would result in adverse hydraulic or process performance except temporary shutdowns as detailed below. In general, construction should proceed in the order outlined below to provide continuous, uninterrupted flow. Construction sequencing shall facilitate Substantial Completion at Keegans Bayou WWTP prior to commencement of activities at Greenridge WWTP. Exceptions to substantial completion requirements to facilitate overall construction sequencing will be considered on a specific system basis for approval by Construction Group upon formal written request.

C. All work at site which potentially could interfere with normal operations at the plant (and/or off-site facilities) shall be coordinated with Wastewater Operations. Contractor shall submit a construction sequencing plan that shows no plant operations (or off-site facility operations) will be adversely affected for more than four (4) hours in any 24 hour period. All requests which impact normal operation of the plant shall be submitted at least five (5) working days in advance of the proposed shutdown date. Approval for shutdown(s) may be dependent upon influent flow conditions (wet-weather vs. dry-weather) and the operating status of near-by facilities to supplement lost influent pumping capacity. The maximum entire plant shutdown period shall be no more than four (4) consecutive hours. Central control/monitoring of the pump station operation and local control of the plant shall be restricted to the same scheduling constraints regarding outages.

D. The following sequences are provided for information only to assist the Contractor in preparing sequencing and schedules. They are not intended to replace the Contractor's means and methods. The Contractor can submit an alternative work sequence as a submittal for approval.

Keegan's Bayou WWTP

1. Pre-Construction Activities

   a) Furnish one temporary field office at Keegan's Bayou WWTP.

   b) Mobilize and submit key project submittals and shop drawings.

   c) Take pre-construction photographs of the existing site, including site paving, curbs, landscaping features, etc., prior to commencing any work in accordance with Section 01321 – Construction Photographs.

   d) Schedule/attend a meeting with the Project Managerand Wastewater Operations to determine acceptable protocol (i.e., duration, scheduling, notification procedures, etc.) that will be used for any planned shutdown of existing WWTP facilities.

2. Construction Activities

   a) Clarifier Gate Improvements

      (1) Remove Clarifier No. 1 gate from service.

      (2) Removal manual operator and retrofit Clarifier No 1. Gate with new electric motor operator.

      (3) Test and startup Clarifier No. 1 gate motor operator.

      (4) Complete the same procedures (Items 1 through 3) for Clarifier No. 2 gate.

      (5) Complete the same procedures (Items 1 through 3) for Clarifier No. 3. Gate.

(6) Complete the same procedures (Items 1 through 3) for Clarifier No. 4. Gate.

b) Headworks Crack Repair

(1) Isolate existing overflow bypass channel by use of existing gates and provide temporary stop logs as shown on the drawings.

(2) Expand existing weirs through select demolition and structural modifications as shown on the drawings

(3) Clean and removal all existing solids and miscellaneous debris within the limits shown on the drawings.

(4) Contractor shall repair existing cracks and existing joints in concrete exterior walls and base slab of bypass channel structure at locations of active visible leaks and at locations where visible efflorescence exists that has been deposited by previous leaks.

(5) Contractor shall repair cracks at overflow weirs as shown on the drawings.

(6) Leak testing shall be performed prior to completion.

c) Grit System Improvements. The sequence of events is expected to be as follows:

(1) Isolate existing mechanical bar screen by use of existing gates and route all flow through the existing bypass channel including the manual bar screen. If gates do not function, provide means of isolating flow such as sand bags, coffer dams, etc. as approved by the Engineer during construction operations.

(2) Contractor is responsible for assisting City to maintain solids handling through manual bar screen during duration of construction. City will rake solids from existing manual screen and Contractor will assist with solids removal to existing dumpster.

(3) Removal of all sludge/settled debris from existing mechanical bar screen channel.

(4) Removal of all sludge/settled debris from existing grit chamber.

(5) Demolition of existing grit removal equipment and structures as shown on the contract drawings and specified including site preparation, protection of existing structures, demolition of existing equipment, concrete structures, gates, pipes, miscellaneous metals and associated items.

(6) Construction of new grit removal structures as shown on the contract drawings and specified including but not limited to excavation, structural fill, reinforced concrete structures.

(7) Installation of grit system equipment including but not limited to exposed and underground piping, grit pumps, baffles, grit classifiers, valves, fittings, instrumentation systems, electrical systems, miscellaneous metals, testing, training, start-up and site restoration, complete in place and fully operational.

(8) Complete all other miscellaneous site improvements and connections of associated appurtenances.

d) Digester Blowers Improvements - Contractor shall provide and install a "Turnkey" system as described here for the replacement of six (6) existing blower control panels.

(1) Complete removal of the existing blower's control panels.

(2) Existing blower starters and MCC shall be reused in conjunction with new control panels.

(3) Blower Control Panels shall be NEMA 12 enclosure with approximate dimensions 30"X 18"X 72", and to be placed on existing control panel pad. Contractor shall repair and extend each pad as required to facilitate new installation.

(4) Installation of new 480 volt Lube Oil contactor panel shall be coordinated with the General Contractor and Electrical Sub-contractor.

(5) Lube Oil combination starter/Contactor within a NEMA 12 enclosure complete with 480 VAC power supply. Contactor shall be equipped with an integral circuit breaker disconnect means.

(6) Refer to the Project Manual Section 11375 – Digester Blower Control Retrofit for other applicable requirements.

(7) Signals integration with control panels shall be coordinated with the General Contractor and Controls Sub-Contractors.

e) Control & instrumentation Improvements

(1) Field-verify existing control signals, terminations, and field devices for PLC systems to be replaced. Analyze and report findings with proposed list of signal reconnection and demolitions. Submit findings and obtain approval of engineer and owner.

(2) Review existing control functionality that must be maintained manually throughout the construction period with COHWW operations personnel.

(3) Provide installations and field devices as indicated.

(4) Unless otherwise noted, remove existing control and instrumentation equipment and replace with new equipment.

(5) Complete new equipment check-out, software programming, and system commissioning.

(6) Complete any remaining demolition of abandoned equipment, systems, and wiring.

(7) Complete system demonstrations.

Greenridge WWTP

3. Pre-Construction Activities **(Note: Items a through d can be performed simultaneously unless noted below).**

a) Furnish one temporary field office at Greenridge WWTP.

b) Mobilize and submit key project submittals and shop drawings.

c) Take pre-construction photographs of the existing site, including site paving, curbs, landscaping features, etc., prior to commencing any work in accordance with Section 01321 – Construction Photographs.

d) Schedule/attend a meeting with the WWTP Plant Superintendent to determine acceptable protocol (i.e., duration, scheduling, notification procedures, etc.) that will be used for any planned shutdown of existing WWTP facilities.

4. Construction Activities

a) Blower Building Improvements: The sequence of events is expected to be as follows:

(1) Demolish all old structures and piping excluding existing blower building.

(2) Clear and grade site.

(3) Construct new blower building.

(4) Install new mechanical equipment including blowers, piping, bridge crane and associated appurtenances.

(5) Install new electrical equipment including MCCs, conduit, wiring, control panels, and associated appurtenances.

(6) Install new blower piping and make connections to existing process air lines.

(7) Test and startup new blowers and associated equipment.

(8) Demolish old blower building.

(9) Construct associated site area improvements including paving and grading, electrical and instrumentation, and appurtenances.

b) Aeration Basin Improvements. The sequence of events is expected to be as follows. **(Note - Aerators and Clarifier Influent Gate improvements can be constructed independent of each other)**.

Aerators:

(1) Isolate influent gate to Aerators No. 1 and No. 3. Note: Only one set of aerator flow trains can be removed at a time.

(2) Clean and remove settled debris from Aeration Basin channels.
(3) Inspect condition of existing aerator components to remain in use.

(4) Remove and replace motor on existing aerators.

(5) Install new dissolved oxygen probe and sensor.

(6) Install new variable frequency drive for aerators.

(7) Install new cable and conduit for aerator and control system.

(8) Test and startup aerator No. 1 and 3.

(9) Complete the same procedures (Items 1 through 8) for Aerators No. 2 and 4.

(10) Complete the same procedures (Items 1 through 8) for Aerators No. 5 and 7.

(11) Complete the same procedures (Items 1 through 8) for Aerators No. 6 and 8.

Clarifier Gates

(12) Remove Clarifier No. 1 gate from service.

(13) Removal manual operator and retrofit Clarifier No 1. Gate with new electric motor operator.

(14) Test and startup Clarifier No. 1 gate motor operator.

(15) Complete the same procedures (Items 12 through 14) for Clarifier No. 2 gate.

(16) Complete the same procedures (Items 12 through 14) for Clarifier No. 3. gate.

c) Main Electrical Panel Improvements.

(1) Complete new electrical branch feeder installation up to but not including termination at main electrical panel.
(2) Mobilize portable generators on site, install temporary feeders from generators to existing branch loads other than terminations.

(3) Schedule and execute a planned outage with plant operations and utility (if required). De-energize main electrical panel and energize generators.
(4) Complete main electrical panel improvements.
(5) Schedule and execute a second planned outage with plant operations and utility (if required). De-energize generators and re-energize main electrical panel.
(6) Disconnect and remove temporary feeders and remove portable generators.

d) Chlorination/Dechlorination Improvements. The sequence of events is expected to be as follows. Sodium Bisulfite System, Chlorine Analyzers, and Mix Point Improvements can be constructed independent of each other.

Sodium Bisulfite System:

(1) Demolish old building slab and abandoned tank.

(2) Construct new below ground piping including drain and new sodium bisulfite discharge piping.

(3) Construct new containment basin and coat interior basin walls.

(4) Install new storage tanks, FRP shelter, pumps, and associated piping and appurtenances.

(5) Install electrical and instrumentation appurtenances.

(6) Connect new sodium bisulfite piping to existing discharge line.

(7) Test and start up new sodium bisulfite system.

(8) Demolish old sodium bisulfite system.

Chlorine Analyzers

(9) Schedule temporary shutdown of chlorination system with Wastewater Operations.

(10) Remove and replace mix-point and pre-dechlorination analyzers.

(11) Test and startup new analyzers.

(12) Coordinate chlorination system startup with Wastewater Operations.

Chlorination Mix Point Improvements:

(13) Demolish and abandon air piping.

(14) Construct new structural improvements including grating, stairs and appurtenances.

(15) Install new mixer over chlorination location.

(16) Install associated electrical and instrumentation improvements.

(17) Test and startup new mixer.

e) Scum System Improvements

(1) Construct new structural improvements including grating, stairs and appurtenances for scum screen platform.

(2) Install new piping to existing scum pumps.

(3) Furnish & install two new static scum screens.

(4) Install bypass piping for existing scum pumps.

(5) Demolish existing scum pumps pipes and appurtenances.

(6) Install new scum pumps, pipes and appurtenances.

f) Stormwater Drainage Improvements

(1) Remove and replace approximately 300 LF of 24" RCP storm sewer and existing manhole as shown on the plans.

g) Paving Improvements

(1) Remove and replace existing roadway pavement with or without base (all types and thicknesses) as shown on the drawings. All concrete pavements to be 7" unless otherwise noted. The construction of the pavement will include the removal of the existing gravel surfaces, asphalt surfaces and concrete surfaces (with and without asphalt overlay).

(2) Remove and replace existing driveway from West Fuqua Drive to plant entrance.

h) Controls & Instrumentation Improvements

(1) Field verify existing conditions and review existing control functionality that must be maintained manually throughout the construction period with COHWW operations personnel.

(2) Provide installations and field devices as indicated.

(3) Unless otherwise noted, remove existing control and instrumentation to be demolished.

(4) Complete new equipment check-out, software programming, and system commissioning.

(5) Complete any remaining demolition of abandoned equipment, systems, and wiring.

(6) Complete system demonstrations.

i) Complete all other miscellaneous improvements such as yard piping, site grading and associated improvements.

1.07 CONTRACTOR USE OF PREMISES

A. Comply with procedures for access to the site and Contractor's use of rights-of-way as specified in Section 01145 - Use of Premises.

B. Coordinate with other ongoing construction projects at the Keegans Bayou WWTP to avoid disruption of those construction activities.

C. Coordinate with other ongoing construction projects at the Greenridge WWTP to avoid disruption of those construction activities.

D. Construction Operations: Limited to the City's rights-of-way provided by the City and areas shown or described in the Contract documents.

E. Utility Outages and Shutdown: Provide a minimum of 48 hours notice to the City and private utility companies (when applicable), excluding weekends and holidays, in advance of required utility shutdown. Coordinate all work as required.

1.08 STREET CUT ORDINANCE

A. Excavations on or under pavement in the City's right-of-way must have a permit. Comply with City of Houston, Texas Ordinance No. 2000-1115, an ordinance amending Chapter 40 of the Code of Ordinances, Houston, Texas, relating to excavating in the public right-of-way.

B. Comply with the latest edition of street cut New Pavement repair and Pavement replacement details.

C. Include payment for street cut pavement repair and replacement in lump sum bid for Stipulated Price contracts.

1.09 EQUIPMENT AND MATERIAL REUSE OR SALVAGE

A. The City shall have the first right of refusal to retain or salvage all items shown to be demolished and/or removed. Provide the City 72 hours advance notice prior to demolition. Prior to initiating demolition, the Contractor and City Engineer shall make a joint inspection of each site to identify all equipment to be retained by the City for salvage or reuse. All other items shown to be demolished and/or removed which are not retained by the City shall become the property of the Contractor. The Contractor shall remove these items from the City property and dispose of these items in accordance with all federal, state, and local regulations.

1.10 GENERAL CONSTRUCTION NOTES/CONDITIONS

A. All excess dirt from excavation shall be disposed of offsite by Contractor at no additional cost to the Owner.

B. All dimensions shown are approximate and shall be field verified by the Contractor. Necessary horizontal and vertical alignment changes are to be approved by the City.

C. Contractor shall remove all trash, excess material, debris, etc., from the site upon completion of the project prior to inspection and approval by the approving agencies.

D. Contractor shall verify horizontal and vertical locations of all existing utilities prior to commencement of construction activity.

E. Contractor is responsible for his own horizontal and vertical control. Reference points and construction staking is incidental to the project.

F. The Contractor will install all equipment and related accessories to operate in the manner intended by the City of Houston and the manufacturer and be in compliance with all application codes and contract specification. The Contractor will coordinate work between the various trades and subcontractors to provide a complete installation so that the equipment is operational at the completion of the project. The completed work will not lack any part which can be reasonably implied as incidental for proper and useful operation of the facility. This includes all items of equipment, labor, and materials, whether or not shown in the contract documents, where such items are required to fulfill the intent of the contract, and will be in accordance with code requirements, standards, regulatory agencies, manufacturer's recommendations, and acceptable industry practice. This work will be done at no additional cost to the City.

1.11 PROTECTION OF EXISTING STRUCTURES

A. The Contractor is required to protect all equipment, buildings, structures, piping, electrical cables, tanks, basins, roadways, covered parking, elevated crossings, wet wells, manholes, meter vaults, underground utilities, and all associated appurtenances during construction.

B. The Contractor is clearly responsible for all temporary supports and bracing for all structural elements including, but not limited to, pumps, piping, walls, and foundations. All proposed temporary bracing and supports must be submitted by the Contractor for approval by the City and must be prepared and sealed by a Registered Professional Engineer retained by the Contractor. It is the Contractor's responsibility to insure the safety and functionality of the piping and associated appurtenances in the intermediate conditions of sequencing between these said phase conclusions. Furthermore, should the Contractor feel that any supports or bracing illustrated or depicted within these construction documents present a potential problem in terms of safety or interference with operations, it is his responsibility to immediately document these concerns and immediately present this said documentation to the City's attention.

1.12 DISCONNECTION/RECONNECTION OF EQUIPMENT

A. The Contractor will be responsible for disconnection/reconnection of electrical and mechanical equipment, as required under this contract, under the direct supervision of the City. The City will not be responsible for the disconnection/reconnection of any electrical and mechanical equipment.

B. The Contractor shall follow the City's Lockout/Tagout Procedure, Accident Prevention Plan Section 14; Control of Hazardous Energy (Lockout/Tagout) Program for the disconnection/reconnection of all equipment.

1.13 SITE RESTORATION

A. Contractor shall restore all construction site covered by this Contract, including but not limited to existing paving, structures, landscaping, etc., to a condition that is equal to or better than that which existed prior to construction operations. Restoration of construction sites shall be performed at no additional cost to the City.

1.14 WARRANTY

A. Comply with warranty requirements in accordance with Document 00700 - General Conditions. Where warranties different from that identified in Section 00700 are listed in technical specifications for equipment, comply with the longest duration warranty and any accompanying conditions.

1.15 ADDITIONAL CONDITIONS FOR SUBSTANTIAL COMPLETION

A. In addition to requirements outlined in Document 00700 – General Conditions, for Contractor to be substantially complete with the Work and call for inspection by Project Manager to confirm, the following conditions must be met or completed:

1. All testing shall be completed and accepted by Project Manager. All equipment and process systems will require a seven consecutive day test prior to training and the issuance of a Partial Substantial Completion Certificate.

2. Draft O&M manuals shall be delivered to Project Manager including six (6) navigable, digital versions for review.

3. Training to be conducted, utilizing draft O&M manuals and a training video will be provided by the contractor for the installed equipment.

4. All added or modified instrumentation in this project shall be calibrated, functional and properly communicating with the SCADA System HMI.

5. All status and alarm points added in this project shall properly communicate with the SCADA System HMI.

6. Partial substantial completion certificates may be issued on a system completion basis. Installed equipment will remain the Contractor's responsibility until this milestone is reached.

7. Acceptance as noted under warranty in the individual equipment specification begins from the date of substantial completion for that individual process area and not the individual equipment in that process area.

8. Relocation of trailer from one site to another will not be granted until Substantial Completion is achieved at the first site.

9. Substantial completion shall be contingent upon the successful completion of the seven day continuous operational test of installed equipment for the affected system. Successful completion of the seven day operational test is defined as normal operation of the system for seven consecutive days without shut downs, failures, system malfunctions or SCADA errors. The Contractor shall request, in writing, that the Project Manager notify Wastewater Operations Branch (WOB) at

least three (3) weeks prior to the proposed start of the seven day test to confirm that the facility to be tested and WOB is ready for the seven day test. WOB will then authorize the Project Manager to run the seven day test and WOB will set the start date for this test.

10. The City reserves the right to take beneficial use and operate portions of the project as and when they are completed. However, it will be the Contractor's responsibility to perform the Periodic Preventive and Scheduled Maintenance on the City-operated equipment per Manufacturer's recommendations until partial or full substantial completion is granted by the City for that particular process area.

11. Approval of warranty documents.

12. All Pay Items Complete report.

13. Contractor shall contact Construction Project Manager to complete Texas Department of Licensing and Regulation Post Construction Inspection of pedestrian elements for Texas Accessibilty Standards.

B. No additional condition described herein may be included in Contractor's punch list.

C. This Contract has improvements in several distinct process areas of two (2) Wastewater Treatment Plants and site wide improvements at one of these plants. These twelve (12) areas are defined as Grit Removal, Clarifier Gate Motor Operators (both plants), SCADA improvements (both plants), Blower Building Improvements, Aeration Basin Improvements, Chlorination/De-Chlorination Improvements, Scum Removal Improvements, Digester Piping Modifications, Stormwater Improvements and Paving Improvements. When requested by the Contractor, the City shall give twelve independent partial substantial completions as and when improvements in each process area is completed as defined in Section 01110 Item 1.15A. This shall allow the warranty to start at that particular process or work area of the plant from the date of its partial substantial completion. However, the project retainage will not be reduced at this time. When all the work and associated requirements in the twelfth and final process or work area is completed, the Contractor will be given a full substantial completion for the whole project, at which time the warranty will commence on the twelfth process area as well as the retainage reduction will occur for the Contract as a whole.

Acceptance as noted under warranty in the individual equipment specification begins from the date of substantial completion for that individual process area and not the individual equipment in that process area. For example, the aerator process area includes 8 aeration basins with two aeration basins that will be released in tandem for work in sequence, one tandem set at a time. Partial substantial completion for the aeration basin process area will be granted only after work is complete and accepted for all 8 aeration basins.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION – Not Used

END OF SECTION

Section 01145

USE OF PREMISES

1.01 SECTION INCLUDES

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

1.02 RIGHTS-OF-WAY

A. Confine access, and operations and storage areas to rights-of-way provided by the City as stipulated in Document 00700 - General Conditions; 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 of 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 witnesses.

C. Obtain written permission from City of Houston Parks and Recreation Department for storage of materials on esplanades and other areas within rights-of-way under that department's jurisdiction. Submit copies of written permission 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 City Engineer.

1.03 PROPERTIES OUTSIDE OF RIGHTS-OF-WAY

A. Do not alter the condition of properties 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-ways at no cost to the city

1.04 USE OF SITE

A. Obtain approvals from governing authorities prior to impeding or closing public roads and streets. Do not close more than two consecutive intersections at one time.

B. Notify Project Manager and Public Works and Engineering Traffic Management Branch at least five working days prior to closing a street or street crossing. Obtain permits for street closures in advance.

C. Maintain 10-foot-wide minimum access lanes 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 that may exist within the site. Repair or replace damaged systems to condition existing at start of the Work, or better. Test irrigation system prior to construction.

F. Conform to daily clean-up requirements of Article 3 of Document 00700 - General Conditions.

G. Beware of overhead power lines existing in area and in close 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 effected by the Work of proposed construction and time schedule. Notify not less than 72 hours or more than two weeks prior to work performed within 200 feet of homes or businesses. Follow form and content of sample door hanger provided by Project Manager.

B. Include in notification nature of the Work, and names and telephone numbers of two company representatives for resident contact available on 24-hour call.

C. Submit proposed notification to Project Manager for approval. Consider ethnicity of the neighborhood where English is not the dominant language. Provide notice in an understandable language.

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 it is necessary to close public roads or streets.

B. Provide mats or other means to prevent overloading or damage to existing roadways from tracked equipment, large tandem axle trucks or equipment that will damage the existing roadway surfaces.

C. Construct and maintain access roads and parking areas as specified in Section 01504 - Temporary Facilities and Controls.

1.07 EXCAVATION IN STREETS AND DRIVEWAYS

A. Avoid hindering or inconveniencing public travel on streets or intersecting alleys for more than two blocks at any one time, except by permission of City Engineer.

B. Obtain Traffic Management Branch and City Engineer's approval when nature of the Work requires closure of an entire street. Permits required for street closure are 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 crossings or complete excavation and backfill in one continuous operation to minimize duration of obstruction when excavation is required across drives or entrances.

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

1.08 TRAFFIC CONTROL

A. Comply with traffic regulation as specified in Section 01555 - Traffic Control and Regulation.

1.09 SURFACE RESTORATION

A. Restore the site including landscaping to the condition existing before construction, or better.

B. Repair paved areas per the requirements of Section 02951 - Pavement Repair and restoration.

C. Repair damaged turf areas, level with bank run sand conforming to Section 02317 - Excavation and Backfill for Utilities, or topsoil conforming to Section 02911 - Topsoil, and re-sod in accordance with Section 02922 - Sodding. Water and level newly sodded areas with adjoining turf using appropriate steel wheel rollers for sodding. Do not use spot sodding or sprigging.

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.

1.11 EQUIPMENT AND MATERIAL SALVAGE

A. Upon completion of the Work, carefully remove salvageable equipment and material. Deliver them to City of Houston as directed by Project Manager. Dispose of equipment offsite at no additional cost to the City when Project Manager deems equipment unfit for further use.

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 01255

CHANGE ORDER PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for processing Change Orders, including:

1. Assignment of a responsible individual for approval and communication of changes in the Work;
2. Documentation of change in Contract Price and Contract Time;
3. Change procedures, using proposals and Modifications;
4. Execution of Change Orders;
5. Correlation of Contractor submittals.

1.02 REFERENCES

A. Blue Book is defined as the Rental Rate Blue Book for Construction Equipment (a.k.a. Data Quest Blue Book).

B. Rental Rate is defined as the full-unadjusted base rental rate for the appropriate item of construction equipment.

1.03 RESPONSIBLE INDIVIDUAL

A. Provide a letter indicating the name and address of the individual authorized to execute Modifications, and who will be responsible for informing others in Contractor's employ and Subcontractors of changes to the Work. Provide this information at the pre-construction meeting.

1.04 DOCUMENTATION OF CHANGE IN CONTRACT PRICE AND CONTRACT TIME

A. Maintain detailed records of changes in the Work. Provide full information required for identification and evaluation of proposed changes, and substantiate costs of changes in the Work.

B. Document each proposal for change in Contract Price or Contract Time with sufficient data to allow evaluation of proposal.

C. Include the following minimum information on proposals:

1. Quantities of items in original Document 00410 – Bid Form with additions, reductions, deletions, and substitutions.

2. Quantities and cost of items in original Schedule of Values with additions, reductions, deletions and substitutions.

3. Provide Unit Prices for new items, with supporting information, for inclusion in Schedule of Unit Price Work.

4. Justification for changes in Contract Time.

5. Additional data upon request.

D. For changes in the Work performed on a time-and-material basis, provide the following additional information:

1. Quantities and description of Products.

2. Taxes, insurance and Bonds.

3. Overhead and profit as noted in Document 00700 - General Conditions.

4. Dates, times and by who work was performed.

5. Time records and certified copies of applicable payrolls.

6. Invoices and receipts for Products, rental equipment, and subcontracts, similarly documented.

E. For changes in the Work performed on a time-and-materials basis, rental equipment is paid as follows:

1. Actual invoice cost for duration of time required to complete extra work without markup for overhead and profit. When extra work comprises only a portion of a rental invoice where equipment would otherwise be on site, compute hourly equipment rate by dividing the actual monthly invoice by 176. One day equals eight hours and one week equals 40 hours.

2. Do not exceed estimated operating costs given in Blue Book for items of equipment. Overhead and profit will be allowed on the operating cost.

F. For changes in the Work performed on a time-and-materials basis using Contractor-owned equipment, use Blue Book rates as follows:

1. Contractor-owned equipment will be paid at the Blue Book Rental Rate for the duration of time required to complete extra work without markup for overhead and profit. Utilize lowest cost combination of hourly, daily, weekly or monthly rates. Use 150 percent of Rental Rate for double shifts, one extra shift per day, and 200 percent of Rental Rate for more than two shifts per day. Standby rates shall be 50 percent of the appropriate Rental Rate shown in Blue Book. No other rate adjustments apply.

2. Do not exceed estimated operating costs given in Blue Book. Overhead and profit will be allowed on operating costs. Operating costs will not be allowed for equipment on standby.

1.05 CHANGE PROCEDURES

A. Changes to Contract Price or Contract Time can only be made by issuance of Document 00941 - Change Order. Issuance of Document 00940 - Work Change Directive will be formalized into a Change Order. Changes will be in accordance with requirements of Document 00700 - General Conditions.

B. City Engineer will advise of Minor Changes in the Work as authorized by the Document 00700 - General Conditions by issuing Document 00942 – Minor Change.

C. Request clarification of Drawings, Specifications, Contract documents or other information by using Document 00931- Request for Information. Response by Project Manager to Requests for Information does not authorize Contractor to perform tasks outside scope of the Work. Changes must be authorized as described in this Section.

1.06 PROPOSALS AND CONTRACT MODIFICATIONS

A. Project Manager may issue Document 00932- Request for Proposal, which includes a detailed description of the proposed change with supplementary or revised Drawings and Specifications. Project Manager may also request a proposal in response to a Request for Information. Prepare and submit the proposal within seven days or as specified in request.

B. Submit requests for Contract changes to City Engineer describing proposed change and its full effect on the Work, with a statement describing reason for change and effect on Contract Price and Contract Time including full documentation.

C. Design Consultant may review Change Orders.

1.07 WORK CHANGE DIRECTIVE

A. City Engineer may issue a signed Work Change Directive instructing Contractor to proceed with a change in the Work. Work Change Directive will subsequently be incorporated into a Change Order.

B. Work Change Directives will describe changes in the Work and designate the method of determining change in Contract Price or Contract Time.

C. Proceed promptly to execute changes in the Work in accordance with the Work Change Directive.

1.08 STIPULATED PRICE CHANGE ORDER

A. A Stipulated Price Change Order will be based on an accepted proposal.

1.09 UNIT PRICE CHANGE ORDER

A. Where Unit Prices for affected items of the Work are included in Document 00410 – Bid Form, the Change Order will be based on Unit Prices, subject to Articles 7 and 9 of Document 00700 - General Conditions.

B. Where Unit Prices of the Work are not pre-determined in Document 00410-Bid Form, the Work Change Directive or accepted proposal will specify the Unit Prices to be used.

1.10 TIME-AND-MATERIAL CHANGE ORDER

A. Provide itemized account and supporting data after completion of change, within time limits indicated for claims in Document 00700 - General Conditions.

B. City Engineer will determine the change allowable in Contract Price and Contract Time as provided in Document 00700 - General Conditions.

C. Maintain detailed records for work done on time-and-material basis as specified in Paragraph 1.04 above.

D. Provide full information required for evaluation of changes and substantiate costs for changes in the Work.

1.11 EXECUTION OF CHANGE DOCUMENTATION

A. City Engineer will issue Change Orders, Work Change Directives, or Minor Change in the Work for signatures of Parties as described in Document 00700 - General Conditions.

1.12 CORRELATION OF CONTRACTOR SUBMITTALS

A. For Stipulated Price Contracts, promptly revise Schedule of Values and Application for Payment forms to record authorized Change Orders as separate line item.

B. For Unit Price Contracts, the next monthly estimate of the Work after acceptance of a Change Order will be revised to include new items not previously included with appropriate Unit Prices.

C. Promptly revise progress schedules to reflect change in Contract Time, and to adjust time for other items of work affected by the change, and resubmit for review.

D. Promptly enter changes to on-site and record copies of Drawings, Specifications or Contract documents as required in Section 01785 - Project Record 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 01270

MEASUREMENT AND PAYMENT

PART 1 GENERAL

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 criteria of this Section. In event of conflict, requirements of the Specification section shall govern.

B. Project Manager will take all measurements and compute quantities accordingly.

C. Assist by providing necessary equipment, workers, and survey personnel.

D. Measurement and Payment paragraphs are included only in those Specification sections of Division 01 where direct payment will be made. Include costs in the total bid price for those Specification sections in Division 01 that do not contain Measurement and Payment paragraphs,

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 Project Manager will determine payment as stated in Article 9 of Document 00700 - General Conditions.

B. When actual work requires greater or lesser quantities than those quantities indicated in Document 00410 – Bid Form, provide required quantities at Unit Prices contracted, except as otherwise stated in Article 9 of Document 00700 - General Conditions.

1.04 MEASUREMENT OF QUANTITIES

A. Measurement by Weight: Reinforcing steel, rolled or formed steel or other metal shapes are measured by CRSI or AISC Manual of Steel Construction weights. Welded assemblies are measured by CRSI or AISC Manual of Steel Construction or scale weights.

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 average end area method.

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

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

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

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

G. Measurement by Each: Measured by each instance or item provided.

H. Measurement by Lump Sum: Measure includes all associated 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 Document 00410 – Bid Form. Claims for payment as Unit Price work, but not specifically covered in the list of Unit Prices contained in Document 00410 – Bid Form, will not be accepted.

C. Interim payments for stored materials will be made only for materials to be incorporated under items covered in Unit Prices, unless disallowed in Document 00800 - Supplementary Conditions.

D. Progress payments will be based on Project Manager's observations and evaluations of quantities incorporated in the Work multiplied by Unit Price.

E. Final payment for work governed by Unit Prices will be made on the basis of actual measurements and quantities determined by Project Manager 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 work, or portions of the Work, not conforming to the Contract documents.

B. When not practical to remove and replace work, City Engineer will direct one of the following remedies:

1. Nonconforming work will remain as is, but Unit Price will be adjusted lower at discretion of City Engineer.

2. Nonconforming work will be modified as authorized by City Engineer, and the Unit Price will be adjusted lower at the discretion of City Engineer, when modified work is deemed less suitable than specified.

C. Specification sections may modify the above remedies or may identify a specific formula or percentage price reduction.

D. Authority of City Engineer to assess nonconforming work and identify payment adjustment is final.

1.07 NONPAYMENT FOR REJECTED PRODUCTS

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

1. Products wasted or disposed of in an unacceptable manner.

2. Products determined as nonconforming before or after placement.

3. Products not completely unloaded from transporting vehicles.

4. Products placed beyond lines and levels of 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 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.

1.02 PREPARATION

A. For Stipulated Price Contracts, subdivide the Schedule of Values into logical portions of the Work, such as major work items or work in contiguous construction areas. Use Section 01325 - 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 value of the Work by Sections. A pro rata share of mobilization, Bonds, and insurance may be listed as separate items for each portion of the Work.

B. For Unit Price Contracts, items should include a proportional share of Contractor's overhead and profit so that total of all items will equal Contract Price.

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

1. submittal of maintenance data is valued at five percent of the lump sum amount for each equipment item and

2. submittal for testing and adjusting is valued at five percent of the lump sum amount for each equipment item.

Round off figures for each item listed to the nearest $100. Set the value of one item, when necessary, to make 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 requirements of Section 01330 - Submittal Procedures, at least 10 days prior to processing of the first Certificate for Payment.

B Submit the Schedule of Values in an approved electronic spreadsheet file and an 81/2-inch by 11-inch print on white bond paper.

C. Revise Schedule of Values for items affected by Contract Modifications. After City Engineer has reviewed changes, resubmit at least 10 days prior to the next scheduled Certificate for Payment date.

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 01312

COORDINATION AND MEETINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General coordination including pre-construction meeting, site mobilization conference, and progress meetings.

1.02 COORDINATION OF DOCUMENTS

A. Coordination is required throughout documents. Refer to Contract documents and coordinate as necessary.

1.03 CONTRACTOR COORDINATION

A. Coordinate scheduling, submittals, and work of various Specification sections to assure efficient and orderly sequence of Installation of interdependent construction elements.

B. Coordinate completion and clean up of the Work prior to the Date of Substantial Completion and for portions of the Work designated for City's partial occupancy.

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

1.04 PRE-CONSTRUCTION MEETING

A. Project Manager will schedule pre-construction meeting.

B. Attendance Required: City representatives, Design Consultant, special consultants as required by Project Manager, Contractor, and major Subcontractors and Suppliers.

C. Agenda:

1. Distribution of Contract documents.

2. Designation of personnel representing the Parties and Design Consultant.

3. Review of insurance.

4. Discussion of formats for Schedule of Values and Construction Schedule.

5. Procedures and processing of Shop Drawings, substitutions, pay estimates or Applications for Payment, Requests for Information, Requests for Proposal, Modifications, and the Contract closeout, other submittals.

6. Scheduling of the Work and coordination with other contractors.

7. Review of Subcontractors and Suppliers.

8. Appropriate agenda items listed for the site mobilization conference, Paragraph 1.05.C, when pre-construction meeting and site mobilization conference are combined.

9. Procedures for testing.

10. Procedures for maintaining record documents.

1.05 SITE MOBILIZATION CONFERENCE

A. When required by Contract documents, Project Manager will schedule a conference at the Project site prior to Contractor mobilization.

B. Attendance Required: City representatives, Design Consultant, special consultants, Superintendent, and major Subcontractors.

C. Agenda:

1. Use of premises by the City and Contractor.

2. Safety and first aid procedures.

3. Construction controls provided by the City.

4. Temporary utilities.

5. Survey and layout.

6. Security and housekeeping procedures.

7. Field office requirements.

1.06 PROGRESS MEETINGS

A. Hold meetings at Project field office or other location designated by Project Manager. Hold meetings at monthly intervals, or more frequently when directed by Project Manager.

B. Attendance Required: Superintendent, major Subcontractors and Suppliers, City representatives, Design Consultant and its subconsultants as appropriate for agenda topics for each meeting.

C. Project Manager will make arrangements for meetings, and for recording minutes.

D. Project Manager will prepare the agenda and preside at meetings.

E. Provide required information and be prepared to discuss each agenda item.

F. Agenda:

1. Review minutes of previous meetings.

2. Review of construction schedule, pay estimates, cash flow curve, payroll and compliance submittals.

3. Field observations, problems, and necessary decisions.

4. Identification of problems that impede planned progress.

5. Review of submittal schedule and status of submittals.

6. Review of RFI and RFP status.

7. Modification status.

8. Review of off-site fabrication and delivery schedules.

9. Maintenance of Construction Schedule.

10. Corrective measures to regain Construction Schedule.

11. Planned progress during the succeeding work period.

12. Coordination of projected progress.

13. Maintenance of quality and work standards.

14. Effect of proposed Modifications on Construction Schedule and coordination.

15. Review Project Record Contract Drawings.

16. Other item relating to the 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 01321

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 DEFINITIONS

A. Pre-construction Photographs: Photographs taken, in sufficient numbers and detail, prior to Date of Commencement of the Work, to show original construction site conditions.

B. Progress Photographs: Photographs, taken throughout the duration of construction at regular intervals and from fixed vantage points, pre-approved by the City, that document progress of the Work.

C. Finished Photographs: Photographs, taken by a professional photographer near Date of Substantial Completion and before City Council's acceptance of the Work, that are suitable for framing and for use in brochures or on the Internet

1.03 SUBMITTALS

A. Refer to Section 01330, Submittal Procedures, for submittal requirements.

B. Format and Media. Film or digital photography may be used. Submit color photographs, unless otherwise specified.

1. Prints. Submit each Progress or Pre-construction Photograph print in a three-hole plastic pocket or sleeve, bound in a three-ring notebook. Produce prints on photographic-quality paper approved by Project Manager. Minimum size for Pre-construction Photograph prints shall be 3-inches by 5-inches. Progress Photograph prints shall be 8-inches by 10-inches.

2. Film. Use 35mm or larger color film. Submit negatives used to make submitted photographs, in 3-hole 8-1/2 inch by 11-inch plastic sheets with sleeves for negatives.

3. Digital Photography. Use 2.1 megapixel density or greater for photographs. Scanned photographs must equal or exceed 400 dots

per inch when scanned from 8-inch by 10-inch prints. Submit digital photographic files on computer disks. Format disks for MS-DOS (Microsoft Disk Operating System) filing system and in JPEG (Joint Photographic Experts Group) format.

C. Submittal Quantities and Frequencies.

1. Pre-construction Photographs:
   a. For Stipulated Price Contracts, submit two sets of Pre-construction Photographs, if required, prior to first Application for Payment.
   b. For Unit Price Contracts, submit two sets of Pre-construction Photographs prior to start of construction operations.

2. Progress Photographs:
   a. For Stipulated Price Contracts, submit three sets of Progress Photographs with each Application for Payment at the times established for submittal of Applications for Payment. Monthly Applications for Payment shall be deemed incomplete if not accompanied by the required Progress Photographs. Contractor's failure or election to not submit a monthly Application for Payment shall not affect the requirement for monthly Progress Photographs.
   b. Progress Photographs are not required for Unit Price Contracts unless otherwise specified.

3. Finished Photographs: For Stipulated Price Contracts submit two sets of Finished Photographs, if required, after Date of Substantial Completion and prior to final payment. Each set shall contain one 11-inch by 14-inch matte finish color photographic print from each of the two vantage points pre-approved by the City. Vantage points for Finished Photographs will be approved separately from vantage points approved for Progress Photographs. Finished Photographs are not required for Unit Price Contracts unless otherwise specified.

D. Labeling. Place a label on the back of each photographic print, applied so as to not to show through on the front. Labels shall contain the following information:

1. Name of Project, address of Project and GFS Number.

2. Name and address of Contractor.

3. Date photograph was taken.

4. Location photo was taken from and short description of photo subject.

5. Name and address of professional photographer who took the photograph, if applicable.

E. Hand-deliver or transmit prints in standard photographic mailers marked "Photographs - Do Not Bend".

F. Photographic prints, negatives, photographic files and disks become the property of the City. Do not be publish photographs without written consent by the City.

1.04 QUALITY ASSURANCE

A. Contractor shall be responsible for the quality of and timely execution and submittal of photographs.

B. For Finished Photographs, Contractor shall use a professional photographer, with five years minimum professional experience in the Houston area. Contractor shall submit name, address and credentials of professional photographer for Project Manager's review and approval.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 PRE-CONSTRUCTION PHOTOGRAPHS

A. Prior to commencement of construction operations, photograph the site to include initial construction corridor, detour routes, and staging or storage areas.

1. For Stipulated Price Contracts, unless specified as a requirement in other Sections, these photographs are optional for Contractor, but are highly recommended for areas bounded by other property owners.

2. Pre-construction photographs are required for Unit Price Contracts. For line projects with scheduled construction segments, take Pre-construction Photographs prior to commencement of work on each segment.

B. Prepare Pre-construction Photographs as follows:

1. Show the following information on a non-reflective chalkboard placed within the picture frame:
   a. Job number.
   b. Project Number.
   c. Date and time photographs were taken (Automatic date/time in negative is acceptable).
   d. Baseline station, direction of view (i.e. N, S, NW, etc.) and house number or street address and street name.

2. Pre-construction Photographs shall indicate condition of the following:
   a. Esplanades and boulevards.
   b. Yards (near side and far side of street).
   c. House walks and sidewalks.
   d. Curbs.
   e. Areas between walks and curbs.
   f. Particular features (e.g. yard lights, shrubs, fences, trees).

3. Show date photographs were taken on negatives.

C. Show the location of vantage points and direction of shots on a key plan of the site.

3.02 PROGRESS PHOTOGRAPHS

A. Progress Photographs document monthly advancement of the Work. Select vantage points for each shot so as to best show status of construction and progress since last photograph submittal. Select camera stations that will require little or no movement or adjustment over the duration of construction.

B. Take monthly Progress Photographs at regular intervals to coincide with cutoff dates associated with each Application for Payment.

3.03 FINISHED PHOTOGRAPHS

A. Finished Photographs shall be "staged" and taken by a professional photographer to depict the most flattering images of a finished facility. Two vantage points, from which Finished Photographs will be taken, shall be agreed to in advance by the City. Photographer shall consider lighting, time of day, height of eye, landscaping and placement of vehicles, people and other props in each picture. Filters and post-photography processing may be utilized to achieve a finished product acceptable to the City.

3.04 LOCATION

A. Vantage points, times and conditions for camera stations and photography for Progress and Finished Photographs shall be mutually agreed upon by the City, Contractor and Photographer. Progress Photograph vantage points may be changed by mutual agreement as the Work progresses, at no additional cost to the City.

END OF SECTION

Section 01325

CONSTRUCTION SCHEDULE

PART 1 G E N E R A L

1.01 GENERAL

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 capable of mathematical analysis of Precedence Diagramming Method (PDM) plan. Provide printed activity listings and bar charts in formats described in this Section.

B. Combine activity listings and bar charts with narrative report to form Construction Schedule submittal for Project Manager.

1.02 SCHEDULING STAFF

A. Employ or retain services of individual experienced in CPM scheduling for duration of the Contract. Individual shall cooperate with Project Manager and update schedule monthly as required to indicate current status of the Work.

1.03 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. During preconstruction meeting, as described in Section 01312 - Coordination and Meetings, provide sample bar charts and activity listings produced from scheduling software proposed. Scheduling software is subject to review by Project Manager and must meet requirements provided in this Section. Project Manager will provide review of samples within seven days of submittal.

C. Within 21 days of receipt of approval of Contractor's format, or 30 days of Notice to Proceed, whichever is later, submit proposed Construction Schedule for review. Base Construction Schedule submittal on the following:

1. Level of detail and number of activities required in schedule are dependent on project type.
   a. For wastewater projects, categorize work type and area code in schedule.
      1) For wastewater rehabilitation projects, there are six work-type categories. An area code will be assigned for each

3. a predecessor/successor listing sorted by Activity ID that meets criteria outlined in this Section and is produced by Contractor's scheduling software.

4. A logic network diagram is required with the first Construction Schedule submittal for facilities projects.

5. Prepare and submit graphic or tabular display of estimated monthly billings (i.e. a cash flow curve for the Work) with the first schedule submittal. This information is not required in monthly updates, unless significant changes in work require re-submittal of schedule for review. Display shall allocate units indicated in bid schedule or Schedule of Values to Construction Schedule activities. Weighted allocations are acceptable, where appropriate. Dollar value associated with each allocated unit will be spread across the duration of that activity on a monthly basis. Total for each month and cumulative total will be indicated. These monthly forecasts are only for Project Manager's planning purposes. Monthly payments for actual work completed will be made in accordance with Document 00700 - General Conditions.

6. Narrative Report that provides the information outlined in this Section.

E. No payment will be made until Project Manager approves Construction Schedule and billing forecast.

F. If Contractor desires to make changes in its method of operating and scheduling, after Project Manager has reviewed original schedule, notify Project Manager in writing, stating reasons for changes. When Project Manager considers these changes to be significant, Contractor may be required to revise and resubmit for review all or affected portion of Contractor's Construction Schedule to show effect on the Work.

G. Upon written request from Project Manager, revise and submit for review all or any part of Construction Schedule submittal to reflect changed conditions in the Work or deviations made from original schedule.

H. Updated Construction Schedule with actual start and actual finish dates, percent complete, and remaining duration of each activity shall be submitted monthly. Data date used in updating monthly Construction Schedule shall be the same date as used in monthly Payment Application. Monthly update of Construction Schedule is required for monthly Payment Application to be processed for payment.

printed or plotted on 8-1/2 by 11-inch, 8-1/2 by 14-inch or 11 by 17-inch sheet sizes. Over-size plots are not acceptable.

1.05 NARRATIVE SCHEDULE REPORT

A. 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.

B. 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 re-calculation of mathematical analysis.

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 01326

CONSTRUCTION SCHEDULE (BAR CHART)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provide an initial Construction Schedule as required by this section for the Work. Do not start construction until Project Manager reviews the schedule.

1.02 FORM AND CONTENT OF INITIAL CONSTRUCTION SCHEDULE

A. Bar Chart:

1. Show major construction activities such as pipe laying, by traffic control phases or other approved key areas; tunnel construction, pavement removal, pavement replacement, pressure testing, chlorination, clean up and punch list as separate activities on the schedule.

2. Show week duration for each activity.

3. Show separate activities for each Shop Drawing and Product Data submittal critical to timely completion. Show submittal dates and dates Project Manager needs to provide approved submittals.

4. Provide separate horizontal bar for each activity. List start and finish date for each activity at left side of diagram.

5. Horizontal Time Scale: Identify first work day of each week.

6. Scale and Spacing: Notes must be legible. Allow space for notations and future revisions.

7. Order of Listings: Order bar chart listings by phases or other approved groups of activities that are contiguous. List activities in chronological order within each phase or group.

B. Narrative Description:

1. Submit narrative descriptions of anticipated work sequences as indicated by the sequence of activities presented in the schedule.

2. Discuss any activity that affects the public (such as phases of traffic control), interaction with specific forces of the City (such as valve operation, chlorination and testing) or other associated contractors.

1.03 PROGRESS REVISIONS

A. Submit progress revisions or necessary information to complete and process Payment Applications. When required, re-submittals for rejected revisions must be submitted and reviewed prior to the following month's processing of a Payment Application. The following month's Payment Application will not be processed until the re-submittal is reviewed and required progress revisions are received.

B. Provide a narrative report to describe:

1. Major changes in scope.

2. Revised projections in progress, completion, or changes in activity duration.

3. Other identifiable changes.

4. Problem areas, anticipated delays, and the impact on schedule.

5. Corrective action recommended and its effect.

6. Effect of changes on schedules or other contractors.

7. Product delivery lead times.

C. Include additional data with Bar Chart described in Paragraph 1.03A of this Section:

1. Show original dates for each activity in the approved initial progress schedule by narrow bar next to a wider bar for the current schedule.

2. Show date each activity actually started or finished when an event has occurred. Clearly identify actual dates in two right-most columns in left portion of an 11 by 17-inch chart.

3. Indicate the percentage progress to the date of submittal for each activity.

1.04 SUBMITTALS

A. Submit the initial progress schedule within 15 days after award of contract. Project Manager will review the schedule and return a reviewed copy within 21 days after receipt.

B. Cut-off dates for progress revisions may be as early as the 20th of the month to avoid delaying processing of Payment Applications. Use the cut-off date for the first approved revision for further revisions.

C. When required, re-submit within seven days after return of review copy.

D. Include connecting lines between bars in the schedule to indicate the sequence that activities will be accomplished. Connecting lines when the activity's start or finish is modified will identify impact of preceding or succeeding activities. Submit a minimum of six copies of the bar chart on 11 by 17-inch opaque reproductions. Project Manager will retain five copies and return the remaining copy.

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 01330

SUBMITTAL PROCEDURES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Submittal procedures for:

1. Schedule of Values
2. Construction Schedules and Cash Flow Curve (billing forecast).
3. Shop Drawings, Product Data and Samples
4. Operations and Maintenance (O&M) Data
5. Manufacturer's Certificates
6. Construction Photographs
7. Project Record Documents and monthly certification.
8. Video Tapes
9. Design Mixes

1.02 SUBMITTAL PROCEDURES

A. Scheduling and Handling:

1. Submit Shop Drawings, data and Samples for related components as required by Specifications and Project Manager.
2. Schedule submittals well in advance of need for construction Products. Allow time for delivery of Products after submittal approval.
3. Develop submittal schedule that allows sufficient time for initial review, correction, resubmission and final review of all submittals. Allow a minimum of 30 days for initial review. Project Manager will review and return submittals to Contractor as expeditiously as possible but time required for review will vary depending on complexity and quantity of data submitted.

C. Contractor's Stamp:

1. Apply Contractor's Stamp certifying that the items have been reviewed in detail by Contractor and that they comply with Contract requirements, except as noted by requested variances.

2. As a minimum, Contractor's Stamp shall include:
   a. Contractor's name
   b. Job number
   c. Submittal number
   d. Certification statement Contractor has reviewed submittal and it is in compliance with the Contract
   e. Signature line for Contractor

D. Submittals will be returned with one of the following Responses:

1. "ACKNOWLEDGE RECEIPT" when no response and resubmittal is required.

2. "NO EXCEPTION" when sufficient information has supplied to determine that item described is accepted and that no resubmittal is required.

3. "EXCEPTIONS AS NOTED" when sufficient information has been supplied to determine that item will be acceptable subject to changes, or exceptions, which will be clearly stated. When exceptions require additional changes, the changes must be submitted for approval. Resubmittal is not required when exceptions require no further changes.

4. "REJECTED-RESUBMIT" when submittal does not contain sufficient information, or when information provided does not meet Contract requirements. Additional data or details requested by Project Manager must be submitted to obtain approval.

1.03 MANUFACTURER'S CERTIFICATES

A. When required by Specification sections, submit manufacturers' certificate of compliance for review by Project Manager.

B. Place Contractor's Stamp on front of certification.

C. Submit supporting reference data, affidavits, and certifications as appropriate.

D. Product certificates may be recent or from previous test results, but must be acceptable to Project Manager.

Section 01340

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Methods, schedules, and processes to be followed for Shop Drawings, Product Data and Sample submittals.

1.02 REQUIREMENT

A. Submit Shop Drawings, Product Data and Samples as required by Document 00700 - General Conditions and Specification sections, using procedures specified in Section 01330 - Submittal Procedures and the requirements of this Section.

B. Shop Drawings, Product Data and Samples are not considered Contract documents.

1.03 SHOP DRAWING/SUBMITTAL SCHEDULE

A. Submit a separate Shop Drawing submittal schedule at same time the Construction Schedule is submitted. List Products for which Shop Drawings and other submittals are required in the order that they appear in Specifications. Include Product Data and Sample submittals in the schedule. Payment Applications or Certificates for Payment will not be processed until Project Manager has approved the Shop Drawing submittal schedule.

1.04 SHOP DRAWINGS

A. Submit a minimum of seven sets of Shop Drawings and Product Data in a form and quality suitable for microfilming. Review and sign Shop Drawings indicating compliance with the Contract.

B. Place Contractor's Stamp on each drawing as described in Section 01330 - Submittal Procedures.

C. Show the following accurately and distinctly:

1. Field and erection dimensions;

2. Arrangement and section views;

as described in Section 01630 - Product Substitution Procedures, within 30 days after Notice to Proceed.

2. For Products proposed as alternates to "approved" products, provide information required to demonstrate that the proposed Products meet the level of quality and performance criteria of the "approved" product.

1.06 SAMPLES

A. Submit Samples for review as required by Specifications. Have Samples reviewed and signed by a Registered Professional.

B. Place Contractor's stamp on each Sample or firmly attach a sheet of paper with Contractor's stamp, as described in Section 01330 - Submittal Procedures.

C. Submit the number of Samples specified in Specifications; Project Manager will retain one.

D. Reviewed Samples that may be used in the Work are identified in Specifications.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

SECTION 01351

ENVIRONMENTAL SAFETY AND WORKER PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

Environmental Safety and Worker Protection including monitoring emissions and exposure to workers and providing an appropriate response. The role of the Certified Industrial Hygienist (CIH) is also defined.

1.02 MEASUREMENT AND PAYMENT

No separate measurement and payment for work performed under this Section. The Contractor shall include the cost for this work in the contract bid price for work of which this is a component part.

1.03 REFERENCES

The following is a list of applicable requirements to this project. It is not intended to be a complete listing of all laws and regulations to which the Contractor must comply.

A. Code of Federal Regulations

1. 29 CFR 1910, "Occupational Safety and Health Standards".

   a. 29 CFR 1910.146 "Permit-required confined spaces".

2. 29 CFR 1926, "Safety and Health Regulations for Construction" (Construction Industry Standards).

   a. 29 CFR 1926.33 "Access to Employee Exposure and Medical Records".

   b. 29 CFR 1926.51, "Sanitation Standard".

   c. 29 CFR 1926.59, "Hazard Communication".

   d. 29 CFR 1926.62, "Lead".

   e. 29 CFR 1926.103 "Respiratory Protection".

3. 40 CFR 50, "National Primary and Secondary Ambient Air Quality

Standards"

a. 40 CFR 50 Appendix B, "Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High Volume Method)".

b. 40 CFR 50 Appendix G, "Reference Method for the Determination of Lead in Suspended Particulate Matter Collected from Ambient Air".

4. 40 CFR 58, "Ambient Air Quality Surveillance".

5. 40 CFR 60 Appendix A, "Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Fires".

6. 40 CFR 117, "Determination of Reportable Quantities for Hazardous Substances".

7. 40 CFR 122, "Administered Permit Program: The National Pollutant Discharge Elimination System".

B. National Institute for Occupational Health and Safety

NIOSH Method 7082, "Lead" (or equivalent).

C. American Society for Testing and Materials

ASTM D3335, "Test Method for Low Concentrations for Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy."

D. EPA (Environmental Protection Agency) Publications

1. SW-846, "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods".

2. EPA Method 3050, "Acid Digestion of Sediments, Sludges, and Soils".

E. SSPC Guide 6, "Guide for Containing Debris Generated During Paint Removal Operations".

F. SSPC Guide 7, "Guide for the Disposal of Lead Contaminated Surface Preparation Debris".

G. SSPC Publication 91-18, "Industrial Lead Paint Removal Handbook".

H. Texas Commission on Environmental Quality

1. Texas Administrative Code (TAC) 30, Chapter 101, "General Rules".

2. Texas Administrative Code (TAC) 30, Chapter 111, "Control of Air Pollution from Visible Emissions and Particulate Matter".

3. Texas Administrative Code (TAC) 30, Chapter 290, "Water Hygiene".

4. Texas Administrative Code (TAC) 30, Chapter 307, "Surface Water Quality Standards".

5. Texas Administrative Code (TAC) 30, Chapter 309, "Effluent Limitations".

6. Texas Administrative Code (TAC) 30, Chapter 335, "Industrial Solid Waste and Municipal Hazardous Waste".

1.04 SUBMITTALS

A. Submittals shall conform to requirements of Section 01330 – Submittal Procedures.

B. Submittals shall conform to appropriate codes for regulatory requirements.

1.05 DEFINITION

A. Acceptance Criteria: Minimum standards for the content of programs, plans, procedures, and designs required by this specification for the performance of this project. Acceptance criteria will be the basis for judging the responsiveness of Contractors' programs and will also be used as a basis for suspending work, if necessary.

B. Action Level: Employee exposure, without regard to the use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air (µg/m3) calculated as an eight hour time-weighted average (TWA).

C. CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act; commonly called Superfund. Federal laws addressing the clean up of hazardous waste sites. Amended in 1986 by Superfund Amendments and Re-Authorization Act (SARA). EPA implementing regulations are contained in 40 CFR 300-373.

D. Competent Person: One who is capable of identifying existing and predictable lead hazards in the surroundings or working conditions and who has authorization to take prompt corrective measures to eliminate them.

E. Containment System: An enclosure built around lead paint removal areas designed to contain lead paint debris and prevent emissions to the environment.

F. Dust Collection: Mechanical ventilation system designed specifically for the containment, capture, and removal of airborne particulate from the containment. Dust collection systems shall include ductwork, plenums and/or hoppers, and dust collector(s) for the removal of leaded paint dust from the air stream prior to discharging to the atmosphere.

G. Emission: A release of material to the air, water, or ground.

H. Entry/Exit Airlock: An isolated enclosure located at the entrance of the containment in which the workers remove contaminated dust and debris from their work clothes.

I. EPA: The US. Environmental Protection Agency. Regulations are contained in Title 40 of the Code of Federal Regulations (40 CFR).

J. Hazardous Waste (lead paint debris): Waste that is classified as hazardous due to its concentrations of regulated hazardous substances. Paint debris is classified as hazardous waste if, after testing by the Toxicity Characteristic Leaching Procedure (TCLP), the leachate contains any of the 8 metals or other substances in concentrations at or above limits established in 40 CFR 261.

K. HEPA: A high efficiency particulate filter (HEPA) that is 99.97% efficient against particles of 0.3 microns in size or larger.

L. Lead Containing Dust and Debris: Dust and debris generated during the project which contains lead in any amount, including but not limited to pulverized paint, spent abrasive, filters (wet and dry), and containment materials upon which lead is still present.

M. NIOSH: National Institute of Occupational Safety and Health.

N. OSHA: Occupational Safety and Health Administration. Standards are contained in Title 29 of the Code of Federal Regulations, Parts 1910 and 1926 (29 CFR 1910 and 29 CFR 1926).

O. Owner: The City of Houston

P. PEL: Permissible Exposure Limit. An employee exposure, without regard to the use of respirators, to an airborne concentration of lead of 50 µg/m3 over an 8 hour TWA.

Q. POTW: Publicly Owned Treatment Works

R. RCRA: Resource Conservation and Recovery Act. Federal law pertaining to hazardous waste management. EPA implementing regulations are contained in 40 CFR 240-280.

S. Regulated Area: Area established by the Contractor to demarcate the zone(s) beyond which airborne concentrations of lead do not exceed the Action Level.

T. SSPC: Society for Protective Coatings. An independent, non-profit organization of engineers, technical specialists, and Contractors whose goal is research and development of new coatings and methods for removal, application, and disposal of existing coatings on industrial structures.

U. Tarpaulins: Flexible fabric, vinyl, plastic or canvas cover sheets, impenetrable to dust, wind, and water, used to enclose the cable and/or scaffold support system comprising the containment enclosure.

V. TCLP: Toxicity Characteristic Leaching Procedure. Laboratory tests conducted on wastes that determine the amount of hazardous materials that leach out into a test solution. The test is intended to simulate the properties of water as it leaches through a solid waste landfill. TCLP testing is defined in 40 CFR 261, Appendix II.

W. TSP: Total Suspended Particulate

PART 2 PRODUCTS

2.01 MATERIAL AND EQUIPMENT

A. The Contractor is to supply materials and equipment to insure the safety and protection of workers and the environment in accordance with these specifications.

PART 3 EXECUTION

3.01 ENVIRONMENTAL PROTECTION AND MONITORING

NOTE: Section 09971 "Painting and Protective Coatings", 2.04 "Containment System" specifically identifies containment system requirements.

A. Protection of Ambient Air: Visible emissions are to be controlled to meet, as a minimum, TAC 30 Chapter 111," Control of Air Pollution from Visible Emissions and Particulate Matter" requirements and SSPC-Guide 6I (CON), Level 1 Emissions. Air monitoring and analysis may be performed by the City during abrasive blast cleaning operations. Such monitoring will be in accordance with 40

CFR 50, Appendix B, "Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere" and/or 40 CFR 50, Appendix G, "Reference Method for the Determination of Lead in Suspended Particulate Matter Collected from Ambient Air". The limits for down wind pollutant concentrations allowed during blasting operations are as follows:

PM-10: 450 micrograms/cubic meter/ 8 hr.. (40 CFR 50.6)

Lead (Pb): 13.5 micrograms/cubic meter/8 hr.. (40 CFR 50.12)

Visible emissions and/or monitored emissions for PM-10 and TSP lead in excess of the above levels shall be cause for shut down of the project until corrections to control/ containment system or paint removal/ surface preparation operations are made to comply with these requirements.

B. Protection of Surface and Storm Water: The Contractor shall take all necessary precautions to ensure lead contaminants do not enter surface waters or storm water drainage systems.

1. The Contractor shall protect the area around ditches and drainage inlets. Daily verification of proper protection to minimize the potential contaminants reaching the drainage system shall be performed.

2. The Contractor shall collect all potentially contaminated process waters for testing and, as appropriate, treatment. Process water from pressure washing, wet abrasive blast cleaning or hygiene facilities shall not be discharged to drainage systems or surface waters.

3. The Contractor may remove lead or other heavy metals from such waters through filtration, ion exchange or other approved means. Following treatment, water samples must be tested prior to disposal. Discharge to sanitary sewer lines requires authorization, in writing, from a POTW.

C. Protection of Soil and Grounds: The Contractor shall protect the soil around the structure to ensure that the soil does not become contaminated. Where lead is present in the coatings to be removed, as indicated in Section 02136 "Waste Material Handling and Disposal", the Contractor shall provide for the sampling and analysis of soil samples for total lead content.

1. Sampling and analysis shall be performed prior to commencement of paint removal operations to establish a background "base level". Soil samples shall be taken 3 feet from the base of the tank(s), at a distance of 6-10 feet beyond the proposed containment structure and at the property line.

2. Samples from each area shall be taken in a minimum of four directions, at

circular increments of 90^0, one of which shall include the direction of prevailing wind. Samples shall also be obtained, at the direction of the engineer, at the closest points of public access (i.e. housing, park, school).

3. The soil sampling procedure shall be as outlined in SSPC Guide 6 Section 5.5.5. Each sampling point shall be sufficiently identified on a site map to allow return to the exact location upon project completion.

4. Each sample shall be split in two portions, one for immediate analysis and the other sealed, preserved and furnished to the Engineer. The samples shall be analyzed in accordance with EPA Method 3050, "Acid Digestion of Sediments, Sludges and Soils", and shall be performed by a qualified laboratory approved by the Engineer.

5. Samples shall be obtained at the completion of work (post-construction samples) from all locations from which pre-construction samples were obtained. Samples shall be collected, handled and tested in the same manner as described above.

6. Upon completion of the work, soils found to be contaminated with lead in greater quantity than found in the background "base level", established at the start of the work, shall be removed by the Contractor to the depth necessary to achieve a lead content equivalent to, or below, the pre-construction back ground levels. Disposal shall be in accordance with applicable regulations.

7. The Contractor shall replace in-kind (i.e., topsoil, structural fill, etc.) with an equivalent amount of non-contaminated soil, compact in place and grade to pre-existing conditions. The Contractor shall also replace in-kind any surface improvements, such as grass, shrubs, etc. that were damaged or destroyed by the work. The soil removal, replacement and related work is to be performed by the Contractor at no additional cost to the Owner.

3.02 WORKER PROTECTION

A. The Contractor shall develop a written Compliance Program to establish and implement practices and procedures for assuring that no employee is exposed to lead at concentrations greater than 50 micrograms per cubic meter of air ($\mu g/m^3$), the OSHA permissible exposure limit (PEL). This program is in addition to other OSHA hazard communication and safety and health requirements of the project, and shall be revised and updated at least every six months.

1. The program shall establish methods for complying with this specification and the OSHA Construction Industry Lead Standard, 29 CFR 1926.62(e)(2)(ii). The Federal regulation is referred to as the "Lead

Standard" for the purpose of this specification.

2. The program shall apply to all Contractor employees associated with lead on the project, and to subcontractors working under the direct control of the Contractor who are associated with lead on the project.

3. The program shall assign the specific responsibility for implementation and enforcement of the program to the Contractors' company management. The Contractor's Competent Person(s) shall be identified, by name, and qualifications submitted. The Competent Person shall be on-site during any operations which involve the removal, handling or disturbing of lead containing materials.

4. The program shall contain a description of each activity in which lead is emitted (e.g. equipment used, material involved, controls in place, crew size, employee job responsibilities, operating procedures and maintenance practices).

5. The program shall contain a report of the technology considered in meeting the PEL and air monitoring data which documents the source of lead emissions.

6. The program shall contain a work practice program which includes items required in the lead standard such as protective clothing and equipment, housekeeping, and hygiene facilities and practices.

B. Exposure Monitoring: The Contractor shall be responsible for conducting and reporting worker exposure assessments in accordance with 29 CFR 1926.62.

1. Representative personal air samples shall be collected at the beginning of the lead removal work to determine employee lead exposures. Tasks involving potential lead exposure include, but are not limited to, paint removal operations, clean-up, and debris handling operations. Full shift (at least 7 hours) air samples shall be collected for each job classification in the exposure area. The range of exposures for lead removal and cleanup activities shall be determined.

2. During the initial monitoring, workers performing the following activities (or equivalent) shall be protected to the anticipated exposure levels which are dictated by the lead standard:

   a. 500 $\mu g/m^3$: Manual demolition of structures containing lead-containing coatings or paint (e.g., dry wall), manual scraping, manual sanding, heat gun applications, power tool cleaning with dust collection systems, and spray painting with lead paint.

b. 2,500 $\mu g/m^3$: Using lead-containing mortar, lead burning, or conducting the following activities where lead-containing coatings or paint are present: rivet busting, power tool cleaning without dust collection systems, clean-up activities where dry expendable abrasives are used, and the movement and removal of abrasive blasting enclosures.

c. More than 2,500 $\mu g/m^3$: Activities involving lead containing coatings or paint on structures disturbed by abrasive blasting, welding, cutting, and torch burning.

3. Protection requires compliance with the necessary respiratory protection, personal protective clothing and equipment, change areas and washing facilities, blood lead and zinc protoporphyrin monitoring, and employee training. The protection measures shall be modified, as necessary, after the exposure results are received.

4. Where initial monitoring indicates that lead exposures are below the Action Level, and where work activities and conditions remain the same as at the time of initial sampling, additional monitoring need not be repeated for that work activity.

5. Where the initial monitoring of a given work activity indicates that lead exposures are at or above the Action Level, additional exposure monitoring shall be conducted monthly. The monthly monitoring is more frequent than frequencies established in the lead standard which are at least every 6 months if above the Action Level, but below the PEL, or every 3 months if above the PEL.

6. All air samples shall be collected and analyzed according to NIOSH Method 7082, or equivalent. All samples shall be analyzed by laboratories accredited by the American Industrial Hygiene Association for metals analysis.

7. All exposed employees shall be notified in writing of the monitoring results within five (5) days after receiving the results.

8. The Action Level for airborne lead exposure is 30 $\mu g/m^3$, as an 8-hour time weighted average (TWA) concentration, without regard to the use of respirators. Whenever workers' airborne lead exposures exceed the Action Level, the Contractor shall implement the following:

   a. Periodic Exposure Monitoring
   b. Employee Information and Training

c. Employee Medical Surveillance and Medical Removal Protection
d. Housekeeping
e. Record keeping
f. Signs and Regulated Areas

9. The Permissible Exposure Limit (PEL) for airborne lead exposure is 50 $\mu g/m^3$, as an 8-hour TWA concentration. When the work area contains airborne lead levels above the PEL the Contractor shall implement the following in addition to those items listed in 3.02.B.8 of this section:

a. Compliance Program
b. Respiratory Protection
c. Protective Clothing and Equipment
d. Hygiene Facilities and Practices

C. Respiratory Protection: After feasible engineering controls and work practices have been implemented, respiratory protection shall be used to maintain employees' lead exposures below the PEL.

1. Respirators shall be worn by all employees, other Contractors, inspectors, or observers who enter regulated areas.

2. The Contractor shall develop a written Respiratory Protection Program in compliance with 29 CFR 1910.134, paragraphs (b), (d), (e), and (f), and the lead standard. The program shall address the selection, use, maintenance, and inspection of respirators, and qualifications for respirator users.

D. Protective Clothing and Equipment: The Contractor shall provide protective clothing and equipment and ensure they are worn by all employees whose lead exposures exceed the PEL, or who enter regulated areas.

1. Protective clothing shall include washable and/or disposable full body coveralls, gloves, foot coverings, and hoods. Other protective equipment shall include face shields, hard hats, eye protection, and hearing protection as appropriate.

2. Disposable protective clothing shall be used for no more than one work day. Such clothing may have to be disposed of as hazardous waste.

3. Reusable protective equipment shall be cleaned or replaced weekly if exposure levels are less than 200 $\mu g/m^3$, or daily if the exposure levels are greater than or equal to 200 $\mu g/m^3$.

4. Clothing shall not be removed or "cleaned" by any means which could reintroduce the lead dust into the ambient air. This includes brushing,

shaking, and blowing. Vacuums equipped with HEPA filters shall be used for this purpose.

5. Reusable coveralls shall be collected at the end of each work day in closed containers. The containers shall be labeled in accordance with the requirements of 29 CFR 1926.62(g)(2)(vii). Contaminated clothing shall be cleaned in accordance with all applicable Federal, State, or local regulations pertaining to lead-contaminated laundry and water discharge. Laundries shall be informed that the clothing contains lead. If the clothing is washed on site, the discharge water shall be filtered, containerized, and arrangements made with the local POTW or other approved means of proper disposal.

6. Protective clothing and equipment shall be removed in the contaminated section of the change area and shall not be worn into any clean areas.

7. The Contractor shall provide the necessary clothing and equipment for use by the Owner and its designated representatives.

E. Housekeeping: Accumulations of lead-containing dust and debris generated by work activities shall be removed and cleaned daily.

1. All persons doing the cleanup shall be trained in performing lead activities, respirator qualified, and participate in the medical surveillance program. Respirators and protective clothing shall be worn by all persons doing the cleanup.

2. Compressed air may be used for housekeeping if used within containment and in conjunction with a ventilation system designed to capture the dust. Otherwise, HEPA-filtered vacuum cleaners shall be employed.

3. All lead-containing dust and debris shall be collected in sealed containers. The waste shall be tested to determine whether it will be disposed of as hazardous waste.

F. Personal Hygiene Facilities and Practices

1. Clean change areas shall be provided when employees' lead exposures exceed the PEL. The change areas shall be equipped with storage facilities for street clothing and a separate area for the removal and storage of lead-contaminated clothing and equipment. They shall be designed and used so that contamination of street clothing does not occur. Employees shall not leave the project site wearing any clothing worn while performing lead activities. Airborne lead exposures in the change area shall be maintained below the Action Level.

2. Shower facilities shall be provided whenever employees' lead exposures exceed the PEL. Shower facilities shall comply with OSHA Sanitation Standard, 29 CFR 1929.51. All employees whose lead exposures exceed the PEL shall shower at the end of each work shift or before leaving the project area. The shower facilities shall be made available for use by the Owner and its representatives, such as inspectors or observers.

3. Arrangements shall be made with the local POTW for the proper disposal of the shower and wash water after filtration (e.g., through a three stage 100, 50, and 5 micron filtering system), ion exchange, or other approved treatment technology.

4. Clean lunch areas shall be provided for all employees whose lead exposures exceed the PEL. Employees shall remove or clean (by vacuuming) their protective clothing and wash their hands and face before entering the lunch area. Lead exposures in the lunch area shall be maintained as free as practicable from lead contamination.

5. An adequate number of clean lavatory and hand washing facilities shall be provided. These shall comply with the OSHA Sanitation Standard, 29 CFR 1929.51.

6. Eating, drinking, smoking, chewing of food or tobacco products, or the application of cosmetics shall not be permitted in any areas where the lead exposures exceed the PEL. Thorough washing of hands and face is required prior to undertaking any of these activities.

G. Medical Surveillance and Medical Removal Protection

1. All employees who are exposed to lead above the Action Level in a single day during this project shall be provided with initial and periodic medical examinations and blood lead tests as required by the lead standard. A final blood lead test shall be provided for each worker upon completion of the project, or at any time a worker's employment at the project ceases.

2. When blood lead levels over 50 µg/dl are encountered, the Contractor shall provide for the temporary removal of employees from lead exposure above the Action Level. The required medical surveillance and periodic blood lead tests shall be provided in strict accordance with the lead standard throughout the removal.

3. Employees who will be required to wear a respirator or who request one shall be provided with a respirator and the necessary medical examinations to determine their ability to wear a respirator.

4. All examinations shall be provided by the Contractor and shall be performed by or under the direct supervision of a licensed physician.

H. Employee Information and Training

1. The Contractor shall provide lead training for all employees who are exposed to lead above the Action Level for this project.

2. The content of lead training shall include, as a minimum, those items listed in the lead standard.

3. Training shall also include hazard communication in accordance with 29 CFR 1926.59.

4. The Contractor shall notify other employers at the project site of the nature of the lead exposure work, the need to remain out of exposure areas, the warning sign and labeling system in effect, and the potential need for them to take measures to protect their employees.

I. Signs and Regulated Areas

1. The Contractor shall establish a regulated area surrounding activities where lead exposures exceed the Action Level. This includes locations where lead-containing debris is handled or transferred to storage containers.

2. The regulated area shall be demarcated by ropes, tape, walls, or containment's with caution signs posted at all accessible sides. Signs shall contain the legend:

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

3. The Contractor shall control access of persons into regulated areas. Access shall be limited to individuals with proper training and personal protective equipment, and medical surveillance testing.

4. All persons entering regulated areas shall wear protective clothing and respirators.

5. Eating, drinking, smoking, and chewing of food or tobacco products shall be prohibited in regulated areas and in any area where lead exposures exceed the Action Level.

J. Record keeping: All records relating to training, medical examinations, blood lead monitoring, and exposure monitoring shall be maintained by the Contractor as required by the lead standard. All records shall be available for review by the Owner or its representative upon request.

3.03 CERTIFIED INDUSTRIAL HYGIENIST (CIH)

A. The Contractor shall provide for the services of a Certified Industrial Hygienist (CIH) who must be certified by the American Board of Industrial Hygiene in comprehensive practice.

B. Duties of the CIH shall be as follows:

1. Conduct and/or verify training for contractor employees in accordance with 29 CFR 1926.62 (l).

2. Review and approve Contractor's Written Compliance Plan for conformance to 29 CFR 1926.62(e)(2)(ii) and this Specification.

3. Monitor and evaluate work weekly to assure conformance with the approved plan and that hazardous exposure is adequately controlled in accordance with worker safety and health requirements of these specifications

4. Provide monthly reports of work compliance with control requirements in regards to working in a lead environment.

C. Activities of the CIH shall include:

1. Meet with City to discuss details of Contractor's Written Compliance Plan for lead paint removal.

2. Ensure worker and area air monitoring, testing and reporting are conducted by or under the direction of the CIH.

3. Furnish a detailed worker and area air monitoring schedule coordinated with Contractor's proposed production schedule.

4. Directing, monitoring and inspecting lead paint removal work to ensure that the requirements of the Contract have been satisfied during the entire lead paint removal operation.

5. Report results of air monitoring samples to the Engineer, signed by the CIH within 48 hours after the air samples are taken.

6. The CIH shall review sampling data, collected on a day when lead paint

removal operations occur, to determine if conditions require any change in work methods. Removal work shall not continue until approval is given by the CIH.

7. The CIH shall verify in writing and submit monitoring data to verify that:

   a. Air borne lead levels at and beyond the lead control (regulated) area were and remained less than 30 mg/m^3 of air

   b. Contractor conformance to 29 CFR 1926.62 and Item 3.02, above

   c. There were no visible accumulations of lead contaminated paint, dust or debris on the work site. Adjacent areas that may have become contaminated were properly cleaned and inspected.

   d. The CIH shall verify that the work area and contractor's equipment have been adequately cleaned of lead contamination prior to demobilization from the work site.

3.04 DEMOBILIZATION

The Contractor shall not remove the lead control area, boundaries, warning signs, etc. prior to proper removal of all hazardous wastes, debris and materials from the site and the City's receipt and acceptance of the CIH's verification.

END OF SECTION

Section 01410

TPDES REQUIREMENTS

1.01 SECTION INCLUDES

A. Documentation to be prepared and signed by Contractor/Operator 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).

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 appropriate practices shown on the Drawings or specified elsewhere in the Contract.

C. Review of the Storm Water Pollution Prevention Plan (SWP3) implementation in a meeting with Project Manager prior to start of construction.

1.02 DEFINITIONS

A. Commencement of Construction Activities: The exposure of soil resulting from activities such as clearing, grading, and excavation activities, as well as other construction related activities (e.g., stock piling of fill material, demolition).

B. Large Construction Activity: Project that:o

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:

Operator - The person or persons associated with a large or small construction activity that is either a primary or secondary as defined below:

Primary Operator – the person or persons associated with a large or small construction activity that meets either of the following two criteria:

(a) the persons have operational control over construction plans and specifications, including the ability to make modifications to those plans and specifications; or

(b) the person or persons have day-to-day operational control of those activities at a construction site that are necessary to ensure compliance with a storm water pollution prevention plan (SWP3) for the site or other permit conditions (e.g., they are authorized to direct workers at a site to carry out activities required by the SWP3 or comply with other permit conditions).

Secondary Operator – The person whose operational control is limited to the employment of other operators or to the ability to approve or disapprove changes to plans and specifications. A secondary operator is also defined as a primary operators if there are no other operators if there are no other operators at the construction site.

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 POLLUTION PREVENTION PLAN (SWP3)

A. Prepare a SWP3 following Part III of the Construction General Permit and the Storm Water Management Handbook for Construction Activities issued under City Ordinance Section 47-695(b). If conflicts exist between the Construction General Permit and the handbook, the more stringent requirements will apply.

B. Update or revise the SWP3 as needed during the construction following Part III, Section E of the Construction General Permit.

C. Submit the SWP3 and any updates or revisions to Project Manager 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 01410.

B. Transmit the signed Contractor's copy of TCEQ Form 20022 (03/05/2008), along with a $325.00 check, made out to Texas Commission on Environmental Quality, and the completed Payment Submittal Form to Project Manager.

C. Project Manager 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 City and Contractor to TCEQ if mailing is required a minimum of seven days before Commencement of Construction Activities.

3.03 CONSTRUCTION SITE NOTICE FOR SMALL CONSTRUCTION ACTIVITY

A. Fill out, sign, and date the Construction Site Notice, Attachment 2 to TPDES General Permit TXR 150000, "Construction Site Notice", **ATTACHMENT 2** of this Section 01410.

B. Transmit the signed Construction Site Notice to Project Manager 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 01410, 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 01410. Include this certification with other Project certification forms.

C. Submit properly completed certification forms to Project Manager 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 City of Houston Storm Water Pollution Prevention Plan, Construction Site Inspection Report, **ATTACHMENT 5** of this Section 01410 to record maintenance inspections and repairs.

3.05 RETENTION OF RECORDS

A. Keep a copy of this document and the SWP3 in a readily accessible location at the construction site from 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 SWP3 implementation shall have a copy of the SWP3 available at a central location, on-site, for the use of all operators and those identified as having responsibilities under the SWP3. Upon submission of the NOT, submit all required forms and a copy of the SWP3 with all revisions to Project Manager.

3.06 REQUIRED NOTICES

A. Post the following notices from effective date of the SWP3 until date of final site stabilization as defined in the Construction General Permit:

1. Post the TPDES permit number for Large Construction Activity, with a signed TCEQ Construction Site Notice for large or Small Construction Activity. Signed copies of the City's and Contractor's NOI must also be posted.

2. Post notices near the main entrance of the construction site in a prominent place where it is safely and readily available for viewing by General Public, Local, State, and Federal Authorities. Post name and telephone number of Contractor's local contact person, brief project description and location of the SWP3.

    a. If posting near a main entrance is not feasible due to safety concerns, coordinate posting of notice with Project Manager 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 access 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 SWP3.

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 best management practices. Keep a copy of the description with the SWP3.

3.08 NOTICE OF TERMINATION

A. Submit a NOT, **ATTACHMENT 7** of this Section 01410, to Project Manager 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 SWP3, or transferred to a new operator if the new operator has sought permit coverage.

B. Project Manager will complete City's NOT and submit Contractor and City's notices to the TCEQ and MS4 entities.

END OF SECTION

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ATTACHMENT 1

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

For help completing this application, read the TXR150000 NOI Instructions (TCEQ-20022-Instructions).

TCEQ Office Use Only
TPDES Permit Number: TXR15 __|__|__|__| - NO
GIN Number: |__|__|__|__|__|__|__|__|__|__|

A. Construction Site Operator ☐ New ☐ No Change Customer Reference Number: CN_____
Name:_____
Mailing Address:_____ City:_____ State:____ Zip Code:_____
Country Mailing Information (*if outside USA*) Territory:_____ Country Code:_____ Postal Code:_____
Phone Number:_____ Extension:_____ Fax Number:_____
E-mail Address:_____
Type of Operator: ☐ Individual ☐ Sole Proprietorship - D.B.A. ☐ Partnership ☐ Corporation ☐ Federal Government
☐ State Government ☐ County Government ☐ City Government ☐ Other:_____
Independent Operator? ☐ Yes ☐ No Number of Employees: ☐ 0-20 ☐ 21-100 ☐ 101-250 ☐ 251-500 ☐ 501 or higher
Federal Tax ID:_____ State Franchise Tax ID Number:_____ DUNS Number:_____

B. Billing Address
Name:_____
Mailing Address:_____ City:_____ State:____ Zip Code:_____
Country Mailing Information (*if outside USA*) Territory:_____ Country Code:_____ Postal Code:_____

C. Project / Site Information ☐ New ☐ No Change Regulated Entity Reference Number: RN_____
Name:_____
Mailing Address:_____ City:_____ State:____ Zip Code:_____
Physical Address:_____ City:_____ County:_____ Zip Code:_____
Location Access Description:_____
Latitude:___°___'___" N Longitude:___°___'___" W Degrees (°), Minutes ('), and Seconds (")
Latitude:_____ Longitude: -_____ Decimal Form
Standard Industrial Classification (SIC) code:_____ Also, describe the construction activity at this site (*do not repeat the SIC code*):
_____
Has a storm water pollution prevention plan been prepared as specified in the general permit (TXR150000)? ☐ Yes ☐ No
Estimated area of land disturbed (to the nearest acre):_____ Is the project / site located on Indian Country Lands? ☐ Yes ☐ No
Does this project / site discharge storm water into a municipal separate storm sewer system (MS4)? ☐ Yes ☐ No
If yes, provide the name of the MS4 operator:_____
Provide the name or segment number of the water body that receives storm water from this project / site:_____

D. Contact - If the TCEQ needs additional information regarding this application, who should be contacted?
Name:_____ Title:_____
Phone Number:_____ Extension:_____ Fax Number:_____
E-mail Address:_____

E. Payment Information - Check / Money Order Number:_____ Name on Check / Money Order:_____

F. Certification
I certify under penalty of law that this document was 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.
Construction Site Operator:
Prefix:_____ First:_____ Middle:_____
Last:_____ Suffix:_____ Title:_____
Signature:_____ Date:_____

If you have questions on how to fill out this form or about the storm water program, please contact us at (512) 239-4671.
Individuals are entitled to request and review their personal information that the agency gathers on its forms. They may also have any errors in their information corrected. To review such information, contact us at (512) 239-3282.

The completed NOI must be mailed to the following address. Use the attached document to submit the $100 application fee. Please note that the NOI and application fee are submitted separately to different addresses.

Texas Commission on Environmental Quality
Storm Water & General Permits Team; MC - 228
P.O. Box 13087
Austin, Texas 78711-3087

TCEQ-20022 (05/03) **Page 1 of 2**

ATTACHMENT 1

Texas Commission on Environmental Quality
Payment Submittal Form

The storm water application fee shall be sent under separate cover to the Texas Commission on Environmental Quality.

This form must be used to submit your Storm Water Application Fee. Please complete the following information, staple your check in the space provided at the bottom of this document, and mail it to:

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

Fee Code: GPA

Storm Water General Permit: TXR150000

Check / Money Order No: _____

Amount of Check/Money Order: _____

Date of Check or Money Order: _____

Name on Check or Money Order: _____

Facility / Site Name: _____

Facility / Site Physical Address: _____

City: _____

Zip Code: _____

Staple Check In This Space

ATTACHMENT 1

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

A. Construction Site Operator Information

Check boxes and Customer Reference Number

These boxes designate the operator's status as a TCEQ "customer"—in other words, an individual or business that is involved in an activity that we regulate. We assign each customer a number that begins with "CN," followed by nine digits. ***This is not a permit number, registration number, or license number.*** In the remainder of this section, we will use "this customer" to mean the operator for Part A of the form.

- If this customer has not been assigned a Customer Reference Number or if this number is unknown, check "New" and 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 and:
  - Check "No Change" if all the remaining customer information is the same as previously reported. However, you must still complete most blanks in this form for this notice of intent to be valid.
  - If this customer's information has changed since the last time it was reported to the TCEQ, check neither box and complete the remainder of this notice of intent.
- ***Do not enter a permit number, registration number, or license number in place of the Customer Reference Number.***

Name

Enter the legal name of this customer as authorized to do business in Texas. Include any abbreviations (LLC, Inc., etc.)

Mailing Address

Enter a central and general mailing address for this customer to receive mail from the TCEQ. For example, if this customer is a large company, this address might be the corporate or regional headquarters. On the other hand, for a smaller business, this address could be the same as the site address.

If this is a street address, please follow US Postal Service standards. In brief, these standards require this information in this order.

- the "house" number—for example, the 1401 in 1401 Main St
- if there is a direction before the street name, the one- or two-letter abbreviation of that direction (N, S, E, W, NE, SE, SW, or NW)
- the street name (if a numbered street, do not spell out the number—for example, 6th St, not Sixth St)
- an appropriate abbreviation of the type of street—for example, St, Ave, Blvd, Fwy, Exwy, Hwy, Cr, Ct, Ln
- if there is a direction after the street name, the one- or two-letter abbreviation of that direction (N, S, E, W, NE, SE, SW, or NW)
- if there is a room number, suite number, or company mail code

City, State, *and* ZIP Code

Enter the name of the city, the two-letter USPS abbreviation for the state (for example, TX), and the ZIP Code. (Enter the full ZIP+4 if you know it.)

Country Mailing Information

If this address is ***outside*** the United States, enter the territory name, country code, and any non-ZIP mailing codes or other non-U.S. Postal Service features here. If this address is ***inside*** the United States, leave these spaces blank.

Phone Number *and* Extension

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.

Fax Number

This number should correspond to this customer's mailing address given earlier. Enter the area code and fax number here.

E-mail Address

As with the mailing address, this should be a general address that is appropriate for e-mail to this customer's central or regional headquarters, if applicable.

If "No Change" was checked for this customer, you may skip the rest of the fields in this part of the form and continue to the next part of the NOI.

Type of Operator

Check *only one* box

Check ...	*if this customer ...*
Individual	is a person and has not established a business to do whatever causes them to be regulated by us.
Sole Proprietorship—D.B.A.	is a business 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 business that is established as a partnership as defined by the Texas Secretary of State's Office
Corporation	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
Federal, state, county, or city government (as appropriate)	is either an agency of one of these levels of government or the governmental body itself (If a utility district, water district, tribal government, college district, council of governments, or river authority, check "Other" and write in the specific type of government.)
Other	fits none of the above descriptions. Enter a short description of the type of customer in the blank provided

Independent Operator?

Check "No" if this customer is a subsidiary or part of a larger company. Otherwise, check "Yes."

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 this NOI.***

Federal Tax ID

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

State Franchise Tax ID

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.

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. Billing Address

We will mail the annual fee invoice for this site to the address entered in this section.

Name

Enter the legal name of the person or business to which we should mail this site's fee invoice each year.

Mailing Address

Enter the specific mailing address to which we should mail this site's fee invoice each year. If this is a street address, please follow the US Postal Service standards as described under "A. Construction Site Operator Information" on page 1 of these instructions.

City, State, *and* ZIP Code

Enter the name of the city, the two-letter USPS abbreviation for the state (for example, TX), and the ZIP Code. (Enter the full ZIP+4 if you know it.)

Country Mailing Information

If this address is ***outside*** the United States, enter the territory name, country code, and any non-ZIP mailing codes or other non-U.S. Postal

ATTACHMENT 1

Service features here. If this address is ***inside*** the United States, leave these spaces blank.

C. Project / Site Information

Check boxes *and* Regulated Entity Reference Number
These boxes designate this site's status as a TCEQ "regulated entity"—in other words, a location where an activity that we regulate occurs. We assign each regulated entity a number that begins with "RN," followed by nine digits. ***This is not a permit number, registration number, or license number.***

- If this site has not been assigned a Regulated Entity Reference Number or if this number is unknown, check "New" and leave the space for the Regulated Entity Reference Number blank.
- If this site has already been assigned this number, enter the Regulated Entity Reference Number and:
  - Check "No Change" if all the remaining information is the same as previously reported. However, even if there has been no change, you must complete this section at least through "E-mail Address" for this NOI to be valid.
  - If this site's information has changed since the last time it was reported to the TCEQ, check neither box and complete the remainder of this notice of intent.
- ***Do not enter a permit number, registration number, or license number in place of the Regulated Entity Reference Number.***

Name
Enter the name by which you want this site to be known to the TCEQ.

Mailing Address
Enter the specific mailing address for this site. If this is a street address, please follow the US Postal Service standards as described under "A. Construction Site Operator Information" on page 1 of these instructions. If the project / site's mailing address is the same as what is provided in Section A, you may enter "Same as Section A".

City, State, *and* ZIP Code
Enter the name of the city, the two-letter USPS abbreviation for the state (for example, TX), and the ZIP Code. (Enter the full ZIP+4 if you know it.)

Physical Address
Enter the physical address of the site itself. TCEQ staff should be able to use this address to find the site. Please follow the US Postal Service standards as described under "A. Construction Site Operator Information" on page 1 of these instructions. If the project / site does not have a physical address, enter "No Address".

City, County, *and* ZIP Code
Enter the name of the city, the county, and the ZIP Code. (Enter the full ZIP+4 if you know it.) This information must be provided even if you have entered "No Address" in the previous field.

Location Access Description
Enter a physical description of the location of the site based on highway intersections and/or permanent landmarks.

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:
http://www.tnrcc.state.tx.us/gis/drgview.html

Standard Industrial Classification (SIC) Code and Activity Description

Provide the SIC code that best describes the construction activity being conducted at the site.

For help with SIC codes, go to:
http://www.osha.gov/oshstats/sicser.html

In addition to the SIC code, you must also provide a description of the construction activity being conducted at the site. This may include such descriptions as: "Apartment Building Construction" or "Shopping Center Construction."

Storm Water Pollution Prevention Plan
This plan identifies the areas and activities that could produce contaminated runoff at your site and then tells how you will ensure that this contamination is mitigated. For example, in describing your mitigation measures, your site's plan might identify the devices that collect and filter storm water, tell how those devices are to be maintained, and tell how frequently that maintenance is to be carried out. ***You must develop this plan before you complete this NOI.*** This plan must be available for a TCEQ investigator to review on request. Specific requirements for the development of the plan can be found in the *Texas Pollutant Discharge Elimination System Construction General Permit (TXR150000)*.

Estimated Area of Land Disturbed
Provide the approximate number of acres that the construction site will disturb. It is appropriate to enter a value less than 5, only if the project is part of a larger common plan that disturbs five or more acres. If the acreage is less than 1, enter 1. "Disturb" means any clearing, grading, excavating, or other similar activities.

Is the site located on Indian Country Lands?
Check "Yes" only if the site is on a reservation or other areas designated by the federal government as Indian Country Lands. If not, check "No."

Destination of Storm Water Discharge
The storm water from your site eventually reaches a receiving water body such as a local stream or lake, possibly via a drainage ditch. The discharge may initially be into a municipal separate storm sewer system (MS4). Check the appropriate boxes for whether storm water is discharged into an MS4. If you checked "Yes" to "An MS4?", then enter the name of the entity that operates the storm sewer—often a city, town, or utility district, but possibly another form of government.

You must also provide the name of the water body that receives the discharge from the construction site (a local stream or lake). Storm water may be discharged directly to a receiving stream or via a storm sewer system. If known, please include the segment number if the discharge is to a classified water body.

For a map that includes segment numbers, go to:
http://www.tnrcc.state.tx.us/water/quality/data/index.html

D. Contact

Give all the relevant information for the person whom TCEQ can contact if there are questions about any of the information on this form—perhaps the same person who completed the form.

E. Payment Information

Provide the number and account holder name from the check or money order used to pay the $100 application fee.

F. Certification

The operator must sign and date this statement to validate this NOI. Be sure to enter the full legal name of the person signing the form and the relevant title—for example, "Operator," "Vice-President," or "Partner." Use the "Prefix" blank for such titles as Dr., Mr., or Ms., as desired. Use the "Suffix" blank for such designations as Ph.D., Jr., Sr., III, or J.D., if applicable.

For a corporation, the application shall be signed by a responsible corporate officer. 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 applications may provide for assignment or delegation to applicable corporate positions rather than to specific individuals.

For a partnership or sole proprietorship, the application shall be signed by a general partner or the proprietor, respectively.

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 application, 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 United States Environmental Protection Agency).

Questions?

If you have questions about any of the information on this form, contact our Storm Water Program at 512/239-4671 or look for "Storm Water" on our Web site.

www.tceq.state.tx.us

ATTACHMENT 2

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.D.2.** of the TCEQ General Permit Number TXR150000 for discharges of storm water runoff from construction sites. Additional information regarding the TCEQ storm water permit program may be found on the internet at:
www.tnrcc.state.tx.us/permitting/waterperm/wwperm/tpdestorm

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 Construction Sites Authorized Under Part II.D.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.D.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 implemented according to permit requirements. A copy of this signed notice is supplied to the operator of the MS4 if discharges enter an MS4 system. 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

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ATTACHMENT 3

TPDES OPERATOR'S INFORMATION

Owner's Name and Address: City of Houston

Mr. _____
(City Official)

_____
(Department)
P. O. Box 1562
Houston, Texas 77251-1562
(713) 247-1000

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

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ATTACHMENT 4

CONTRACTOR'S / SUBCONTRACTOR'S

CERTIFICATION FOR TPDES PERMITTING

I certify under penalty of law that I understand the terms and conditions of TPDES General Permit No. TXR150000 and the Storm Water Pollution Prevention Plan for 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: _____

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ATTACHMENT 5

EPA NPDES Construction Inspection Form

The following inspection is being performed in compliance with Part IV.D.4. of the NPDES Region 6 Storm Water Construction General Permit [63 Fed. Reg. 36502] and being retained in accordance with Part V of the Permit. 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 at least 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 Texas and New Mexico. Permittees on Indian Country lands in Oklahoma, Louisiana and Arkansas and some oil and gas facilities in Oklahoma may use this form if they are eligible for this permit. 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 (301)495-4145. 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 http://www.epa.gov/region06/sw/. Any person with a complaint about the operation of this facility in regards to this permit should contact EPA Region 6 at (214)665-7112.

Permit Number(s) covered by this inspection (e.g. owners, developers, general contractor, builders)	
Signature and Certification in accordance with Part VI.G 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 gathered and evaluated 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. Signature_____Date_____
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 IV.C. of the permit.

Revision 4, March 1, 2000

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).

ATTACHMENT 6

City of Houston

Storm Water Pollution Prevention Plan
Construction Site Inspection Report

TPDES/EPA Permit Number _____

COH Storm Water Quality Permit Number _____

DATE _____

No exceptions noted.

The following must be corrected prior to continuing work:

Public Notice improperly posted

Initial Construction Site Inspection Report information requires updating

Copy of NOI not on site

Storm water pollution prevention plan not on site

Erosion and sediment controls improperly installed

Erosion and sediment control devices improperly maintained

Fueling or washout areas not properly protected

Portocan or other sanitary facilities not properly protected

Self-inspection and maintenance records incomplete

Sediment from site outside area of construction

Other (see description below)

_____

_____

Please contact the Storm Water Quality Engineer at
611 Walker, RA-257, Houston TX 77002
713-837-7383 fax 713-837-0570

Once the above items have been corrected, call to arrange for reinspection. No further inspections for any construction related activity shall be made until the above items have been corrected.

Inspector's Signature	Contractor's Signature
Inspector's Name	Contractor's Name

not present

Distribution Stormwater Quality Engineer, Code Enforcement, Inspector, Operator
(Operator is Contractor)

Form _____ (10-01-01)

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ATTACHMENT 7

Notice of Termination (NOT) for Storm Water Discharges Associated with Construction Activity under the TPDES Construction General Permit (TXR150000)

TCEQ

TCEQ Office Use Only
TPDES Permit Number: TXR15-____ - NO
GIN Number: ____

For help completing this application, read the TXR150000 NOI Instructions (TCEQ-20023-Instructions).

A. TPDES Permit Number: TXR15_____

B. Construction Site Operator Customer Reference Number: CN_____
Name:_____
Mailing Address:_____
City:_____ State:_____ Zip Code:_____
Country Mailing Information (*if outside USA*) Territory:_____ Country Code:_____ Postal Code:_____
Phone Number:_____ Extension:_____ Fax Number:_____
E-mail Address:_____

C. Project / Site Information Regulated Entity Reference Number: RN_____
Name:_____
Physical Address:_____
Location Access Description:_____
City:_____ County:_____ Zip Code:_____

D. Contact - If the TCEQ needs additional information regarding this termination, who should be contacted?
Name:_____ Title:_____
Phone Number:_____ Extension:_____ Fax Number:_____
E-mail Address:_____

E. Certification
I certify under penalty of law that authorization under the TPDES Construction General Permit (TXR150000) is no longer necessary based on the provisions of the general permit. I understand that by submitting this Notice of Termination, I am no longer authorized to discharge storm water associated with construction activity under the general permit TXR150000, and that discharging pollutants in storm water associated with construction activity to waters of the U.S. is unlawful under the Clean Water Act where the discharge is not authorized by a TPDES permit. I also understand that the submittal of this Notice of Termination does not release an operator from liability for any violations of this permit or the Clean Water Act.

Construction Site Operator Representative:

Prefix:_____ First:_____ Middle:_____
Last:_____ Suffix:_____
Title:_____
Signature:_____ Date:_____

If you have questions on how to fill out this form or about the storm water program, please contact us at (512) 239-4671. Individuals are entitled to request and review their personal information that the agency gathers on its forms. They may also have any errors in their information corrected. To review such information, contact us at (512) 239-3282.

The completed NOT must be mailed to the following address:

Texas Commission on Environmental Quality
Storm Water & General Permits Team; MC - 228
P.O. Box 13087
Austin, Texas 78711-3087

TCEQ - 20023 (02/03) Page 1 of 1

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ATTACHMENT 7

Completing the Notice of Termination for Storm Water Discharges Associated with Construction Activity under the TPDES Construction General Permit (TXR150000)

Who May File a Notice of Termination (NOT) Form
Permittees disturbing 5 acres or more (or part of a larger common plan of development or sale disturbing 5 acres or more) who are presently covered under the Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit must submit a Notice of Termination (NOT) when final stabilization has been achieved on all portions of the site that is the responsibility of the permittee; or another permitted operator has assumed control over all areas of the site that have not been finally stabilized and all silt fences and other temporary erosion controls have either been removed, scheduled for removal as defined in the SWP3, or transferred to a new operator if the new operator has sought permit coverage. Erosion controls that are designed to remain in place for an indefinite period, such as mulches and fiber mats, are not required to be removed or scheduled for removal.

Final Stabilization occurs when either of the following conditions are met:

(a) All soil disturbing activities at the site have been completed and a uniform (e.g, evenly distributed, without large bare areas) perennial vegetative cover with a density of 70% of the native background vegetative cover for the area has been established on all unpaved areas and areas not covered by permanent structures, or equivalent permanent stabilization measures (such as the use of riprap, gabions, or goetextiles) have been employed.

(b) For individual lots in a residential construction site by either:

(1) the homebuilder completing final stabilization as specified in condition (a) above; or

(2) the homebuilder establishing temporary stabilization for an individual lot prior to the time of transfer of the ownership of the home to the buyer and after informing the homeowner of the need for, and benefits of, final stabilization.

(c) For construction activities on land used for agricultural purposes (e.g. pipelines across crop or range land), final stabilization may be accomplished by returning the disturbed land to its preconstruction agricultural use. Areas disturbed that were not previously used for agricultural activities, such as buffer strips immediately adjacent to a surface water and areas which are not being returned to their preconstruction agricultural use must meet the final stabilization conditions of condition (a) above.

A. TPDES Permit Number
Provide the TPDES permit number assigned to the operator of the construction site.

B. Construction Site Operator Information
Customer Reference Number
This number designates the operator's status as a TCEQ "customer"—in other words, an individual or business that is involved in an activity that we regulate. We assign each customer a number that begins with "CN," followed by nine digits. ***This is not a permit number, registration number, or license number.*** In the remainder of this section, we will use "this customer" to mean the operator for Part B of the form.

- 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.
- ***Do not enter a permit number, registration number, or license number in place of the Customer Reference Number.***

Name
Enter the legal name of this customer as authorized to do business in Texas. Include any abbreviations (LLC, Inc., etc.).

Mailing Address
Enter a central and general mailing address for this customer to receive mail from the TCEQ. For example, if this customer is a large company, this address might be the corporate or regional headquarters. On the other hand, for a smaller business, this address could be the same as the site address.

If this is a street address, please follow US Postal Service standards. In brief, these standards require this information in this order:

- the "house" number—for example, the 1401 in 1401 Main St
- if there is a direction before the street name, the one- or two-letter abbreviation of that direction (N, S, E, W, NE, SE, SW, or NW)
- the street name (if a numbered street, do not spell out the number—for example, 6th St, not Sixth St)
- an appropriate abbreviation of the type of street—for example, St, Ave, Blvd, Fwy, Exwy, Hwy, Cr, Ct, Ln
- if there is a direction after the street name, the one- or two-letter abbreviation of that direction (N, S, E, W, NE, SE, SW, or NW)
- if there is a room number, suite number, or company mail code

City, State, *and* ZIP Code
Enter the name of the city, the two-letter USPS abbreviation for the state (for example, TX), and the ZIP Code. (Enter the full ZIP+4 if you know it.)

ATTACHMENT 7

Country Mailing Information
If this address is ***outside*** the United States, enter the territory name, country code, and any non-ZIP mailing codes or other non–U.S. Postal Service features here. If this address is ***inside*** the United States, leave these spaces blank.

Phone Number *and* Extension
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.

Fax Number
This number should correspond to this customer's mailing address given earlier. Enter the area code and fax number here.

E-mail Address
As with the mailing address, this should be a general address that is appropriate for e-mail to this customer's central or regional headquarters, if applicable.

C. Project / Site Information

Regulated Entity Reference Number
This number designates this site's status as a TCEQ "regulated entity"—in other words, a location where an activity that we regulate occurs. We assign each regulated entity a number that begins with "RN," followed by nine digits. ***This is not a permit number, registration number, or license number.***

- If this site has not been assigned a Regulated Entity Reference Number, leave the space for the Regulated Entity Reference Number blank.
- If this site has already been assigned this number, enter the Regulated Entity Reference Number.
- ***Do not enter a permit number, registration number, or license number in place of the Regulated Entity Reference Number.***

Name
Enter the name by which you want this site to be known to the TCEQ.

Physical Address
Enter the physical address of the site itself. TCEQ staff should be able to use this address to find the site.

Location Description
Enter a physical description of the location of the site based on highway intersections and/or permanent landmarks.

City, County, *and* ZIP Code
Enter the name of the city, the county, and the ZIP Code. (Enter the full ZIP+4 if you know it.)

D. Contact

Give all the relevant information for the person whom TCEQ can contact if there are questions about any of the information on this form—perhaps the same person who completed the form.

E. Certification

The operator must sign and date this statement to validate this NOI. Be sure to enter the full legal name of the person signing the form and the relevant title—for example, "Operator," "Operator's attorney," or "Senior Site Manager." Use the "Prefix" blank for such titles as Dr., Mr., or Ms., as desired. Use the "Suffix" blank for such designations as Ph.D., Jr., Sr., III, or J.D., if applicable.

For a corporation, the application shall be signed by a responsible corporate officer. 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 applications may provide for assignment or delegation to applicable corporate positions rather than to specific individuals.

For a partnership or sole proprietorship, the application shall be signed by a general partner or the proprietor, respectively.

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 application, 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 United States Environmental Protection Agency).

Questions?

If you have questions about any of the information on this form, contact our Storm Water Program at 512/239-4671 or look for "Storm Water" on our Web site:

www.tceq.state.tx.us

Section 01422

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, trade, 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 Project Manager 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. Washington, DC 20001
ACI	American Concrete Institute P.O. Box 9094 Farmington Hills, MI 48333-9094
AGC	Associated General Contractors of America 333 John Carlyle Street Alexandria, VA 22314
AI	Asphalt Institute Research Park Drive P.O. Box 14052 Lexington, KY 40512

AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235
COH	City of Houston P.O. Box 1562 Houston, TX 77251-1562
CLFMI	Chain Link Fence Manufacturers Institute 9891 Broken Land Parkway, Suite 300 Columbia, MD 21046
CRSI	Concrete Reinforcing Steel Institute 933 Plum Grove Road Schaumburg, IL 60173-4758
EJMA	Expansion Joint Manufacturers Association 25 North Broadway Tarrytown, NY 10591
FS	Federal Standardization Documents General Services Administration Specifications Unit (WFSIS) 7th and D Streets, S.W. Washington, DC 20406
ICEA	Insulated Cable Engineer Association P.O. Box 440 S. Yarmouth, MA 02664
IEEE	Institute of Electrical and Electronics Engineers 445 Hoes Lane P.O. Box 440 Piscataway, NJ 08855-459
ISA	International Society of Arboriculture P.O. Box 3129 Champaign, IL 61826-3129
MIL	Military Specifications General Services Administration Specifications Unit (WFSIS) 7th and D Streets, S.W. Washington, DC 20406

UL	Underwriters' Laboratories, Inc. 333 Pfingston Road Northbrook, IL 60062
UNI-BELL	UNI-BELL Pipe Association 2655 Villa Creek Drive, Suite 155 Dallas, TX 75234

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 01450

CONTRACTOR'S QUALITY CONTROL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Quality assurance and control of Installation and manufacturers' field services and reports.

1.02 QUALITY ASSURANCE AND CONTROL OF INSTALLATION

A. Monitor quality control over Suppliers, manufacturers, Products, services, site conditions and workmanship, to produce work of specified quality at no additional cost to the City.

B. Comply fully with manufacturers' Installation instructions, including each step in sequence.

C. Request clarification from Project Manager before proceeding when manufacturers' instructions conflict with the Contract.

D. Comply with specified standards as minimum requirements for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform the Work by persons qualified to produce a specified level of workmanship.

1.03 REFERENCES

A. Obtain copies of standards and maintain at job site when required by individual Specification sections.

1.04 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. When specified in individual Specification sections, or as required by Project Manager, provide Product suppliers' or manufacturers' technical representative to observe site conditions, conditions of surfaces and Installation, quality of workmanship, start-up of equipment, operator training, testing, adjusting and balancing of equipment as applicable and to initiate required operation. Conform to minimum time requirements for start-up operations and operator training when provided in Specification sections.

Section 01452

INSPECTION SERVICES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Inspection services and references

1.02 INSPECTION

A. City Engineer will appoint an Inspector to represent the City and perform inspections, tests, and other services specified in individual Specification sections.

B. City Engineer may also appoint, employ, and pay an independent firm to provide additional inspection or construction management services as indicated in Section 01454 - Testing Laboratory Services.

C. The independent firm will submit reports to Project Manager, indicating observations and results of tests and indicating compliance or noncompliance with Contract requirements.

D. Contractor shall assist and cooperate with the Inspector; furnish samples of materials, design mix, equipment, tools, and storage.

E. Contractor shall notify Project Manager 24 hours prior to expected time for operations requiring services.

F. Contractor shall sign and acknowledge reports for Inspector.

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 01454

TESTING LABORATORY SERVICES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Testing laboratory services and Contractor responsibilities related to those services.

1.02 REFERENCES

A. ASTM C 1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

B. ASTM D 3666 - Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials.

C. ASTM D 3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

D. ASTM E 329 - Standard Specification for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

E. ISO/TEC Guide 25 - General Requirements for the Competence of Calibration and Testing Laboratories.

1.03 SELECTION AND PAYMENT

A. The City will select, employ, and pay for services of an independent testing laboratory to perform inspection and testing identified in Part 3 of individual Specification sections.

B. Contractor shall employ and pay for services of an independent testing laboratory or laboratories to perform inspection and testing identified in Part 2 of individual Specification sections.

C. Employment of a testing laboratory by the City shall not relieve Contractor of its obligation to perform work in accordance with requirements of Contract documents.

D. The City will deduct a minimum two-hour charge for testing laboratory time from periodic progress payment when operations requiring testing or inspection are canceled without prior notification.

E. The City will deduct cost of retesting from periodic progress payment whenever failed work is removed, replaced and retested.

1.04 QUALIFICATION OF LABORATORY

A. Meet laboratory requirements of ASTM E 329 and applicable requirements of ASTM C 1077, ASTM D 3666, and ASTM D 3740.

B. Meet ISO/TEC Guide 17025 conditions for accreditation by the American Association for Laboratory Accreditation (A2LA) in specific fields of testing required in individual Specification sections.

C. If laboratory subcontracts are part of the testing services, such work will be placed with a laboratory complying with the requirements of this Section.

1.05 LABORATORY REPORTS

A. Testing laboratory shall provide and distribute copies of laboratory reports to the distribution list Project Manager provides at the pre-construction conference.

B. Keep one copy of each laboratory report distributed or faxed at the site field office for duration of the Work.

C. Laboratory will fax material supplier, Contractor and Project Manager reports that indicate failing test results by no later than close of business on the working day following test completion and review.

1.06 LIMITS ON TESTING LABORATORY AUTHORITY

A. Laboratory may not release, revoke, alter, or enlarge requirements of the Contract.

B. Laboratory may not approve or accept any portion of the Work.

C. Laboratory may not assume Contractor duties.

D. Laboratory has no authority to stop the Work.

1.07 CONTRACTOR RESPONSIBILITIES

A. Provide safe access to the Work and to manufacturer's facilities for Project Manager and for testing laboratory personnel.

B. Provide testing laboratory with a copy of the Construction Schedule and a copy of each update to Construction Schedule.

C. Notify Project Manager and testing laboratory during normal working hours of the day previous to expected time for operations requiring inspection and testing services. When Contractor fails to make timely prior notification, do not proceed with the operations requiring inspection and testing services.

D. Notify Design Consultant 24 hours in advance when Specification requires presence of Design Consultant for sampling or testing.

E. Request and monitor testing as required to provide timely results and to avoid delays to the Work. Provide samples to laboratory in sufficient time to allow required test to be performed in accordance with specified test methods before intended use of the Product.

F. Cooperate with laboratory personnel in collecting samples on site. Provide incidental labor and facilities for safe access to the Work to be tested, to obtain and handle samples at site or at source of Products to be tested, and to facilitate tests and inspections including storage and curing of test samples.

G. Make arrangements with laboratory through Project Manager. Payment for additional testing will be made in accordance with Document 00700 - General Conditions:

1. Re-testing required for failed tests.

2. Re-testing for nonconforming work.

3. Additional sampling and tests requested beyond specified requirements.

4. Insufficient notification of cancellation of tests for work scheduled but not performed.

PART 2 P R O D U C T S - Not Used

PART 3 EXECUTION

3.01 CONDUCTING TESTING

A Conform to laboratory sampling and testing methods specified in individual Specification sections to the latest issues of ASTM standards, TxDOT methods, or other recognized test standards as approved by Project Manager.

B Requirements of this Section shall also apply to those tests for approval of materials, for mix designs, and for quality control of materials as performed by employed testing laboratories.

END OF SECTION

Section 01502

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.

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 will be included in monthly payment estimates upon written application by Contractor subject to the following provisions:

1. Authorization for payment of 50 percent of that portion of Contract Price designated for mobilization will be made upon receipt and approval by Project Manager of the following items, as applicable:

   a. Safety Program (Document 00700, Paragraph 10.1.1).

   b. Site Utilization Plan (Section 01145).

   c. Schedule of Values (Section 01292), if any.

   d. Initial Construction Photographs (Section 01321), if needed.

   e. Preliminary Construction Schedule and Billing Forecast (Section 01325).

   f. Construction Schedule (Section 01325 or Section 01326, as applicable).

   g. Submittal Schedule (Section 01330).

   h. Site specific Storm Water Pollution Prevention Plan (SWPPP) and Notice of Intent (NOI) along with storm water application fee (Section 01410), if required.

   i. Contractor's Quality Control Plan (Section 01450), if required.

j. Establishment of a Field Office for Project Manager meeting requirements of Section 01520 - Temporary Field Office.

k. Traffic Control Plan (Section 01555), if required.

l. Plan for Control of Ground and Surface Water (Section 01578), if required.

m. Project Signs Submittal (Section 01580).

n. Trench Safety Program (Section 02260), if required.

o. Dewatering plan, when required.

2. Authorization for payment of the balance of that portion of Contract Price designated for mobilization will be made upon completion of the Work amounting to five percent of Original Contract Price. The amount of Contract Price designated for mobilization may not be applied in computing whether or not five percent of the Original Contract Price has been obtained.

3. Mobilization payments will be subject to retainage amounts stipulated in Document 00700 – General 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 01504

TEMPORARY FACILITIES AND CONTROLS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Temporary facilities and necessary controls for the Project, including utilities, telephone, sanitary facilities, storage sheds and building, safety requirements, first aid equipment, fire protection, security measures, protection of the Work and property, access roads and parking, environmental controls, 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 P R O D U C T S - 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 transit meter from City of Houston, Department of Public Works and Engineering, Taps and Meters Section. Pay required deposit based on rates established by latest ordinance.

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.

2. Provide Houston-Metro lines, allowing unlimited calls, without charge in Greater Houston Metropolitan area with "call waiting" and "call forwarding" options. Provide one telephone answering machine with beeperless remote message retrieval capability.

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 STORAGE SHEDS AND BUILDINGS

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.

3.03 SAFETY REQUIREMENTS

A. Submit a safety program at the pre-construction meeting and follow the program in accordance with Document 00700 – General Conditions. Include documented response to trench safety requirements of Section 02260 - Trench Safety System.

B. Conduct operations in strict accordance with applicable Federal, State and local safety codes and statutes and with good construction practice. Establish and maintain procedures for safety of all work, personnel and equipment involved in the Work.

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 Williams-Steiger Occupational Safety and Health Act of 1970, and to other legislation enacted for safety and health of Contractor employees. Safety and health standards apply to Subcontractors and Suppliers as well as to the Contractor.

D. Observance of and compliance with safety regulations is Contractor's responsibility without reliance or superintendence of or direction by Project Manager. Immediately advise Project Manager of investigation or inspection by Federal Safety and Health inspectors of Contractor's or Subcontractor's work or place of work on site under the Contract, and after investigation or inspection, advise Project Manager of results. Submit one copy of accident reports to Project Manager within 10 days of occurrence.

E. Protect areas occupied by workmen using the best available devices for detection of lethal and combustible gases. Test devices frequently to assure 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. Implement safety measures, including but not limited to safety personnel, first-aid equipment, ventilating equipment and other safety equipment specified or detailed on Drawings.

G. Maintain required coordination with City Police and Fire Departments during entire period covered by the Contract.

H. Include Project safety analysis in safety plan. Itemize major tasks and potential safety hazards. Plan to eliminate hazards or protect workers and public from each hazard.

3.04 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 and CPR procedures present on the site when work is in progress. Contractor to conform to protocols and requirements for training and protection against "blood borne pathogens".

3.05 FIRE PROTECTION

A. Conform to specified fire protection and prevention requirements established by Federal, State, or local governmental agencies and as provided in Safety Program.

3.06 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.

3.07 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 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 shown on the construction document drawings. Contractor should anticipate that such service lines exit and should exercise extreme caution during construction. The utility service lines should be repaired and restored immediately as per the specification, if damaged due to any construction activities. No separate payment will be made for this repair and restoration work. 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, tranformers, and poles as may be required by site conditions.

3.08 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 except on 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 01555 – Traffic Control and regulation.

C. 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 will direct Contractor in writing to perform the Work under Modification provisions in Document 00700 - General Conditions.

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 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.

D. Employ a structural engineer to ensure protection measures are adequate for the safety and integrity of structures and facilities.

E. 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.

3.09 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.

3.10 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.

3.11 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.

3.12 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.

3.13 NOISE CONTROL

A. Provide vehicles, equipment, and use construction activities that minimize noise to the greatest degree practicable. Conform to noise levels of Chapter 30 –Noise and Sound Level Regulation, City Code of Ordinances, and latest OSHA standards. Do not permit noise levels to interfere with the Work or create a nuisance to surrounding areas.

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.

3.14 DUST CONTROL

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

3.15 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 01506-S

DIVERSION PUMPING

The following supplements modify Section 01506 – Diversion Pumping Standard Specification. Where a portion of the Specification is modified or deleted by this Supplementary Specification, the unaltered portions of the Specification shall remain in effect.

PART 1 GENERAL: *Add the following Paragraph 1.00:*

1.00 Unit Prices

A. Payment for diversion pumping shall be in accordance with Document 00410B – Bid Form Part B. No payment shall be made for diversion pumping performed for the convenience of the Contractor. All diversion pumping shall be as directed by the City only.

1. The pump setup item shall compensate the contractor for the mobilization, installation and removal of each bypass pump and associated suction and discharge piping. Measurement for payment shall be unit price by each setup.

2. The pump operation item shall serve as compensation for operation of pump including pump operator and fuel. Measurement for payment of this item shall be the unit price for every full hour of pump operation or fraction thereof.

3. The pump and piping item shall compensate the contractor for the cost of the equipment and all pump and piping maintenance. Measurement for payment of this item shall be unit price on a per day basis for every day that an installed pump is available for operation. Pump operation shall be verified by pump operator's logbook and hour meter on pump.

B. No payment shall be made for diversion pumping for sanitary sewers with diameters less than 24-inches. Include the costs in other related bid items.

C. No payment shall be made for diversion pumping of the first 6-inch pump. Payment for the first such pump is incidental to performance of work. Payment shall be made for each additional 6 or 8-inch pump as required for uninterrupted customer service.

1.01 DEFINITIONS: *Delete Paragraph A and add the following paragraph.*

A. Diversion-pumping: Installation and operation of bulkheads, plugs, hoses, piping, and pumps required to maintain sewer flow, prevent backups and overflows, and re-establish sewer service where existing sewer is not flowing.

SUPPLEMENT

1.02 SYSTEM DESCRIPTION: *Delete Paragraph B and add the following Paragraphs B, C and D.*

B. When pumps are operating, have an experienced operator on site to monitor operation, adjust pumps, make minor repairs to system, and report problems. Each pump operator shall be required to maintain a daily log of time on job site, pump operation time, problems encountered and resolutions, contacts made, etc. This log shall be available for review on a daily basis by the City Inspector.

C. As directed by the City, and after a Work Order has been issued, the Contractor shall take over the responsibility for any existing diversion pumping system. Contractor shall provide a suitable system sized to maintain sewer flows without surcharging and overflows. The City will be responsible for removing its pumps and piping.

D. No diversion pumping systems utilizing pumps less than 4-inches is allowed.

1.03 SUBMITTALS: *Delete Paragraph B and replace with the following.*

B. For systems that bypass sanitary sewer line segments of 24-inch diameter or larger, or that require plugging of sewer and diversion of flow to accomplish Cured-in-Place type rehabilitation, submit a Diversion Pumping Plan prior to installation. Provide a plan with sufficient detail to show location, number and size of pumps, number, location, size and type of hoses or rigid piping, location of plugs, and location of suction and discharge manholes; and special features where pipes or hoses cross roadways, temporary trenches, or support bridges.

Provide two 24-hour accessible telephone numbers for the Contractor and its diversion pumping personnel for inquires and post them legibly at the work site.

1.04 SCHEDULING: *Delete Paragraph A and add the following to Paragraph A:*

A. The Contractor shall assume (take over) any existing (City or others) diversion pumping upon mobilization to any job site. Mobilization, for this purpose, means beginning of any work item on a Work Order. The Contractor shall maintain this system in reliable manner to provide efficient sewer service and prevent surcharging that could result in backups, overflows, or service disruptions. The Contractor shall immediately report any sanitary sewer overflows via the City's 311 Houston Service Helpline. If a diversion pumping system is in operation at any site on the Work Order, the City shall remove its pumps and discharge piping systems. The Contractor shall immediately replace them with its own reliable, leak free pumping and discharge piping of adequate capacity.

END OF SUPPLEMENT

Section 01506

DIVERSION PUMPING

PART 1 G E N E R A L

1.01 DEFINITIONS

A. Diversion-pumping: Installation and operation of bulkheads, plugs, hoses, piping, and pumps required to maintain sewer flow and prevent backups and overflows.

1.02 SYSTEM DESCRIPTION

A. Provides continuous sewer service to users of sewer systems while maintenance or construction operations are in progress, by diverting flow around construction locations. Maintain sewer flow to prevent backup or overflow onto streets, yards and unpaved areas or into buildings, adjacent ditches, storm sewers, and waterways. Do not divert sewage outside of sanitary sewer system.

B When pumps are operating, have an experienced operator on site to monitor operation, adjust pumps, make minor repairs to system, and report problems.

1.03 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittals Procedures.

B. For systems that bypass sanitary sewer line segments of 42-inch diameter or larger, submit a Diversion Pumping Plan prior to installation. Show location, number and size of pumps, number, location, size and type of hoses or rigid piping, and location of downstream discharge; and special features where pipes or hoses cross roadways, temporary trenches, support bridges.

1.04 SCHEDULING

A. When the City operates or maintains diversion pumping in construction areas, coordinate construction activities with Project Manager.

B. Cease operation of diversion pumping when approved by Project Manager.

PART 2 PRODUCTS

2.01 MATERIALS

A. Design piping, joints and accessories to withstand at least twice maximum system pressure or 50 psi, whichever is greater.

B. Use self-priming type or submersible electric pumps, with a working pressure gauge on the discharge. Pumps shall meet requirements of City of Houston Noise and Sound Level Regulations.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. During diversion pumping, do not allow sewage to leak, dump, or spill into or onto areas outside of existing sanitary sewer systems.

B. In the event of an accidental spill or overflow, immediately stop discharge and take action to clean up and disinfect spill. Promptly notify Project Manager so required reporting can be made to the Texas Commission on Environmental Quality (TCEQ) and the Environmental Protection Agency (EPA).

3.02 CLEANING

A. When diversion-pumping operations are complete, drain sewage within piping into sanitary sewers prior to disassembly.

END OF SECTION

Section 01520

TEMPORARY FIELD OFFICE

PART 1 GENERAL

1.01 SECTION INCLUDES

A Temporary field office building and associated parking area.

1.02 FACILITY DESCRIPTION

A Temporary field office to be utilized by authorized representatives of the City to coordinate and monitor daily construction activities performed by Contractor.

B. Field office shall be a non-smoking facility.

PART 2 PRODUCTS

2.01 FIELD OFFICE

A General:

1. Locate office in vicinity of the Work at a location approved by Project Manager or where indicated on Drawings.

2. Furnish, Install and maintain field office for exclusive use of authorized representatives of the City. Provide sufficient room for Project meetings and Inspector's office.

3. Provide office within 10 days of Date of Commencement of the Work.

4. Construct two all-weather, hard surfaced parking spaces for exclusive use of authorized representatives of the City. Provide all-weather surfaced walk between parking spaces and field office.

B. Minimum Construction:

1 Structurally sound foundation and superstructure.

Weather tight with insulated roof, walls and 7-foot ceiling (minimum).

3. Stairs or walkway with handrail and covered entrance platform (minimum 4 feet by 4 feet) with mud scraper at door.

4. Resilient floor covering.

5. Screened windows with area equal to approximately 10 percent of floor area sufficient for light, view of the site, and ventilation. Provide each window with operable sash and burglar bars.

6. Secure exterior doors with dead-bolt cylinder locks and burglar bars.

C. Minimum Services:

1. Exterior entrance light.

2. Interior lighting of 75 foot-candles minimum at desktop height

3. Automatic heating to maintain 65 degrees F in winter.

4. Automatic cooling to maintain 75 degrees F in summer.

5. Electric power service.

6. Three telephone service lines one for voice, one for data, and one for fax, for exclusive use of authorized representatives of the City.

7. Sanitary facilities in field office with one water closet, one lavatory, and one medicine cabinet for exclusive use of authorized representatives of the City.

D. Minimum Furnishings:

1. One 5-drawer desk

2. Two swivel desk chairs with casters.

3. One plan table.

4. One drawing plan rack.

5. One 4-drawer legal file cabinet complete with fifty legal-size hanging folders and two full-sized carriers.

6. One marker board with cleaner and markers.

7. Two waste baskets.

8. One 30-inch by 36-inch tack board.

9. One all-purpose fire extinguisher.

10. Six protective helmets (hard hats) with ratchet adjustment for exclusive use of authorized representatives of the City.

11. Conference table and chairs to accommodate 10 persons.

12. All in one printer, copier, plain paper fax machine.

13. Telephone instrument separate from fax machine.

E. Provide adequate space for one set of Contract documents for ready reference.

PART 3 EXECUTION

3.01 MAINTENANCE

A Maintain all-weather surface driveway and parking areas, buildings, walkways, stairs and required furnishings and equipment for duration of the Contract.

B. Provide janitorial services for duration of the Contract consisting of twice weekly sweeping and mopping floors, trash removal, weekly restroom cleaning, and weekly dusting of furniture and equipment.

C. Provide soap, paper towels, toilet paper, cleansers and other necessary consumables.

D. Immediately repair damage, leaks or defective service.

3.02 PROJECT CLOSEOUT

A Remove temporary field office and signs and restore site as specified in Section 01770 - Closeout Procedures.

END OF SECTION

SECTION 01554

TRAFFIC CONTROL AND STREET SIGNS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Materials, hardware and installation of Traffic Signs.

1.02 SUBMITTALS

A. Contractor shall submit a list of intended suppliers and products to be used for all signs, posts, and associated hardware. City reserves the right to request actual product samples prior to approval.

1.03 MEASUREMENT AND PAYMENT

A. Signs installed or replaced will be measured by the each sign. Signs refurbished will be measured by each sign.

B. Payment for installation of traffic signs will be on the basis of each sign installed.

C. The price is full compensation for furnishing and installing new signs and hardware. Cost of associated posts, footings, and miscellaneous mounting hardware will not be paid for directly but is to be included in the unit price bid for installation of each traffic sign.

D. Non-standard signs installed or replaced will be measured by the square foot of the sign face. Non-standard signs shall not be installed without prior approval from the City.

PART 2 PRODUCTS

2.01 MATERIALS

A. The following ASTM Standards and documents, of the issue in effect on the date of Invitation for Bid, form a part of this specification to the extent herein.

1. ASTM B 209 Specification for Aluminum and Aluminum Alloy Sheet and Plate

2. ASTM D 523 Standard Method for Test for Specular Gloss

3. ASTM D 4956 Standard Specification for Retroreflective Sheeting for Traffic Control

4. ASTM E 284 Standard Definition of Terms Relating to Appearance of Materials

5. ASTM E 308 Computing the Colors of Objects by Using the CIE System

6. ASTM E 810 Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting

7. ASTM E 1164 Standard Practice for Obtaining Spectrophotometric Data for Object-Color Evaluation

B. Substrate (Sign Blanks). This shall be aluminum alloy 5052-H38 and otherwise in conformance with ASTM B-209 and have gold chromate finish. The size, shape and thickness of the sign blanks are as indicated on the standard detail sheet in the plans or as specified by the Engineer.

1. Metal working. The aluminum shall be free of burrs and pits on both sides, including
edges and holes, and shall be made ready for applications of the sheeting.

2. Surface Preparation. The aluminum shall be thoroughly cleaned and degreased with solvent and alkaline emulsions cleaner by immersion, spray, or vapor degreasing and dried prior to application of the gold chromate sheeting coat. The aluminum shall be new and corrosion-free with holes drilled or punched, corners rounded to the radii shown in the standard detail sheet, and all edges smoothed prior to application of sheeting. The heavy or medium chromate coating shall conform in color and corrosion resistance to that imparted by the Alodine 1200F treatment.

3. Size. The dimensions of substrate applications for regulatory, warning, and guide signs shall be as specified by the Engineer and as shown on the plans.

C. Sign Face (Background, Legends, Symbols, and Colors). These shall be in accordance with the Standard Highway Sign Designs (SHSD) for Texas and with the Texas Manual of Uniform Traffic Control Devices (TMUTCD).

1. The sign face, made of electronic film and retro-reflective sheeting shall comply with the appearance, specification, and good workmanship designated by the using agency for sign faces constructed of screen processed retro-reflective sheeting of the same type.

2. All sign blanks shall be covered with appropriate retro-reflective sheeting.

   a. All ground mounted stop signs, warning signs, and other regulatory signs, shall use at a minimum High Intensity Prismatic Reflective Sheeting.

   b. All overhead signs shall use Diamond Grade Reflective Sheeting.

   c. All other signs shall use Super Engineer Grade Sheeting

3. Application Methods. The method of application of sheeting, letters, numbers, and symbols shall be precisely as prescribed in writing by the manufacturer.

   a. Legend Spacing and Layout. Spacing and layout for all traffic control signs shall conform to the SHSD.

   b. Tolerance for Horizontal Alignment. Letters, numerals, and symbols shall be horizontally aligned to a tolerance of 1/16 inch.

   c. Tolerance for Vertical Alignment. Letters, numerals, and symbols shall be vertically aligned to a tolerance of 1/16 on each letter in each line.

D. Sign Posts. Steel post shall conform to the standard specification for hot rolled carbon sheet steel, structural quality, ASTM designation A570, Grade 50. Average minimum yield strength after cold forming is 60,000 psi. The cross section of the post shall be square tube formed steel, carefully rolled to size and shall be welded directly in the corner by high frequency resistance welding or equivalent process and externally scarified to agree with corner radii. Sign posts shall be hot dipped galvanized conforming to ASTM A653, G90.

1. Installation. The square end of the post shall not be modified or pointed.

   a. Flange. When sign post installation is required over building basements, bridges and cavities, a galvanized cast iron pipe flange shall be used. The base shall be 8 inches in diameter with six 5/16 inch holes drilled equidistant around the circumference, ⅝ inch from the outer edge. The neck of the flange shall be 3inches in diameter, drilled and threaded to receive a 2 inch diameter galvanized post.

   b. Hardware. All ground mounted signs shall be attached to posts using 5/16" nut and bolt assembly, the bolt being 2 ½" in length. Stainless steel banding material, brackets and clips will be used for signs installed on light standards or mast arms.

c. Construction. Anchors shall be anchored in a minimum of one cubic foot of class "C" concrete, 28 inches deep, with a 6 inch long, ⅜ inch diameter pin inserted through the pre-drilled hole 3 inches from the bottom of the pole. Where the pole installation requires surface mounting, an 8 inch flange with a 2 inch threaded collar shall be used. The pole shall be galvanized, two inches in diameter and threaded to fit the flange. Sign placement and orientation shall be as specified in the construction plans.

E. Each finished sign shall have the following sticker affixed to the back in a location where it will be visible when the sign is installed:

CITY OF HOUSTON

VERNON CIVIL STATUTES
ART 6701d / ARTICLE III, SEC. 37
Unlawful to Deface, Remove, Knockdown, or Alter Any Traffic Control Device
MAXIMUM FINE $200.00
Date of Sign Manufacture: 00/04
Sheeting Manufacturer: XYZ, Inc.
Sheeting Lot No.: 12345-678

The sticker shall be Zebra Technologies Z-Ultimate 3000 White or approved equal. Finished product shall be weather and fade resistant for the expected life of the sign.

F. Warranty. The Contractor shall warrant the materials and workmanship of each sign in accordance with the maximum limits of material warranties extended by manufacturers of raw materials, subject to the conditions they specify. The retro-reflective sheeting will be considered unsatisfactory if it has deteriorated due to natural causes to the extent that: (1) the sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions; or (2) the coefficient of retro-reflection is less than the minimum specified for that sheeting. When sign failure occurs prior to the minimum years indicated and an inspection demonstrates that the failure is caused by materials warranted to contractor to endure at least that long, the sign will be replaced or repaired free of materials charges. When failure occurs and inspection demonstrates that such failure is due to poor workmanship, the sign will be replaced or repaired at Contractor's expense, including shipping charges.

PART 3 EXECUTION

3.01.1 EQUIPMENT

A. The contractor shall provide machinery, tools, and equipment necessary for proper execution of the work.

3.01.2 CONSTRUCTION

A. Construction shall be high quality with no visible defects in the finished product. Fabrication shall be in accordance with these specifications. Street name signs shall always be supplied and installed at each project intersection whether signs previously existed at the location or not.

B. The removal of existing signs shall be coordinated with the Traffic Operations Section of the Public Works Department (713-803-3054) and arrangements made for a convenient time to deliver City signs and poles. All salvaged traffic signs shall be delivered to the Traffic Operations Center located at 2200 Patterson Street. All deliveries to the Traffic Operations Center requires a minimum notice of two (2) working days prior to returning or delivering any sign and/or sign related material.

3.03 RESPONSIBILITIES

A. The contractor is responsible for providing and supplying aluminum traffic signs covered with retro-reflective sheeting, applying standard legends (or special legends if shown in the plans) to the covered sign blanks, galvanized steel sign poles, pole anchors, all hardware for installing the signs and poles, and for installing traffic signs, poles and anchors as shown in the plans or call for in the contract documents, complete and ready for field installations.

END OF SECTION

Section 01555

TRAFFIC CONTROL AND REGULATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Requirements for signs, signals, control devices, traffic barriers, flares, lights and traffic signals; construction parking control, designated haul routes, and bridging of trenches and excavations.

B. Qualifications and requirements for use of flagmen.

1.02 MEASUREMENT AND PAYMENT

A. Unit Price Contracts.

1. Traffic control and regulation. Payment for traffic control and regulation is on a lump sum basis. Include preparation and submittal of traffic control plan if different than shown on Drawings, and provision of traffic control devices, equipment, and personnel necessary to protect the Work and public. Payment will be based on Contractor's Schedule of Values for traffic control and regulation.

2. Payment for traffic control will be authorized by Project Manager in three (3) parts. Partial payment will be made according to following schedule:

   a. Payment of 25 percent of traffic control amount will be authorized when permanent control devices and necessary temporary markings, sufficiently deployed along job site as required to maintain progress of work, are installed at job site and approved. This limiting percentage will be prorated based upon extent of Contractor's setup.

   b. A payment of 50 percent of traffic control amount will be authorized when pavement replacement commences. This limiting percentage will be prorated based upon linear footage, as measured along centerline axis of water main, of pavement replaced.

   c. A payment of 25 percent of traffic control amount will be authorized when permanent pavement markings are restored and all unnecessary permanent and temporary control devices removed. This limiting percentage will be prorated based upon the extent of restoration.

3. Flagmen: Measurement is on a lump sum basis for flagmen as required for the project. The amount invoiced shall be determined based on the schedule of value submitted for flagmen.

4. New Portable Concrete Low Profile Traffic Barrier Provided. Payment is on a unit price basis for each linear foot of low profile traffic barrier provided, installed with hardware assemblies and connected together in accordance with the approved traffic control plan.

5. Portable Concrete Low Profile Traffic Barrier picked up from City of Houston Stockpile. Payment is on a unit price basis for each linear foot of low profile traffic barrier picked up from designated stockpile, moved onto the project, set at location and connected together.

6. Portable Concrete Low Profile Traffic Barrier Installed. Payment is on a unit price basis for each linear foot of low profile traffic barrier delivered to the project location, installed with hardware assemblies and connected together in accordance with the approved traffic control plan.

7. Portable Concrete Low Profile Traffic Barrier Moved and Reset. Payment is on a unit price basis for each linear foot of low profile traffic barrier disassembled, moved on the project, reset at the new locations and connected together. Include cost to repair roadway in the unit price.

8. Portable Concrete Low Profile Traffic Barrier Removed. Payment is on a unit price basis for each linear foot of low profile traffic barrier removed from the project, including hardware assemblies, and stockpiling at location listed in Section 01110 – Summary of Work. Include cost to repair roadway in the unit price.

9. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price Contracts. Include payment for work under this section in the total Stipulated Price.

1.03 REFERENCES

A. Texas Manual on Uniform Traffic Control Devices (TMUTCD)

B. Article 4413 (29bb), commonly referred to as Private Investigators and Private Security Agencies Act, and Article 2.12, Texas Code of Criminal Procedure.

C. Code of Ordinances, City of Houston, Texas.

1. Chapter 10 Buildings And Neighborhood Protection, Article X Cleanup After Demolition Or Removal Of Structures

2. Chapter 40 Streets and Sidewalks, Article XVII Pedestrian Way Impairments

1.04 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Traffic control plan:

1. If using traffic control plan contained in the Contract without modification, submit a letter confirming use of the plan.

2. If using a different traffic control plan, submit the plan for approval. The plan must conform to TMUTCD requirements and be sealed by a Registered Texas Professional Engineer.

C. Submit copies of approved lane closure permits issued by City Traffic Engineering Branch.

D. Submit Schedules of Values for traffic control plan and flagmen within 30 days following Notice to Proceed.

E. Submit records verifying qualifications of Uniformed Peace Officers and Certified Flagmen proposed for use on the Work.

F. When working in the central business district, submit copies of approved Pedestrian Way permits issued by the City's Traffic Engineering Branch.

1.05 FLAGMEN

A. Use Uniformed Peace Officers and Certified Flagmen to control movement of vehicular and pedestrian traffic when construction operations encroach on public traffic lanes. Unless otherwise approved by Project Manager, use Uniformed Peace Officer for work along major thoroughfares, schools, churches, hospitals and Work at signalized intersections.

B. Uniformed Peace Officer: Individual employed full-time as a peace officer who receives separate compensation as a privately employed flagman. Private employment may be an employee-employer relationship or on an individual basis. Flagman may not be in the employ of another peace officer nor be a reserve peace officer.

1. Uniformed Peace Officers may be:

   a. sheriffs and their deputies;

   b. constables and deputy constables;

   c. marshals or police officers of an incorporated city, town or village; or

   d. as otherwise provided by Article 2.12, Code of Criminal Procedure.

2. The Uniformed Peace Officer must be a full-time peace officer, must work a minimum average of 32 paid hours per week, and must be paid a rate not less than the prevailing minimum hourly wage rate set by the federal Wage and Hour Act. The individual must be entitled to vacation, holidays, and insurance and retirement benefits.

C. Certified Flagman: Individual who receives compensation as a flagman and meets the following qualifications:

1. Formally trained and certified in traffic control procedures by the City s E. B. Cape Center.

2. Speaks English. Ability to speak Spanish is desirable but not required.

3. Paid for flagman duty at an hourly rate not less than the wage rate set for Rough Carpenter under the City's Wage Scale for Engineering Construction.

D. Certified Flagmen must wear a distinctive uniform, bright-colored vest, and be equipped with appropriate flagging and communication devices while at the Work site. They must also have in their possession while on duty, a proof of training identification card issued by the appropriate training institute.

PART 2 PRODUCTS

2.01 SIGNS, SIGNALS, AND DEVICES

A. Comply with TMUTCD requirements.

B. Traffic cones and drums, flares and lights: Conform to local jurisdictions' requirements.

C. When working in the Central business district, provide pedestrian pathway

signage approved by the City's Traffic Engineering Branch.

2.02 PORTABLE LOW PROFILE CONCRETE BARRIERS

A. The low profile concrete barrier is a patented design. Information concerning this barrier may be obtained from Texas Transportation Institute, Texas A&M University System, College Station, Texas 77843-3135, (409) 845-1712.

PART 3 E X E C U T I O N

3.01 PUBLIC ROADS

A. Submit requests forms for lane closure and sidewalk closure to the City's Traffic Engineering Branch at least three working days prior to need for blocking vehicular lanes or sidewalks. Do not block lanes or sidewalks without approved permits. Obtain application from the City's Traffic Engineering Branch at 611 Walker, 5th floor or at the following internet address: http://www.ci.houston.tx.us/pwe/mrow/laneclosure.htm.

B. Follow laws and regulations of governing jurisdictions when using public roads. Pay for and obtain permits from jurisdiction before impeding traffic or closing lanes. Coordinate activities with Project Manager.

C. Give Project Manager one-week notice before implementing approved traffic control phases. Inform local businesses of impending traffic control activities.

D. Notified police department, fire department, METRO, and local schools, churches, and businesses in writing a minimum of five business days prior to beginning work.

E. Maintain 10-foot wide all-weather lanes adjacent to the Work for emergency vehicle use. Keep all-weather lanes free of construction equipment and debris.

F. Do not to obstruct 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 Project Manager.

G. Maintain local driveway access to residential and commercial properties adjacent to work areas at all times. Use all-weather materials approved by Project Manager to maintain temporary driveway access to commercial and residential driveways.

H. Keep streets entering and leaving job site free of excavated material, debris, and 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 Project Manager.

3.02 CONSTRUCTION PARKING CONTROL

A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and the City's operations.

B. Monitor parking of construction personnel's vehicles in existing facilities. Maintain vehicular access to and through parking areas.

C. Prevent parking on or adjacent to access roads or in non-designated areas.

3.03 FLARES AND LIGHTS

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

3.04 HAUL ROUTS

A. Utilize haul routes designated by authorities or shown on drawings for construction traffic.

B. Confine construction traffic to designated haul routes.

C. Provide traffic control at critical areas of haul routes to regulate traffic and minimize interference with public traffic.

3.05 TRAFFIC SIGNS AND SIGNALS

A. Construct necessary traffic control devices for temporary signals required to complete the Work including loop detectors, traffic signal conduits, traffic signal wiring and crosswalk signals. Notify the City's Traffic Engineering Branch a minimum of 60 days in advance of need for control boxes and switchgear. The City will perform necessary service, programming or adjustments, to signal boxes and switchgear if required during construction.

B. Install and operate traffic control signals to direct and maintain orderly traffic flow in areas under Contractor's control affected by Contractor's operations. Post notices, signs and traffic controls before moving into next phase of traffic control.

C. Relocate traffic signs and signals as the Work progresses to maintain effective traffic control.

D. Unless otherwise approved by Project Manager, provide driveway signs with name of business that can be accessed from each crossover. Use two signs for each crossover.

E. Replace existing traffic control devices in Project area.

F. Project Manager may direct Contractor to make minor adjustments to traffic control signage to eliminate driver confusion and maintain orderly traffic flow during construction at no additional cost to the City.

3.06 BRIDGING TRENCHES AND EXCAVATIONS

A. When necessary, construct bridges over trenches and excavation to permit an unobstructed flow of traffic across construction areas and major drives. Use steel plates of sufficient thickness to support H-20 loading and install to operate with minimum noise.

B. Shore trench or excavation to support bridge and traffic.

C. Secure bridging against displacement with adjustable cleats, angles, bolts or other devices when:

1. bridging is placed over existing bus routes,

2. more than five percent of daily traffic is comprised of commercial or truck traffic,

3. more than two separate plates are used for bridging, and

4. when bridge is to be used for more than five consecutive days.

D. Extend steel plates used for bridging a minimum of 1 foot beyond edges of trench or excavation. Use temporary paving materials such as premix to feather edges of plates to minimize wheel impact on secured bridging.

3.07 REMOVAL

A. Remove equipment and devices when no longer required.

B. Repair damage caused by installation.

C. Remove post settings to a depth of 2 feet.

3.08 TRAFFIC CONTROL, REGULATION AND DIRECTION

A. 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. multi-lane vehicular traffic must be diverted into single lane vehicular traffic,

2. vehicular traffic must change lanes abruptly,

3. construction equipment must enter or cross vehicular traffic lanes and walks,

4. construction equipment may intermittently encroach on vehicular traffic lanes and unprotected walks and crosswalk,

5. traffic regulation is needed due to rerouting of vehicular traffic around the Work site, and

6. where construction activities might affect public safety and convenience.

B. Use of Flagmen to assist in the regulation of traffic flow and movement does not relieve Contractor of responsibility to take other means necessary to protect the Work and public.

3.09 INSTALLATION STANDARDS

A. Place temporary pavement for single lane closures, in accordance with TMUTCD.

B. Reinstall temporary and permanent pavement markings as approved by Project Manager. When weather conditions do not allow application according to manufacturer's requirements, alternate markings may be considered. Submit proposed alternate to Project Manager for approval prior to installation. No additional payment will be made for use of alternate markings.

3.10 MAINTENANCE OF EQUIPMENT AND MATERIAL

A. Submit name, address and telephone number of individual designated to be

responsible for maintenance of traffic handling at construction site to Project Manager. Individual must be accessible at all times to immediately correct deficiencies in equipment and materials used to handle traffic including missing, damaged, or obscured signs, drums, barricades, or pavement markings.

B. Inspect signs, barricades, drums, lamps and temporary pavement markings daily to verify that they are visible, in good working order, and conform with traffic handling plans as approved by Project Manager. Immediately repair, clean, relocate, realign, or replace equipment or materials that are not in compliance.

C. Keep equipment and materials, signs and pavement markings, clean and free of dust, dirt, grime, oil, mud, or debris.

D. Obtain approval of Project Manager to reuse damaged or vandalized signs, drums, and barricades.

END OF SECTION

Section 01562

TREE AND PLANT PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tree and plant protection.

B. Minimum qualifications of Arborist and Urban Forester.

1.02 MEASUREMENT AND PAYMENT

A. Payment for Tree Protection, including tree pruning or tree removal, shall be paid as a Lump Sum basis that shall include all items specified in this section unless payment is specified otherwise in this section

B Payment for Zero Curb Cutback will be on a per linear foot basis.

C. Payment for Checker Plate will be on a square foot basis.

D. Refer to Section 01270-Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Conform to requirements of Section 01330 – Submittal Procedures.

B. Submit name and experience of qualified Arborist, proposed for use on the Work, to Project Manager.

1.04 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 or soil contamination from spilled solvents, gasoline, paint, lime slurry, 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 zones.

8. Cutting of roots larger than one inch in diameter.

1.05 DAMAGE ASSESSMENT

A. When trees other than those designated for removal are destroyed or damaged as result of construction operations, remove and replace with same size, species, and variety up to and including 8 inches in trunk diameter. Trees 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 and paid to Tree Fund 0.7854 x D2 x $13.25 where D is diameter in inches of tree or shrub trunk measured 12 inches above grade for that portion of the tree which is greater than 8 inches in diameter. A permit must be applied for and approved by the City of Houston, Urban Forestry Division prior to removal of any tree not scheduled for removal in the tree treatment schedule. Contractor shall contact City of Houston, Urban Forestry, at 832-395-8459 to apply for tree removal permit when needed.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pruning Paint: Black latex, water based paint, free of all petroleum products.

B. Fertilizer: Fertilizer shall be a root stimulant that contains at a minimum the following ingredients: Ectomycorrhizal Fungi, VA Mycorrhizal (VAM) Fungi, Rhizosphere Bacillus spp., Kelp Meal Humic Acid, and Soluble Yucca.

C. Tree Protection Fencing: Orange, plastic mesh fenching, 4 feet in height with 6 feet high "t" bar posts installed 10 feet on centers as per drawings.

D. Plastic Root/Soil Protection: Clear polyethylene sheeting, minimum 6 mil, thickness.

PART 3 EXECUTION

3.01 PROTECTION OF EXISTING TREES AND SHRUBS

A. Site preparation work and/or construction work shall not begin in any area where tree preservation measures have not been completed and approved.

B. Protect exposed roots and root zone areas from contamination from stabilization materials and concrete using polyethylene.

C. Cover exposed roots within 4 hours to reduce damage caused by desiccation. Roots may be covered with soil, mulch, polyethylene, or wet burlap to help protect them from drying.

D. Designate limited areas as concrete washout areas. Locate concrete washout areas away from root zones.

E. Install root pruning trenching where designated in tree treatment schedule and shown on the tree protection drawings. Trees scheduled for root pruning are called out specifically in the treatment schedule. Trench shall be located 2 ft. from the edge of proposed waterline or sanitary sewer for trees called out for root pruning for water or fittings, or sanitary sewer in the treatment schedule, 2 ft. from edge of proposed storm sewer pipe for trees called out for root pruning for storm in the treatment schedule, 30" back of proposed curb for trees called out for root pruning for street, and at edge of sidewalk for trees called out for root pruning for sidewalk. Root pruning shall not be performed where there is not adequate space to be located sufficiently away from tree to prevent damage. All pruning must be evaluated by Contractor's Certified Arborist and reviewed and approved by City Forester before being performed. Trench locations shown on tree preservation plan are drawn to scale and should be located in field as drawn on plan. Exact locations shall be approved in the field by engineer and/or project urban forester prior to installation. Trenching depth shall be a minimum of 2 ft. deep and a maximum of 6 inches wide for water, fittings, sanitary sewer, storm, and street. Trenching depth shall be to the anticipated bottom of sidewalk and base material for sidewalk root pruning, roots lower than sidewalk shall not be pruned. All roots shall be cut by trencher, chainsaw, or handsaw to the specified depth. Roots shall be cut cleanly, and or not ripped, torn, or chopped. Trench shall be backfilled and compacted immediately after trenching. Trench shall be installed prior to any clearing and grubbing, excavation for underground, or any other site work.

F. Install tree protection fencing around each tree to be preserved as indicated in the tree treatment schedule and on the tree protection plan.

1. Each tree to be preserved shall be protected with a tree protection fence. The fencing shall be continuous between posts, shall be pulled taut prior to securing to posts, and shall be firmly attached to the posts with a minimum of 4 wire ties.

2. All tree protection fencing shall be installed prior to site work or construction activity. The fence shall be placed in a continuous alignment as shown on the tree protection plan. Fences shown on tree protection plan are drawn to scale and shall be installed as drawn, in the field. In general fences shall be placed 30" back of existing curb or edge of pavement where root pruning or zero curb cutback is not specified, and 6" back of root pruning trench where root pruning is specified and immediately back of curb where zero curb cutback is specified. Exact locations shall be approved by the project urban forester and/or engineer in the field. The Fences shall be placed to protect roots, trunks, and foliage. The contractor shall not remove or relocate tree protection fencing and shall not operate within the limits shown without direct approval of the project urban forester. In areas where the proposed waterline is located in the existing road side ditch and where tree protection fencing can not be installed across the ditch, the fencing shall be installed at the top of outside ditch bank and no bore pits, peep holes, service taps, or any excavation should occur in the area immediately in front of the tree protection fencing for trees called out with "bore" in the Tree Treatment Schedule. The "bore" limits shall be the same as the limits of the tree protection fencing.

3. Storage of equipment or materials will not be allowed inside a fence. Entryways and access into a protected area shall not be provided unless approved by the project urban forester.

4. Damage to tree fences occurring during the progress of the work shall be repaired immediately at no additional cost to owner. Workmen shall be clearly instructed to exercise caution in performance of work near trees being preserved.

5. Tree protection fencing shall be removed by contractor, at no additional costs, upon completion of all construction activity in each work zone area. Tree protection fencing materials used in the first two work zone areas shall be removed and utilized in subsequent work zone areas. Materials and labor shall be paid for each linear foot of fencing installed in first two work areas. All fencing installed in subsequent work zone areas shall be paid for labor only.

G. Boring/Auguring of water lines or sanitary sewer lines

1. Water line or sanitary sewer line shall be bored/augured/ horizontally drilled under

critical root zones areas of trees designated with auger or bore in the tree treatment schedule. The entire area protected with tree protection fencing shall be bored. No bore pits, come through holes, peep holes, push pits, or long or short side service taps shall be allowed in the areas protected by tree protection fencing. The tree protection plan takes into consideration the limits of augering equipment, there should be room for adequately spaced bore pits, peep holes, come through holes, and push pits. Any changes to the location of the tree protection fencing shall be authorized by the project Urban Forester and City Engineer.

H. Hand digging of Service taps and leads

1. Trees called out for Hand dig short side service tap are located in very close proximity to existing short side water meters. Excavating the service tap with machinery would significantly impact the tree and be in violation of the City of Houston's Street Tree Ordinance. These short side service taps shall be excavated with manual labor to expose any roots 1" in diameter and larger. The first 24" of excavation shall be completed manually to expose the roots. Any root 1" in diameter and larger shall remain undamaged, the roots shall not be cut , nor shall the bark and cambium layer be scraped or damaged. Once the roots are exposed, if there is adequate room to utilize a mini-excavator without damaging the roots, the mini-excavator can be utilized to complete the excavation down to the water line. 1" plywood shall be placed on grade to provide root protection in the area of access of the mini-excavator. If roots 1" diameter or larger are cut or damaged, responsible party will be subject to a citation under the Street Tree Ordinance, and may also be required to incur the cost of tree removal and replacement of damaged tree on an inch for inch basis, if required by City of Houston Urban Forestry Division.

2. Trees called out for Hand dig short side or long side service lead are located in very close proximity to existing water meters. Excavating the service lead with machinery would significantly impact the tree and be in violation of the City of Houston's Street Tree Ordinance. Short side leads shall be excavated with manual labor to expose any roots 1" in diameter and larger from the service tap of the meter. Come out hole and excavation required for long service leads shall be excavated with manual labor to expose roots 1" in diameter and larger, from the come out hole to the meter. In each case, all roots 1" in diameter and larger shall remain undamaged, the roots shall not be cut, nor shall the bark and cambium layer be scraped or damaged. If roots 1" diameter or larger are cut or damaged, responsible party will be subject to a citation under the cost of tree removal and replacement of damaged tree on an inch by inch basis, if required by City of Houston Urban Forestry Division.

3. Trees called out for Hand dig sanitary stub up are located in very close proximity to proposed service lead. Excavating the service lead with machinery would significantly impact the tree and be in violation of the City of Houston's Street Tree

Ordinance. Excavation for sanitary stub up shall be completed with manual labor to expose any roots 1" in diameter and larger. The lead shall be bored from face of curb to stub up hole when called out in the tree treatment schedule. Come out and stub up holes shall be excavated with manual labor to expose roots 1" in diameter and larger. In case, all roots 1" in diameter and larger shall remain undamaged, the roots shall not be cut, nor shall the bark and cambium layer be scraped or damaged. If roots 1" diameter or larger are cut or damaged, responsible party will be subject to a citation under the Street Tree Ordinance, and may be required to incur the cost of tree removal and replacement of damaged tree on an inch by inch basis, if required by City of Houston Urban Forestry Division.

4. Long side service taps shall not be located in an area specified to be bored in the tree treatment schedule. Should it be absolutely necessary to locate a long side service tap in an area specified to be bored, the excavation shall be completed as specified in paragraph 1 of this section-Hand digging short side service taps.
5. All water meters and sanitary service leads called out on P&P drawings and visible in the field have been addressed in the Tree Protection Plan. Should any additional meters or lead be found during construction, or in any new meters or leads installed beneath the canopy of any tree, fenced for tree protection, the excavation shall be completed as specified in paragraph 1 and/or 2 of this section and paid for at the unit cost for each included in contract.

I. Pruning of Trees

1. Trees shall be pruned in accordance with the American National Standard for tree pruning, ANSI A300 (Part 1) – 2001 Pruning Revision of ANSI A300-1995 Tree, Shrub and Other Woody Plant Maintenance – Standard Practices. Pruning shall be completed by professional arborists who has received training in proper pruning techniques.

2. Clearance prune designated trees for public streets, sidewalks, and construction areas. Provide minimum 14 feet and maximum of 18 feet of vertical clearance over proposed water trunk lines. Provide minimum of 14 feet and maximum of 16 feet of vertical clearance over proposed street construction, from 24" back of curb on one side to 24" back of curb on the other side. Provide 20' of vertical clearance over proposed storm sewer up to 38" in size, and 30' of vertical clearance for storm sewer larger than 38" in size. Pruning to be installed prior to any construction activity. Contractor shall notify property owner prior to trimming or pruning any trees with trunks located on private property. Exceptions will be made for trees determined to be arboriculturally significant by City of Houston Urban Forestry. Pruning of trees identified will be completed with approval and supervision of City of Houston Urban Forestry.

3. All cuts should be made sufficiently close to the parent limb or trunk without cutting into the branch collar or leaving a protruding stub, so that closure can readily start under normal conditions. All lateral cuts shall be made to a lateral that is least 1/3 the diameter of the parent limb. Clean cuts shall be made at all times.

4. Trees shall be pruned in a manner that will not destroy or alter the natural shape and character of the tree. Apply black latex paint to all fresh wounds on Oak (Quercus) species immediately after each cut is made.

5. Crown cleaning prune designated trees shall include selective removal of dead, diseased, and/or broken limbs.

J. Tree Removal

1. 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.

2. Only those trees called out for removal in the Tree Treatment Schedule shall be removed, or otherwise damaged. Should it be determined that any additional trees must be removed, a permit must be applied for and approved from the City of Houston Urban Forestry Division prior to removal. Contractor shall contact Urban Forestry at 832-395-8459.

K. Root Stimulation

1. Deep root stimulate designated trees. Mix fertilizer with wetting agent per label instructions.

2. Stimulate entire root zone area within the dripline of the tree and continue 10 feet beyond the dripline, leaving out areas of anticipated root loss (construction areas).

3. Mixture shall be injected into the top 10 inches of soil under pressure of 150 to 200 psi as soil conditions warrant.

4. Mix in a tank with agitation capability per label instructions. Inject the mixture on a 2.5 ft. square grid at 4 lbs, actual nitrogen per 1,000 sq. ft.

L. Regularly water trees which have received root damage, to eliminate additional stress caused by lack of moisture. Water during periods without adequate rainfall. For example, should 1.0" of rain not be received within a week period, the trees should be thoroughly watered.

March through September, water once every two weeks. October through February, water every three weeks. Water thoroughly to saturate the entire root zone area.

M. Chemically treat tree trunks with evidence of borer activity with the appropriate approved insecticide mixed and applied per the manufacturer's product application recommendations. Trees shall be sprayed within 24 hours after observance of borer activity.

N. Grading and filling around trees.

1. Maintain existing grade within the dripline of trees, unless otherwise indicated.

2. Where existing grade around trees is above new finish grade, under supervision of project urban forester, carefully hand excavate within the dripline to make transition to new finish grade.

3. Where existing grade is below new finish grade, place clean bank sand in a single layer to make the transition to new grade. Do not compact; hand grade to required elevation. Specifically to areas where proposed curb is higher than existing and backfill will be required.

O. Demolition, Forming and Pouring Sidewalks (Sidewalk on Grade)

1. Demolition of existing sidewalks, located in or adjacent to the limits of tree protection fencing, shall be completed without disturbing, cutting, or otherwise damaging tree roots and soil located beneath them.

2. The new sidewalk shall be formed at or above the elevation of the existing sidewalk, without disturbing, cutting or otherwise damaging tree roots. Every effort has been made to address tree root and sidewalk elevation issues with information available in the field and on plan and profile sheets. The elevation of every tree root was not available, if tree roots are found to be in conflict with proposed sidewalk, project engineer and urban forester shall be consulted as to how to install sidewalks with minimal impacts to adjacent trees.

3. Checkerplate shall be installed in areas called out only if tree root elevations prohibit construction of ADA compliant sloped concrete sidewalks. Checkerplate shall be installed per detail.

P. Zero curb cutback

1. Disturbance of tree roots or soil behind the existing and/or proposed curb within root zones of trees designated for zero curb cutback shall be prohibited. If the curb can not be removed without disturbing soil or damaging roots back of curb when using

equipment for demolition, the curb shall be broken using a hand held jackhammer and removed by hand.

2. The exposed roots and soil shall be covered immediately after demolition with 6 mil polyethylene in order to avoid desiccation, and contamination by the lime used for road bed stabilization. The polyethylene shall be placed so that it covers the vertical face of soil back of curb and laid back onto the grade 12 inches back of curb. The polyethylene should remain in place, across the entire area specified for zero curb cutback, from the time the existing curb is demolished until the time when the new curb is formed and backfilled. The polyethylene can be pulled up from the vertical face while the road bed is being graded or mixed, to avoid catching the plastic with machinery, but shall be replaced immediately after equipment has completed. The vertical face shall not be exposed for more than 8 hours in any 24 hour period.

3. There shall be no stabilization back of curb in the zero curb cutback areas, or forming with steel forms. The existing grade and roots back of existing curb shall not be disturbed. This may require forming of the new street with wooden forms with stakes inside forms, which may require leaving the forms in place after the street is poured. Should wooden forms be utilized, the wood shall be at minimum a 2x6. The new curb may require hand finishing, as a slip curb machine may not have adequate clearance without disturbing the roots that are to be protected with the zero curb cutback.

4. Roots extending into the street, or on top of the existing curb, in areas to paved shall be cut and removed by hand prior to disturbance or removal with equipment. Roots shall be pruned flush with the proposed back of curb. Roots one inch in diameter and larger shall be cut in a manner to provide a smooth, clean cut surface. Cuts shall be made with the appropriate pruning shears or pruning saws. Roots shall not be chopped or broken.

5. In areas where proposed curb will be may be lower than existing top of curb and tree roots 2" diameter or larger are present, the soil and roots shall not be graded or laid back. The existing elevation shall be maintained and the curb formed to meet elevation or a short elevation difference roots and top of curb maintained.

Q. Demolition, Forming and Pouring of Drive Way Approaches

1. Demolition of existing driveway approaches located beneath the dripline of any tree shall be completed without disturbing, cutting, or otherwise damaging tree roots and soil located beneath them.

2. The new approach shall be formed at or above the elevation of the existing approach where tree roots 2" diameter or larger are present, without disturbing, cutting or

otherwise damaging tree roots. Maximum drive slopes may be needed at bottom of apron to allow forming of drive over tree roots at top of drive. As with sidewalks, the elevation of every tree roots was not available in design. If tree roots are found to be in conflict with proposed approach, project engineer and urban forester shall be consulted as to how to install drive way with minimal impacts to adjacent trees.

R. Replacement Trees for Tree Removals under Ordinance

1. Location, species, and size of replacement trees are indicated on the drawings. Contractor shall layout individual trees at locations shown on drawings. Contractor shall layout individual trees at locations shown on drawings and be responsible for utility locate requirements. In case of conflicts, notify City Engineer and City Urban Forestry before proceeding with work. Trees shall be laid out and locations approved by City Engineer prior to planting.

2. Trees shall meet and be planted according to City of Houston Standard Specification 02915.

S. Arborist and Urban Forester Qualifications

1. Arborist – Employ qualified arborist acceptable to City's Parks and Recreation Department to complete all tree treatments. Arborist shall be normally engaged in the field and have a minimum of 5 years experience. Qualifications of the selected arborist shall be submitted for review and approval by the project engineer and City of Houston.

2. Urban Forester – An Urban forester shall be hired to monitor and assist with field layout (exact locations of fencing, root pruning, and zero curb cutback) of the tree preservation program during demolition and construction to ensure tree protection procedures and techniques are practiced as specified to address concerns and conditions which occur in the field. At a minimum, the individual responsible for monitoring and field layout of the tree protection shall have a minimum of 5 years of experience as a consultant, and shall not be affiliated with a tree care contractor in the Houston area. Qualifications of the selected urban forester shall be submitted for review and approval by the project engineer and City of Houston Urban Forestry Department.

END OF SECTION

Section 01570

STORM WATER POLLUTION PREVENTION CONTROL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Implementation of Storm Water Pollution Prevention Plans (SWP3) described in Section 01410 – TPDES Requirement.

B. Installation, maintenance and removal, of storm water pollution prevention structures: diversion dikes, interceptor dikes, diversion swales, interceptor swales, down spout extenders, pipe slope drains, paved flumes and level spreaders. Structures are used during construction and prior to final development of the site.

C. Filter Fabric Barriers:

1. Type 1: Temporary filter fabric barrier for erosion and sediment control in non-channelized flow areas.

2. Type 2: Temporary reinforced filter fabric barrier for erosion and sediment control in channelized flow areas.

D. Hay Bale Fence.

E. Drop Inlet Basket

F. Inlet Sediment Traps

G. Brush Berm

H. Sand Bag Barrier

I. Bagged Gravel Barrier

J. Sediment Basin

K. Inlet Protection Barrier

1.02 MEASUREMENT AND PAYMENT

A. UNIT PRICES

1. Payment for filter fabric barrier is on a linear foot basis measured between limits of beginning and ending of stakes.

2. Payment for reinforced filter fabric barrier is on a linear foot basis measured between limits of beginning and ending of stakes.

3. Payment for drop inlet baskets is on a unit price basis for each drop inlet basket.

4. Payment for storm inlet sediment traps is on a unit price basis for each storm inlet sediment trap.

5. Payment for storm water pollution prevention structures is on a lump sum basis for the project. Earthen structures with outlet and piping include diversion dikes, interceptor dikes, diversion swales, interceptor swales, and excavated earth-outlet sediment trap, embankment earth-outlet sediment trap, down spout extenders, pipe slope drains, paved flumes, stone outlet sediment trap, and level spreaders.

6. Payment for hay bale barrier, if included in Document 00410 - Bid Form, is on a linear foot of accepted bale barriers, if not include in cost of storm water pollution prevention structures.

7. Payment for brush berm, if included in Document 00410 - Bid Form, is on a linear foot of accepted brush berm, if not include in cost of storm water pollution prevention structures.

8. Payment for sandbag barrier, if included in Document 00410 - Bid Form, is on a linear foot basis measured between limits of beginning and ending of sandbags, if not include in cost of storm water pollution prevention structures.

9. Payment for bagged gravel barrier, if included in Document 00410 - Bid Form, is on a linear foot basis measured between limits of beginning and ending of bagged gravel barrier, if not include in cost of storm water pollution prevention controls.

10. Payment for inlet protection barriers, if included in Document 00410 - Bid Form, is on a linear foot basis measured along outside face of inlet protection barrier, if not include in cost of storm water pollution prevention structures.

11. Refer to Section 01270 - Measurement and Payment for unit price procedures.

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

1.03 REFERENCE STANDARDS

A. ASTM

1. A 36 – Standard Specification for Carbon Structural Steel.

2. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600kN-m/m3)).

3. D3786 – Standard Test Method for Hydraulic Bursting Strength for knitted Goods and Nonwoven Fabrics.

4. D 4355 - Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).

5. D 4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.

6. D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

7. D 4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

8. D 6382 - Standard Practice for Dynamic Mechanical Analysis and Thermogravimetry of Roofing and Waterproofing Membrane Material.

B. Storm Water Management Handbook for Construction Activities prepared by City of Houston, Harris County and Harris County Flood Control District.

1.04 SYSTEM DESCRIPTIONS

A. Filter Fabric Barrier Type 1 and Type 2: Install to allow surface or channel runoff percolation through fabric in sheet-flow manner and to retain and accumulate sediment. Maintain Filter Fabric Barriers to remain in proper position and configuration at all times.

B. Hay Bale Fence: Install to allow surface runoff percolation through hay in sheet-flow manner and to retain and accumulate sediment. Maintain Hay Bale Fence to remain in proper position and configuration at all times.

C. Interceptor Dikes and Swales: Construct to direct surface or channel runoff around the project area or runoff from project area into sediment traps.

D. Drop Inlet Baskets: Install to allow runoff percolation through the basket and to retain and accumulate sediment. Clean accumulation of sediment to prevent clogging and backups.

E. Sediment Traps: Construct to pool surface runoff from construction area to allow sediment to settle onto the bottom of trap.

F. Sand Bags: Are used during construction activities in unstabilized minor swales, ditches, or streambeds when the contributing drainage area is no greater than 2 acres. It is also sediment barrier for stage one Inlet.

G. Bagged Gravel Barrier: Are used during construction activities in unstabilized minor swales, ditches, or streambeds when the contributing drainage area is no greater than 2 acres. It is also sediment barrier for stage two Inlet.

H. Drop Inlet Insert Basket: Is a temporary barrier placed within a storm drain inlet (Lower Portion of Stage I and Upper Portion of Stage II Inlets) consisting of a filter fabric supported by a metal frame work to prevent sediment and other pollutants from entering convey system.

I. Brush Berm: Brush Berm is constructed at the perimeter of a distribute site within the developing area.

1.05 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Submit manufacturer's literature for product specifications and installation instructions.

C. Submit manufacturers catalog sheets and other product data on geotextile or filter fabrics, outlet pipe, perforated riser and connectors.

D. Submit proposed methods, equipment, materials, and sequence of operations for storm-water pollution prevention structures.

E. Submit shop drawings for Drop Inlet Baskets.

PART 2 P R O D U C T S

2.01 CONCRETE

A. Concrete: Class B in accordance with Section 03315 – Concrete for Utility Construction or as shown on the Drawings.

2.02 AGREGATE MATERIALS

A. Use poorly graded cobbles with diameter greater than 3 inches and less than 5 inches.

B. Provide gravel lining in accordance with Section 2320 – Utility Backfill Materials or as shown on the drawings.

C. Provide clean cobbles and gravel consisting of crushed concrete or stone. Use clean, hard crushed concrete or stone free from adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic matter.

D. Sediment Pump Pit Aggregate: Use nominal 2-inch diameter river gravel.

2.03 PIPE

A. Polyethylene culvert pipe or PVC sewer pipe in accordance with Section 02505- High Density Polyethylene (HDPE) Solid and Profile Wall Pipe and Section 02506 Polyvinyl Chloride Pipe or as shown on the Drawings.

B. Inlet Pipes: Galvanized steel pipe in accordance with Section 02642 Corrugated Metal Pipe or as shown on the Drawings.

C. Standpipe for Sediment Pump Pits: Galvanized round culvert pipe or round PVC pipe, minimum of 12-inch and a maximum of 24-inch diameter, perforate at 6 to 12 inch centers around circumference.

2.04 GEOTEXTILE FILTER FABRIC

A. Woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material, in continuous rolls of longest practical length.

B. Grab Strength: 100 psi in any principal direction (ASTM D-4632), Mullen burst strength >200 psi (ASTM D-3786), and equivalent opening size between 50 and 140.

C. Furnish ultraviolet inhibitors and stabilizers for minimum 6 months of expected usable construction life at temperature range of 0 degrees F to 120 degrees F.

D. Mirafi, Inc., Synthetic Industries, or equivalent

2.05 BARRIER

A. Wire Barrier: Woven galvanized steel wire, 14 gauge by 6-inch square mesh spacing, minimum 24 inch roll or sheet width of longest practical length.

B. Barrier Stakes: Nominal 2 by 2 inch moisture-resistant treated wood or steel posts (min. of 1.25 lbs. per linear foot and Brinell Hardness greater than 140) with safety caps on top; length as required for minimum 8 inch bury and full

height of filter fabric.

2.06 SANDBAGS

A. Provide woven material made of polypropylene, polyethylene, or polyamide material.

1. Minimum unit weight of four ounces per square yard.

2. Minimum grab strength of 100 lbs in any principal direction (ASTM D4632)

3. Mullen burst strength exceeding 300 lbs (ASTM D4833).

4. Ultraviolet stability exceeding 70 percent. After 500 hours of exposure (ASTM 4355).

5. Size: Length:18 to 24 inches. Width: 12 to 18 inches. Thickness: 6 to 8 inches. Weight: Approximately 40 to 50 pounds not to exceed 75 pounds.

2.07 Bagged gravel Barrier

1. Minimum unit weight of four ounces per square yard.

2. Minimum grab strength of 100 lbs in any principal direction (ASTM D4632)

3. Mullen burst strength exceeding 300 lbs (ASTM D4833).

4. Ultraviolet stability exceeding 70 percent. After 500 hours of exposure (ASTM 4355).

5. Size: Length:18 to 24 inches. Width: 12 to 18 inches. Thickness: 6 to 8 inches. Weight: Approximately 40 to 50 pounds not to exceed 75 pounds.

2.08 DROP INLET BASKET

A. Provide steel frame members in accordance with ASTM A36.

B. Construct top frame of basket with two short sides of 2 inch by 2 inch and single long side of 1 inch by 1 inch, 1/8 inch angle iron. Construct basket hangers of 2 inch by 1/4 inch iron bars. Construct bottom frame of 1 inch by 1/4 inch iron bar or 1/4 inch plate with center 3 inches removed. Use minimum 1/4 inch diameter iron rods or equivalent for sides of inlet basket.

Weld minimum of 14 rods in place between top frame/basket hanger and bottom frame. Exact dimensions for top frame and insert basket will be determined based on dimensions of type of inlet being protected.

2.09 HAY BALE

A. Hay: Standard-baled agricultural hay bound by wire, nylon, or polypropylene rope. Do not use jute or cotton binding.

B. Hay Bale Stakes (applicable where bales are on soil): No. 3 (3/8 diameter) reinforcing bars, deformed or smooth at Contractor's option, length as required for minimum 18 inch bury and full height bales.

PART 3 E X E C U T I O N

3.01 PREPARATION, INSTALLATION AND MAINTEINANCE

A. Provide erosion and sediment control structures at locations shown on the Drawings.

B. Do not clear, grub or rough cut until erosion and sediment control systems are in place unless approved by Project Manger to allow installation of erosion and sediment control systems, soil testing and surveying.

C. Maintain existing erosion and sediment control systems located within project site until acceptance of Project or until directed by Project Manger to remove and discard existing system.

D. Regularly inspect and repair or replace damaged components of erosion and sediment control structures. Unless otherwise directed, maintain erosion and sediment control structure until project area stabilization is accepted. . Redress and replace granular fill at outlets as needed to replenish depleted granular fill. Remove erosion and sediment control structures promptly when directed by Project Manger. Dispose of materials in accordance with Section 01576 - Waste Material Disposal.

E. Remove and dispose sediment deposits at the designated spoil site for the Project. If a project spoil site is not designated on Drawings, dispose of sediment off site at approved location in accordance with Section 01576 - Waste Material Disposal.

F. Unless otherwise shown on the Drawings, compact embankments, excavations, and trenches in accordance with Section 02315 Roadway

Excavation or Section 2317 Excavation and Backfill for Utilities.

G. Prohibit equipment and vehicles from maneuvering on areas outside of dedicated right of way and easements for construction. Immediately repair damage caused by construction traffic to erosion and sediment control structures.

H. Protect existing trees and plants in accordance with Section 1562 – Tree and Plant Protection.

3.02 SEDIMENT TRAPS

A. Install sediment traps so that surface runoff shall percolate through system in sheet flow fashion and allow retention and accumulation of sediment.

B. Inspect sediment traps after each rainfall, daily during periods of prolonged rainfall, and at a minimum once each week. Repair or replace damaged sections immediately.

C. Use fill material for embankment in accordance with Section 02320 – Utility Backfill Materials.

D. Excavation length and height shall be as specified on Drawings. Use side slopes of 2:1 or flatter.

E. Stone outlet sediment traps:

1. Maintain minimum of 6 inches between top of core material and top of stone outlet, minimum of 4 inches between bottom of core material and existing ground and minimum of 1 foot between top of stone outlet and top of embankment.

2. Embed cobbles minimum of 4 inches into existing ground for stone outlet. Core shall be minimum of 1 foot in height and in width and wrapped in triple layer of geotextile filter fabric.

F. Sediment Basin with Pipe Outlet Construction Methods: Install outlet pipe and riser as shown on the Drawings.

G. Remove sediment deposits when design basin volume is reduced by one-third or sediment level is one foot below principal spillway crest, whichever is less.

3.03 FILTER FABRIC BARRIER CONSTRUCTION METHODS

A. Fence Type 1: Filter Fabric: Barrier

1. Install stakes 3 feet on center maximum and firmly embed minimum 8 inches in soil. If filter fabric is factory preassembled with support netting, then maximum support spacing is 8 feet. Install wood stakes at a slight angle toward the source of anticipated runoff.

2. Trench in the toe of the fence lines so the downward face of the trenches is flat and perpendicular to direction of flow. V-trench configuration as shown on Drawings may also be used.

3. Lay fabric along edges of trenches in longest practical continuous runs to minimize joints. Make joints only at a support post. Splice with minimum 6-inch overlap and seal securely.

4. Staple filter fabric to stakes at maximum 3 inches on center. Extend fabric minimum 18 inches and maximum 36 inches above natural ground.

5. Backfill and compact trench.

B. Barrier Type 2: Reinforced Filter Fabric Barrier

1. Layout barrier same as for Type 1.

2. Install stakes at 6 feet on center maximum and at each joint in wire fence, firmly embedded 1-foot minimum, and inclined it as for Type 1.

3. Tie wire fence to stakes with wire at 6 inches on center maximum. Overlap joints minimum one bay of mesh.

4. Install trench same as for Type 1.

5. Fasten filter fabric wire fence with tie wires at 3 inches on center maximum.

6. Layout fabric same as for Type 1. Fasten to wire fence with wire ties at 3 inches on center maximum and, if applicable, to stakes above top of wire fence it as for Type 1.

7. Backfill and compact trench.

8. Attach filter fabric to wooden fence stakes spaced a maximum of 6 feet apart or steel fence stakes spaced a maximum of 8 feet apart and embedded a minimum of 12 inches. Install stakes at a slight angle toward source of anticipated runoff.

9. Trench in toe of filter fabric barrier with spade or mechanical trencher so that downward face of trench is flat and perpendicular to direction of flow. A V-trench configuration may also be used. Lay filter fabric along edges of trench. Backfill and compact trench upon completion of Construction.

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

11. Cut length of fence to minimize use of joints. When joints are necessary, splice fabric together only at support post with minimum 6 inch overlap and seal securely.

12. When used in swales, ditches or diversions, elevation of barrier at top of filter fabric at flow line location in channel shall be lower than bottom elevation of filter fabric at ends of barrier or top of bank, whichever is less, in order to keep storm water discharge in channel from overtopping bank.

C. Triangular Filter Fabric Barrier Construction Methods

1. Attach filter fabric to wire fencing, 18 inches on each side. Provide a fabric cover and skirt with continuous wrapping of fabric. Skirt should form continuous extension of fabric on upstream side of fence.

2. Secure triangular fabric filter barrier in place using one of the following methods:
   a. Toe-in skirt 6 inches with mechanically compacted material;
   b. Weight down skirt with continuous layer of 3-inch to 5-inch graded rock; or
   c. Trench-in entire structure 4 inches.

3. Anchor triangular fabric filter barrier structure and skirt securely in place using 6-inch wire staples on 2-foot centers on both edges and on skirt, or staked using 18-inch by 3/8-inch diameter re-bar with tee ends.

4. Lap fabric filter material by 6 inches to cover segment joints. Fasten joints with galvanized shoat rings.

3.04 DIKE AND SWALE

A. Unless otherwise indicated, maintain minimum dike height of 18 inches, measured from cleared ground at up slope toe to top of dike. Maintain side slopes of 2:1 or flatter.

B. Dike and Swale Stabilization: When shown on the Drawings, place gravel lining 3 inches thick and compacted into the soil or 6 inches thick if truck crossing is expected. Extend gravel lining across bottom and up both sides of swale minimum height of 8 inches vertically, above bottom. Gravel lining on dike side shall extend up the up slope side of dike a minimum height of 8 inches, measured vertically from interface of existing or graded ground and up slope toe of dike, as shown on Drawings.

C. Divert flow from dikes and swales to sediment basins, stabilized outlets, or sediment trapping devices of types and at locations shown on Drawings. Grade dikes and swales as shown on Drawings, or, if not specified, provide positive drainage with maximum grade of 1 percent to outlet or basin.

D. Clear in accordance with Section 2233 – Clearing and Grubbing Compact embankments in accordance with Section 2315 – Roadway Excavation.

E. Carry out excavation for swale construction so that erosion and water pollution is minimal. Minimum depth shall be 1 foot and bottom width shall be 4 feet, with level swale bottom. Excavation slopes shall be 2:1 or flatter. Clear, grub and strip excavation area of vegetation and root material.

3.05 DOWN SPOUT EXTENDER

A. Down spout extender shall have slope of approximately 1 percent. Use pipe diameter of 4 inches or as shown on the Drawings. Place pipe in accordance with Section 2317 - Bedding and Backfill for Utilities.

3.06 PIPE SLOPE DRAIN

A. Compact soil around and under drain entrance section to top of embankment in lifts appropriately sized for method of compaction utilized.

B. Inlet pipe shall have slope of 1 percent or greater. Use pipe diameter as shown on the Drawings.

C. Top of embankment over inlet pipe and embankments directing water to pipe shall be at least 1 foot higher at all points than top of inlet pipe.

D. Pipe shall be secured with hold-down grommets spaced 10 feet on centers.

E. Place riprap apron with a depth equal to pipe diameter with 2:1 side slopes.

3.07 PAVED FLUME

A. Compact soil around and under the entrance section to top of the embankment in lifts appropriately sized for method of compaction utilized.

B. Construct subgrade to required elevations. Remove and replace soft sections and unsuitable material. Compact subgrade thoroughly and shape to a smooth, uniform surface.

C. Construct permanent paved flumes in accordance with Drawings.

D. Remove sediment from riprap apron when sediment has accumulated to depth of one foot.

3.08 LEVEL SPREADER

A. Construct level spreader on undisturbed soil and not on fill. Ensure that spreader lip is level for uniform spreading of storm runoff.

B. Maintain at required depth, grade, and cross section as specified on Drawings. Remove sediment deposits as well as projections or other irregularities which will impede normal flow.

3.09 INLET PROTECTION BARRIER

A. Place sandbags for Stage I, Bagged gravel for Stage II and filter fabric barriers at locations shown on the SWP3. Maintain to allow minimal inlet in flow restrictions / blockage during storm event.

3.10 DROP INLET BASKET CONSTRUCTION METHODS

A. Fit inlet insert basket into inlet without gaps around insert at locations shown on the SWP3.

B. Support for inlet insert basket shall consist of fabricated metal as shown on Drawings.

C. Push down and form filter fabric to shape of basket. Use sheet of fabric large enough to be supported by basket frame when holding sediment and extend at least 6 inches past frame. Place inlet grates over basket/frame to serve as fabric anchor.

D. Remove sediment deposit after each storm event and whenever accumulation exceeds 1-inch depth during weekly inspections.

3.11 HAY BALE FENCE CONSTRUCTION METHODS

A. Place bales in row with ends tightly abutting adjacent bales. Place bales with bindings parallel to ground surface.

B. Embed bale in soil a minimum of 4 inches.

C. Securely anchor bales in place with Hay Bale Stakes driven through bales a minimum of 18-inches into ground. Angle first stake in each bale toward previously laid bale to force bales together.

D. Fill gaps between bales with straw to prevent water from channeling between bales. Wedge carefully in order not to separate bales.

E. Replace with new hay bale fence every two months or as required by Project Manager.

3.12 BRUSH BERM CONSTRUCTION METHODS

A. Construct brush berm along contour lines by hand placing method. Do not use machine placement of brush berm.

B. Use woody brush and branches having diameter less than 2-inches with 6-inches overlap. Avoid incorporation of annual weeds and soil into brush berm.

C. Use minimum height of 18-inches measured from top of existing ground at upslope toe to top of berm. Top width shall be 24 inches minimum and side slopes shall be 2:1 or flatter.

D. Embed brush berm into soil a minimum of 4-inches and anchor using wire, nylon or polypropylene rope across berm with a minimum tension of 50 pounds. Tie rope securely to 18-inch x 3/8-inch diameter rebar stakes driven into ground on 4-foot centers on both sides of berm.

3.13 STREET AND SIDEWALK CLEANING

A. Keep areas clean of construction debris and mud carried by construction vehicles and equipment. If necessary, install stabilized construction exits at construction, staging, storage, and disposal areas, following Section 01575-Stabilized Construction Exit.

B. In lieu of or in addition to stabilized construction exits, shovel or sweep pavements as required to keep areas clean. Do not waterhose or sweep debris and mud off street into adjacent areas, except, hose sidewalks during off-peak hours, after sweeping.

3.14 WASTE COLLECTION AREAS

A. Prevent water runoff from passing through waste collection areas, and prevent water runoff from waste collection areas migrating outside collection areas.

3.15 EQUIPMENT MAINTENANCE AND REPAIR

A. Confine maintenance and repair of construction machinery and equipment to areas specifically designated for that purpose, so fuels, lubricants, solvents, and other potential pollutants are not washed directly into receiving streams or storm water conveyance systems. Provide these areas with adequate waste disposal receptacles for liquid and solid waste. Clean and inspect maintenance areas daily.

B. 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.

3.16 VEHICLE/ EQUIPMENT WASHING AREAS

A. Install wash area (stabilized with coarse aggregate) adjacent to stabilized construction access, as required to prevent mud and dirt run-off. Release wash water into drainage swales or inlets protected by erosion and sediment controls. Build wash areas following Section 01575- Stabilized Construction access. Install gravel or rock base beneath wash areas.

B. Wash vehicles only at designated wash areas. Do not wash vehicles such as concrete delivery trucks or dump trucks and other construction equipment at locations where runoff flows directly into waterways or storm water conveyance systems.

C. Locate wash areas to spread out and evaporate or infiltrate wash water directly into ground, or collect runoff in temporary holding or seepage basins.

3.17 WATER RUNOFF AND EROSION CONTROL

A. Control surface water, runoff, subsurface water, and water from excavations and structures to prevent damage to the Work, the site, or adjoining properties. Follow environment requirements.

B. Control fill, grading and ditching to direct water away from excavations, pits, tunnels, and other construction areas, and to direct drainage to proper runoff courses to prevent erosion, sedimentation or damage.

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

D. Retain existing drainage patterns external to the site by constructing temporary earth berms, sedimentation basins, retaining areas, and temporary ground cover as required to control conditions.

E. Plan and execute construction and earth work to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.

1. Hold area of bare soil exposed at one time to a minimum.

2. Provide temporary controls such as berms, dikes, and drains.

F. Construct fill and waste areas by selective placement to eliminate surface silts or clays which will erode.

G. Inspect earthwork periodically to detect start of erosion. Immediately apply corrective measures as required to control erosion.

H. Dispose of sediments offsite, not in or adjacent to waterways or floodplains, nor allow sediments to flush into streams or drainage ways. Assume responsibility for offsite disposal location.

I. Unless otherwise indicated, compact embankments, excavations, and trenches by mechanically blading, tamping, and rolling soil in maximum of 8-inch layers. Provide compaction density at minimum 90 percent Standard Proctor ASTM D-698-78 density. Make at least one test per 500 cubic yards of embankment.

J. Prohibit equipment and vehicles from maneuver on areas outside of dedicated rights-of-way and easements for construction. Immediately repair damage to erosion and sedimentation control systems caused by construction traffic.

K. Do not damage existing trees intended to remain.

3.18 REMOVAL OF CONTROLS

A. Remove erosion and sediment controls when the site is finally stabilized or as directed by Project Manager.

B. Dispose of sediments and waste products following Section 01505-Temporary Facilities.

END OF SECTION

Section 01575

STABILIZED CONSTRUCTION ACCESS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Installation and removal of erosion and sediment control for stabilized construction access used during construction and prior to final development of site, as shown in City of Houston Standard Construction details, DWG No. 01571-01.

1.02 MEASUREMENT AND PAYMENT

A. Unit Price Contracts. If Contract is Unit Price Contract, payment for work in this Section will be based on the following:

1. Stabilized construction roads, parking areas, access and wash areas: per square yard of aggregate/recycled concrete without reinforcing placed in 8-inch layers. No separate payment will be made for street cleaning necessary to meet TPDES requirements. Include cost of work for street cleaning under related Specification section.

B. Stipulated Price (Lump Sum) Contracts. If the Contract is a Stipulated Price Contract, include payment for work under this Section in the total Stipulated Price.

1.03 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Submit manufacturer-s catalog sheets and other Product Data on geotextile fabric.

C. Submit sieve analysis of aggregates conforming to requirements of this Specification.

1.04 REFERENCES

A. ASTM D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

B. Storm Water Quality Management Handbook For Construction Activities prepared by the City of Houston, Harris County and Harris County Flood Control District.

PART 2 PRODUCTS

2.01 GEOTEXTILE FABRIC

A. Provide woven or non-woven geotextile fabric made of polypropylene, polyethylene, ethylene, or polyamide material.

B. Geotextile fabric: Minimum grab strength of 200 lbs in any principal direction (ASTM D-4632) and equivalent opening size between 50 and 140.

C. Geotextile and threads: Resistant to chemical attack, mildew, and rot and contain ultraviolet ray inhibitors and stabilizers to provide minimum of six months of expected usable life at temperature range of 0 to 120 degrees F.

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

2.02 COARSE AGGREGATES

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

B. Coarse aggregates to consist of open graded rock 2" to 8" in size.

PART 3 EXECUTION

3.01 PREPARATION AND INSTALLATION

A. Provide stabilized construction roads and access at construction, staging, parking, storage,
and disposal areas to keep street clean of mud carried by construction vehicles and equipment. Construct erosion and sediment controls in accordance with Drawings and Specification requirements.

B. Do not clear grub or rough cut until erosion and sediment control systems are in place, unless approved by Project Manager to allow soil testing and surveying.

C. Maintain existing construction site erosion and sediment control systems until acceptance of the Work or until removal of existing systems is approved by Project Manager.

D. Regularly inspect, repair or replace components of stabilized construction access. Unless otherwise directed, maintain stabilized construction roads and

access until the City accepts the Work. Remove stabilized construction roads and access promptly when directed by Project Manager. Discard removed materials off-site.

E. Remove and dispose of sediment deposits at designated spoil site for Project. If a spoil site is not designated on Drawings, dispose of sediment off-site at a location not in or adjacent to stream or flood plain. Assume responsibility for off-site disposal.

F. Spread compacted and stabilized sediment evenly throughout site. Do not allow sediment to flush into streams or drainage ways. Dispose of contaminated sediment in accordance with existing federal, state, and local rules and regulations.

G. Prohibit equipment and vehicles from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Immediately repair damage to erosion and sediment control systems caused by construction traffic.

H. Conduct construction operations in conformance with erosion control requirements of Specification 01570 – Storm Water Pollution Control.

3.02 CONSTRUCTION MAINTENANCE

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

B. Provide stabilized construction access and vehicle washing areas, when approved by Project Manager, of sizes and at locations shown on Drawings or as specified in this Section.

C. Clean tires to remove sediment on vehicles leaving construction areas prior to entering public right-of-ways. Construct wash areas needed to remove sediment. Release wash water into drainage swales or inlets protected by erosion and sediment control measures.

D. Details for stabilized construction access are shown on Drawings. Construct other stabilized areas to same requirements. Maintain minimum roadway widths of 14 feet for one-way traffic and 20 feet for two-way traffic and of sufficient width to allow ingress and egress. Place geotextile fabric as a permeable separator to prevent mixing of coarse aggregate with underlaying soil. Limit exposure of geotextile fabric to elements between laydown and cover to a maximum 14 days to minimize potential damage.

E. Grade roads and parking areas to provide sufficient drainage away from stabilized areas. Use sandbags, gravel, boards, or similar materials to prevent sediment from entering public right-of-ways, waterways or

storm water conveyance systems.

F. Inspect and maintain stabilized areas daily. Provide periodic top dressing with additional coarse aggregates to maintain required depth. Repair and clean out damaged control systems used to trap sediment. Immediately remove spilled, dropped, washed, or tracked sediment from public right-of-ways.

G. Maintain lengths of stabilized areas as shown on Drawings or a minimum of 50 feet. Maintain a minimum thickness of 8 inches. Maintain minimum widths at all points of ingress or egress.

H. Stabilize other areas with the same thickness, and width of coarse aggregate required for stabilized construction access, except where shown otherwise on Drawings.

I. Stabilized areas may be widened or lengthened to accommodate truck washing areas when authorized by Project Manager.

J. Clean street daily before end of workday. When excess sediments have tracked onto streets, Project Manager may direct Contractor to clean street as often as necessary. Remove and legally dispose of sediments.

K. Use other erosion and sediment control measures to prevent sediment runoff during rain periods and non-working hours and when storm discharges are expected.

END OF SECTION

Section 01576

WASTE MATERIAL DISPOSAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Disposal of waste material and salvageable material.

1.02 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Submit copy of approved "Development Permit", as defined in Chapter 19 of Flood Plain Ordinance (City Ordinance Number 81-914 and Number 85-1705), prior to disposal of excess material in areas designated as being in "100-year Flood Hazard Area" within the City. Contact the City of Houston Flood Plain Manager, 3300 Main Street, at (713) 525-7605 for flood plain information.

C. Obtain and submit disposal permits for proposed disposal sites, if required by local ordinances.

D. Submit copy of written permission from property owner, with description of property, prior to disposal of excess material adjacent to Project. Submit 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 01410 – TPDES Requirements.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 SALVAGEABLE MATERIAL

A. Excavated Material: When indicated on Drawings, load, haul, and deposit excavated material at location or locations shown on Drawings outside limits of Project.

B. Base, Surface, and Bedding Material: Load shell, gravel, bituminous, or other base and surfacing material designated for salvage into City trucks.

C. Pipe Culvert: Load culverts designated for salvage into City trucks.

D. Other Salvageable Materials: Conform to requirements of individual Specification Sections.

E. Coordinate loading of salvageable material on City trucks with Project Manager.

3.02 EXCESS MATERIAL

A. Remove and legally dispose of vegetation, rubble, broken concrete, debris, asphaltic concrete pavement, excess soil, and other materials not designated for salvage from job site.

B. Excess soil may be deposited on private property adjacent to Project when written permission is obtained from property owner. See Paragraph 1.02 D above.

C. Verify flood plain status of any proposed disposal site. Do not dispose of excavated materials in area designated as within 100-year Flood Hazard Area unless "Development Permit" has been obtained. Remove excess material placed in "100-year Flood Hazard Area" within the City, without "Development Permit", at no additional cost to the City.

D. Remove waste materials from site daily, in order to maintain site in neat and orderly condition.

END OF SECTION

Section 01578

CONTROL OF GROUND AND SURFACE WATER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Dewatering, depressurizing, draining, and maintaining trenches, shaft excavations, structural excavations and foundation beds in stable condition, and controlling ground water conditions for tunnel excavations.

B. Protecting work against surface runoff and rising floodwaters.

C. Trapping suspended sediment in the discharge form the surface and ground water control systems.

1.02 MEASUREMENT AND PAYMENT

A. UNIT PRICES

1. When noted, dewatering of trench or excavation during course of project shall be measured per linear foot and paid for at contract unit prices for dewatering, when directed to perform such work by Project Manager. Dewatering must be fully detailed in submittal and submittal must be approved prior to performing dewatering work before payment will be made for dewatering. No payment will be made for work unless directed to perform work by Project Manager.

2. Presence of a pump on project does not constitute dewatering for payment under bid item "Ground Water Control for Open Cut Construction."

3. Dewatering required during course of project to lower water table for other utility installation less than 24 inches in diameter, construction of structures, removal of standing water, surface drainage seepage, or to protect against rising waters or floods shall be considered incidental to Work unless otherwise noted.

4. No separate payment will be made for groundwater control associated with augering, tunnels or casing. Include cost in unit price for augering.

5. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum) Contract. If the Contract is a Stipulated Price Contract, include payment for work under this section in the total Stipulated

Price.

1.03 REFERENCES

A. ASTM D 698 - Standard Test Methods for Laboratory Compaction of Soils Using Standard Effort (12,400 ft-lbf/ft3 (600kN-m/m3)

B. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA)

C. Storm Water Management Handbook for Construction Activities prepared by City of Houston, Harris County and Harris County Flood Control District.

1.04 DEFINITIONS

A. Ground water control system: system used to dewater and depressurize water-bearing soil layers.

1. Dewatering: lowering the water table and intercepting seepage that would otherwise emerge from slopes or bottoms of excavations, or into tunnels and shafts; and disposing of removed water. Intent of dewatering is to increase stability of tunnel excavations and 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 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, necessary to prevent failure or heaving of excavation bottom or instability of tunnel excavations.

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 necessary to protect Work from any source of surface water.

D. Monitoring facilities for ground water control system: includes piezometers, monitoring wells and flow meters for observing and recording flow rates.

1.05 PERFORMANCE REQUIREMENTS

A. Conduct subsurface investigations to identify groundwater conditions and to

provide parameters for design, installation, and operation of groundwater control systems. Submit proposed method and spacing of readings for review prior to obtaining water level readings.

B. Design ground water control system, compatible with requirements of Federal Regulations 29 CFR Part 1926 and Section 02260 - Trench Safety Systems, to produce following results:

1. Effectively reduce hydrostatic pressure affecting:

   a. Excavations

   b. Tunnel excavation, face stability or seepage into tunnels

2. Develop 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 loss of fines, seepage, boils, quick condition, or softening of foundation strata

5. Maintain stability of sides and bottom of excavations

C. Provide ground water control systems that 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 other sources entering excavation. Excavation drainage may include placement of drainage materials, 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 settlement or resultant damage caused by 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, adjacent water wells, or potentially contaminated areas. Repair damage caused by ground water control systems or resulting from

failure of system to protect property as required.

H. Install an adequate number of piezometers installed at proper locations and depths, necessary to provide meaningful observations of conditions affecting excavation, adjacent structures and water wells.

I. Install environmental monitoring wells at proper locations and depths necessary to provide adequate observations of hydrostatic conditions and possible contaminant transport from contamination sources into work area or ground water control system.

1.06 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittals Procedures.

B. Submit Ground Water and Surface Water Control Plan for review by Project Manager prior to start of excavation work. Include the following:

1. Results of subsurface investigations and description of extent and characteristics of water bearing layers subject to ground water control

2. Names of equipment Suppliers and installation Subcontractors

3. 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. Description of proposed monitoring facilities 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. 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 means

9. Surface water control and drainage installations

10. Proposed methods and locations for disposing of removed water

C. Submit following records upon completion of 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 weekly during control of ground and surface water 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

1.07 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 necessary permits from agencies with jurisdiction over use of groundwater and matters affecting well installation, water discharge, and use of existing storm drains and natural water sources. Since review and permitting process may be lengthy, take early action to obtain required approvals.

D. Monitor ground water discharge for contamination while performing pumping in vicinity of potentially contaminated sites.

PART 2 P R O D U C T S

2.01 EQUIPMENT AND MATERIALS

A. Select equipment and materials necessary to achieve desired results for dewatering. Selected equipment and materials are subject to review by Project Manager through submittals required in Paragraph 1.06, Submittals.

B. Use experienced contractors, regularly engaged in ground water control system design, installation, and operation, to furnish and install and operate educators, well points, or deep wells, when needed

C. Maintain equipment in good repair and operating condition.

D. Keep sufficient standby equipment and materials available to ensure continuous operation, where required.

E. Portable Sediment Tank System: Standard 55-gallon steel or plastic drums, free of hazardous material contamination.

1. Shop or field fabricate tanks in series with main inlet pipe, inter-tank pipes and discharge pipes, using quantities sufficient to collect sediments from discharge water.

PART 3 EXECUTION

3.01 GROUND WATER CONTROL

A. Perform necessary subsurface investigation 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 draw down characteristics. Present results in the Ground Water and Surface Water Control Plan. submittal

B. Provide labor, material, equipment, techniques and methods to lower, control and handle ground water in manner compatible with construction methods and site conditions. Monitor effectiveness of 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 Project Manager in writing of changes made to accommodate field conditions and changes to Work. Provide revised drawings and calculations with notification.

D. Provide continuous system operation, including nights, weekends, and holidays. Arrange appropriate backup if electrical power is primary energy source for dewatering system.

E. Monitor operations to verify systems lower ground water piezometric levels at rate required to maintain dry excavation resulting in stable subgrade for

subsequent construction operations.

F. Depressurize zones where hydrostatic pressures in confined water bearing layers exist below excavations to eliminate risk of uplift or other instability of excavation or installed works. Define allowable piezometric elevations in the Ground Water and Surface Water Control Plan.

G. Removal of ground water control installations.

1. Remove pumping system components and piping when ground water control is no longer required.

2. Remove piezometers, including piezometers installed during design phase investigations and left for Contractor's use, upon completion of testing, as required in accordance with Part 3 of applicable specification.

3. Remove monitoring wells when directed by Project Manager.

4. Grout abandoned well and piezometer holes. Fill piping that is not removed with cement-bentonite grout or cement-sand grout.

H. During backfilling, maintain water level a minimum of 5 feet below prevailing level of backfill. Do not allow the water level to cause 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 hour after placement.

I. Provide uniform pipe diameter for each pipe drain run constructed for dewatering. Remove pipe drains when no longer required. If pipe removal is impractical, grout connections at 50-foot intervals and fill pipe with cement-bentonite grout or cement-sand grout after removal from service.

J. The extent of ground water control for structures with permanent perforated underground drainage systems may be reduced, for units designed to withstand hydrostatic uplift pressure. Provide a means to drain affected portions of underground systems, including standby equipment. Maintain drainage systems during construction operations.

K. Remove systems upon completion of construction or when dewatering and control of surface or ground water is no longer required.

L. Compact backfill to not less than 95 percent of maximum dry density in accordance with ASTM D 698.

M. Foundation Slab: Maintain saturation line at least 3 feet below lowest elevations where concrete is to be placed. Drain foundations in areas where

concrete is to be placed before placing reinforcing steel. Keep free from water for 3 days after concrete is placed.

3.02 REQUIREMENTS FOR EDUCTOR, WELL POINTS, OR DEEP WELLS

A. For aboveground piping in ground water control system, include a 12-inch minimum length of clear, transparent piping between each eductor well or well point and discharge header to allow visual monitoring of discharge from each installation.

B. Install sufficient piezometers or monitoring wells to show that trench or shaft excavations in water bearing materials are pre-drained 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 selected method of work.

C. Install piezometers or monitoring wells at least one week in advance of the start of associated excavation.

D. Dewatering may be omitted for portions of under drains or other excavations, where auger borings and piezometers or monitoring wells show that soil is pre-drained by existing systems and that ground water control plan criteria are satisfied.

E. Replace installations that produce noticeable amounts of sediments after development.

F. Provide additional ground water control installations, or change method of control if, ground water control plan does not provide satisfactory results based on performance criteria defined by plan and by specifications. Submit revised plan according to Paragraph 1.06B.

3.03 SEDIMENT TRAPS

A. Install sediment tank as shown on approved plan.

B. Inspect daily and clean out tank when one-third of sediment tank is filled with sediment.

3.04 SEDIMENT SUMP PIT

A. Install sediment sump pits as shown on approved plan.

B. Construct standpipe by perforating 12 inch to 24-inch diameter corrugated metal or PVC pipe.

C. Extend standpipe 12 inches to 18 inches above lip of pit.

D. Convey discharge of water pumped from standpipe to sediment trapping device.

E. Fill sites of sump pits, compact to density of surrounding soil and stabilize surface when construction is complete.

3.05 EXCAVATION DRAINAGE

A. Use excavation drainage methods if well-drained conditions can be achieved. Excavation drainage may consist of layers of crushed stone and filter fabric, and sump pumping, in combination with sufficient ground water control wells to maintain stable excavation and backfill conditions.

3.06 MAINTENANCE AND OBSERVATION

A. Conduct daily maintenance and observation of piezometers or monitoring wells while ground water control installations or excavation drainage is operating at the site, or water is seeping into tunnels, and maintain systems in good operating condition.

B. Replace damaged and destroyed piezometers or monitoring wells with new piezometers or wells as necessary to meet observation schedules.

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 specified observations

D. Remove and grout piezometers inside or outside of excavation area when ground water control operations are complete. Remove and grout monitoring wells when directed by Project Manager.

3.07 MONITORING AND RECORDING

A. Monitor and record average flow rate of operation for each deep well, or for each wellpoint or eductor header used in dewatering system. Also, monitor and record water level and ground water recovery. Record observations 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 Work is completed or piezometers or wells are removed, except when Project Manager determines more frequent monitoring and recording are required. Comply with Project Manager's direction for increased monitoring and recording and

take measures necessary to ensure effective dewatering for intended purpose.

3.08 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. 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 agencies.

END OF SECTION

Section 01580

PROJECT IDENTIFICATION SIGNS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project identification sign description.

B. Project sign installation.

C. Maintenance and removal of Project sign.

1.02 SYSTEM DESCRIPTION

A. Sign Construction: Construct signs of new materials in accordance with Standard Detail provided at the Pre-construction Conference.

B. Appearance: Maintain signs to present a clean and neat look throughout contract duration.

C. Sign Manufacturer: Experienced professional sign company.

D. Sign Placement: At locations shown in Drawings unless otherwise specified by Project Manager at pre-construction meeting.

1. Provide one sign at each end of a linear Project involving paving, overlay, sewer line, storm drainage, or water main construction located in rights-of-ways.

2. Provide one sign for site or building construction Contracts

3. Provide one sign at each site for Contracts with multiple sites.

4. Sign Relocation: As work progresses, relocate signs if directed by Project Manager in writing. Include cost for one relocation of post-mounted signs in Contract Price. Subsequent relocations, if directed by Project Manager in writing, will be subject to Change Order.

E. Skid-mounted signs: Use for projects with noncontiguous locations where work progresses from one location to another. Design skid structure to withstand a 60 mile-per-hour wind load to the face or back of sign using stakes, straps, or ballast. Contractor shall be responsible for security of signs at each site.

1.03 SUBMITTALS

A. Submit Shop Drawings under provisions of Section 01330 - Submittal procedures.

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: Use new sign materials.

1. Sign Posts: 4-inch by 4-inch pressure treated wood posts, 9 feet long for skid mounting and 12 feet long minimum for in-ground mounting.

2. Skid Bracing: 2-inch by 4-inch wood framing material.

3. Skid Members: 2-inch by 6-inch wood framing material.

4. Fasteners:
   a. Galvanized steel.
   b. Attach sign to posts with 1/2-inch by 5-1/2 inch button head carriage bolts and secure with nuts and flat head washers.
   c. Cover button heads with white reflective film or paint to match sign background.
   d. Use metal brackets and braces and 3/4-inch wood screws to attach sign header.

B. Sign and Sign Header: 3/4-inch thick marine plywood. Use 4-foot by 8 -foot sheet for the sign and a single piece for the header to minimize joints. Do not piece wood sheets to fabricate sign face.

C. Paint and Primers: White industrial grade, fast-drying, oil-based paint with gloss finish for structural and framing members, sign, and sign header material surfaces. Paint all sign surfaces prior to adding adhesive applications.

D. Colors:

1. Sign Background: Reflective white 3M Scotchlite Engineer Grade, Pressure Sensitive Sheeting (White), or approved equal.

2. Border: For red border around area, which designates project name and project amount, use reflective red 3M Scotchlite Engineer Grade, Pressure Sensitive Sheeting (Red), or approved equal.

3. Sign Film: 3M Scotchcal Pressure Sensitive Films, or approved equal for legends, symbols, lettering, and artwork. Match colors to 3M Scotchcal Pressure Sensitive Films.

a.	Lettering Below Seal:	Black
b.	Lettering Above Project Name:	Vivid Blue
c.	Lettering on Blue Background:	White
d.	Background Behind Project Name:	Vivid Blue

E. City Seal: Project Manager will provide City seals to Contractor, as needed.

2.02 SIGN LAYOUT

A. Lettering:

1. Style, Size, and Spacing: Helvetica Regular lettering.

2. Condensed Style: Text may be condensed if needed to maintain sign composition.

B. Composition:

1. Lines with Standard Text
   a. Top line shall read "BUILDING TOGETHER FOR THE FUTURE".
   b. Use lower left below City Seal to list names and titles for Mayor, Controller and Council Members. Place as shown on Drawings with indicated size and spacing.
   c. Center telephone number of the Customer Response Center, "311", near the bottom of the area with the blue background.

2. Lines with Variable Text. Use blue background space for Project name and dollar amount.
   a. Project Manager will provide Project name and dollar amount of Project for preparation of sign. Center name on one or two lines, and dollar amount immediately below Project name, in area with blue background. Use condensed lettering if necessary.

2.03 LAYOUT AND COMPOSITION FOR HEADER

A. City of Houston Seal:
   1. A space of approximately 24 inches in diameter is provided for the City seal, the top 6 inches of which extends above the sign on the sign header.

   2. Construct sign header of same material as sign face. Cut material to match curve of the City seal.

   3. Project Manager will provide the seal to be affixed to the sign by sign maker.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install Project identification signs within seven days after Date of Commencement of the Work.

B. Erect signs at locations shown in Drawings unless otherwise designated by Project Manager at pre-construction meeting. Position sign so it is fully visible and readable to general public.

C. Erect sign level and plumb.

D. If mounted on posts, sink posts 3 to 4 feet below grade and stabilize posts to minimize lateral motion. Leave a minimum of 8 feet of post above existing grade for mounting of sign.

E. Erect sign so that top edge of sign is at a nominal 8 feet above existing grade.

3.02 MAINTENANCE AND REMOVAL

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

B. Remove signs, framing, supports, and foundations to a depth of at least 2 feet upon completion of Project. Restore area to a condition equal to or better than before construction.

PROJECT No.: (FILE NO:)	CONTRACT No.:	REVIEWED BY:

*INSTRUCTIONS TO SIGN MAKER (LIST COMPANY NAME):		
QTY.	ACTION ITEMS:	
	Make new sign(s)	
	Follow City standards attached	
	Provide submittal (drawing) to the City for project sign showing content, layout, lettering style, lettering size, and colors	
VARIABLE TEXT		
Line 1	Project Name:	
Line 2	Project Amount (rounded to nearest $1000):	
ATTACHMENTS INCLUDED		
QTY.	SEALS / LOGOS	
	City of Houston - 24" diameter	
	STANDARDS	
	Standard Specification Section 01580 - Project Identification Signs	
	Standard Detail 01580-03 Construction Sign	

(Instructions on reverse.)

INSTRUCTIONS

Contractor produces this form. Contractor shall insert the information and provide the form to the sign maker with Contractor's purchase order.

List PROJECT No., (FILE No.), CONTRACT No., and name of City's Project Manager REVIEWED BY.

INSTRUCTIONS TO SIGN MAKER:

- Give COMPANY NAME of sign maker.
- Indicate QUANTITY of new signs to be made.
- Direction for sign maker to follow City Standards in making signs.
- Require submittals from sign maker, who provides Shop Drawing of Project sign showing content, layout, lettering style, lettering size, and colors.

VARIABLE TEXT:

- Give PROJECT NAME. Write it out in all caps and suggest line break. Lines are required.
- Give Project amount to be listed on sign. Round off to nearest $1000.

ATTACHMENTS INCLUDED:

- **Seals**

  City provides the quantity of City seals required one for each Project sign.

- **Standards**

  Contractor provides set of Standards to sign maker, including (Specification Section 01580 - Project Identification Signs, and Standard Detail No. 01580-03 - Construction Sign.

Section 01581

EXCAVATION IN PUBLIC WAY PERMIT SIGNS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Project sign installation.

B. Maintenance and removal of Project sign.

1.02 SYSTEM DESCRIPTION

A. Sign Construction: Construct signs of new materials.

B. Appearance: Maintain signs to present a clean and neat look throughout the Contract duration.

C. Sign Placement: Place signs at each street entrance to street cut excavation.

1.03 SUBMITTALS

A. Submit Shop Drawings under provisions of Section 01330 - Submittal Procedures.

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 LAYOUT

A. Conform to Texas Manual on Uniform Traffic Control Devices. Minimum size: 36 inches by 36 inches.

B. Lettering: Uppercase Helvetica Regular lettering.

C. Composition: Include on sign copy of street cut permit, title "City of Houston", contracting department's name, address, and emergency telephone number and Contractor's name. Project Manager will provide department name, address, and emergency telephone number for preparation of sign.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install Project signs before commencement of pavement excavation in Public Way.

B. Position sign so it is fully visible and readable to general public.

C. Erect sign level and plumb.

D. Erect sign so that top edge of sign is at a nominal 8 feet above existing grade.

3.02 MAINTENANCE AND REMOVAL

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

B. Remove signs, framing, supports and foundations to depth of at least 2 feet upon completion of the Work. Restore area to condition equal to or better than before construction.

END OF SECTION

Section 01610

BASIC PRODUCT REQUIREMENTS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Requirements for transportation, delivery, handling, and storage of Products.

1.02 PRODUCTS

A. Products: Defined in Document 00700 – General Conditions. 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. For material and equipment specifically indicated or specified to be reused in the work:

1. Use special care in removal, handling, storage and reinstallation, to assure proper function in completed work.

2. Arrange for transportation, storage and handling of products which require off-site storage, restoration or renovation. Include cost in unit price for related items.

C. When contract documents require that installation of work comply with manufacturer's printed Instructions, obtain and distribute copies of such instructions to parties involved in installation, including two copies to Project Manager. Maintain one set of complete instructions at job site during installation until completion.

D. Provide Products from the fewest number of manufacturers as 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.

1.03 TRANSPORTATION

A. Make arrangements for transportation, delivery, and handling of Products required for timely completion of the Work.

B. Transport and handle Products in accordance with manufacturer's instructions.

C. Consign and address shipping documents to proper party giving name of the Project and its complete street address. Shipments shall be delivered to

Contractor.

1.04 DELIVERY

A. Arrange deliveries of Products to accommodate short-term site completion schedules and in ample time to facilitate inspection prior to Installation. Avoid deliveries that cause lengthy storage or overburden of limit storage space.

B. Coordinate deliveries to avoid conflict with the Work and conditions at the site and to accommodate the following:

1. Work of other contractors or the City.

2. Limitations of storage space.

3. Availability of equipment and personnel for handling Products.

4. The City's use of premises.

C. Have Products delivered to the site in manufacturer's original, unopened, labeled containers.

D. Immediately upon delivery, inspect shipment to assure:

1. Product complies with requirements of the Contract.

2. Quantities are correct.

3. Containers and packages are intact; labels are legible.

4. Products are properly protected and undamaged.

1.05 PRODUCT HANDLING

A. Coordinate off-loading of Products delivered to the site. If necessary during construction, move and relocate stored Products at no additional cost to the City.

B. Provide equipment and personnel necessary to handle Products, including those provided by the City, 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 Products 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.

1.06 STORAGAE OF PRODUCTS

A. Store and protect Products in accordance with manufacturer's recommendations and requirements of these Specifications.

B. Make necessary provisions for safe storage of Products. Place Products so as 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. Keep Products neatly and compactly stored in locations that will cause minimum inconvenience to other contractors, public travel, adjoining owners, tenants, and occupants. Arrange storage in a manner so as to provide easy access for inspection.

C. Restrict storage to areas available on the site for storage of Products as shown on Drawings or approved by Project Manager.

D. Provide off-site storage and protection when on-site storage is not adequate. Provide addresses of, and access to, off-site storage locations for inspection by Project Manager.

E. Do not use lawns, grass plots, or other private property for storage purposes without written permission of owner or other person in possession or control of premises.

F. Protect stored Products against loss or damage.

G. Store in manufacturers' unopened containers.

H. Neatly, safely, and compactly stack Products delivered and stored along the line of the Work to avoid inconvenience and damage to property owners and general public, and maintain at least 3 feet clearance around fire hydrants. Keep public, private driveways and street crossings open.

I. Repair or replace damaged lawns, sidewalks, streets or other improvements to satisfaction of Project Manager. Total length that Products may be distributed along route of construction at one time is 1000 linear feet, unless otherwise approved in writing by Project Manager.

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 SUBSTITUTION PROCEDURES

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 Products or processes, including pre-approved, pre-qualified, and approved Products or processes.

1.02 DEFINITIONS

A. Product: As defined in Document 00700 – General Conditions. 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 reuse.

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 Products includes Processes.

1.03 SELECTION OPTIONS

A. Pre-approved Products: Construction products of certain manufacturers or Suppliers designated in Specifications as "pre-approved." The City maintains a list of pre-approved products. Pre-approved Products for this Project are designated as pre-approved in Specifications. Products of other manufacturers or suppliers are not acceptable for this Project and will not be considered under the submittal process for approving alternate products.

B. Pre-qualified Products: Construction products of certain manufacturers or Suppliers designated in Specifications as "pre-qualified." Pre-qualified Products for this Project are designated as pre-qualified in Specifications. Products of other manufacturers or suppliers are not acceptable for this Project and will not be considered under the submittal process for approving alternate products.

C. Approved Products: Construction products of certain manufacturers or Suppliers designated in Specifications followed by words "or approved equal." Approval of alternate products not listed in Specifications may be obtained through provisions for product options and substitutions in Document 00700 - General Conditions, and by following submittal procedures specified in

Section 01330- Submittal Procedures. The procedure for approval of alternate products is not applicable to pre-approved or pre-qualified products.

D. 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, select Product that is compatible with other Products already selected, specified, or in use by the City.

1.04 CONTRACTOR'S RESPONSIBILITY

A. Responsibility related to Product options and substitutions is defined in Document 00700 - General Conditions.

B. Furnish information Project Manager deems necessary to judge equivalency of alternate Product.

C. Pay for laboratory testing, as well as any other review or examination costs, needed to establish equivalency between products in order to obtain information upon which Project Manager can base a decision.

D. If Project Manager determines alternate product is not equal to that named in Specifications, Furnish one of the specified Products.

1.05 CITY REVIEW

A. Use alternate Products only when approved in writing by Project Manager. Project Manager's determination regarding acceptance of proposed alternate Product is final.

B. Alternate Products shall be accepted if Products are judged by Project Manager to be equivalent to specified Product or to offer substantial benefit to the City.

C. The City retains the right to accept any Product deemed advantageous to the City, and similarly, to reject any product deemed not beneficial to City.

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 Product information after the effective date of the Contract and within the time period allowed for substitution submittals given in Document 00700 - General Conditions. After the submittal period has expired, requests for alternate Products shall be considered only when specified Product becomes unavailable because of conditions beyond Contractor's control.

D. Submit five copies of each request for alternate Product approval. Include the following information:

1. Complete data substantiating compliance of proposed substitution with the Contract.

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 names of Owner, design consultant, 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 Project Manager.

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.

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 01725

FIELD SURVEYING

PART 1 GENERAL

1.01 QUALITY CONTROL

A. Conform to State of Texas laws for surveys requiring licensed surveyors. Employ a surveyor acceptable to Project Manager if required by the Contract.

1.02 MEASUREMENT AND PAYMENT

A. UNIT PRICES

1. No separate payment will be made for field surveying. Include cost in unit price for related items.

1.03 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Submit name, address, and telephone number of Surveyor to Project Manager before starting survey work.

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

D. Submit certificate signed by Surveyor, that elevations and locations of the Work are in conformance with the Contract.

1.04 PROJECT RECORD DOCUMENTS

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

B. Prepare a certified survey setting forth dimensions, locations, angles, and elevations of construction and site work upon completion of foundation walls and major site improvements.

C. Submit record documents under provisions of Section 01785 - Project Record Documents.

1.05 EXAMINATION

A. Verify locations of survey control points prior to starting the Work.

B. Notify Project Manager immediately if any discrepancies are discovered.

1.06 SURVEY REFERENCE POINTS

A. The City will establish survey control datum as provided in Document 00700 - General Conditions and as indicated on Drawings. Inform Project Manager in Advance of time horizontal and vertical control points will be established so

verification deemed necessary by Project Manager may be done with minimum inconvenience to the City or Contractor.

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

C. Notify Project Manager a minimum of 48 hours before relocation of reference points is needed due to changes in grades or other reasons.

D. Promptly report loss or destruction of reference points to Project Manager.

E. Reimburse the City for cost of reestablishment of permanent reference points disturbed by construction operations.

1.07 SURVEY REQUIREMENTS

A. Utilize recognized engineering survey practices.

B. Establish a minimum of two permanent benchmarks on site, referenced to established control points. Record horizontal and vertical location data on Project record documents.

C. Establish elevations, lines and levels to provide quantities required for measurement and payment and for appropriate controls for the Work. Locate and lay out the following with appropriate instruments:

1. Site improvements including grading, fill and topsoil placement, utilities, and footings and slabs

2. Grid or axis for structures

3. Building foundation, column locations, and ground floor elevations

D. Periodically verify layouts.

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 01731

CUTTING AND PATCHING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Cutting, patching and fitting of the Work or work under construction. Coordinating Installation or connection of the Work to existing facilities, or uncovering work for access, inspection or testing and related submittals.

1.02 MEASUREMENT AND PAYMENT

A. UNIT PRICES

1. No separate payment will be made for cutting and patching. Include cost in unit price for related items.

1.03 CUTTING AND PATCHING

A. Perform activities to avoid interference with facility operations and work of others in accordance with Document 00700 - General Conditions of Contract.

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

1. Remove and replace defective work or work not conforming to Drawings and Specifications;

2. Take samples of installed work as required for testing;

3. Remove construction required to provide for specified alterations or additions to existing work;

4. Uncover work to allow inspection or reinspection by Project Manager or regulatory agencies having jurisdiction;

5. Connect uninstalled work to completed work in proper sequence;

6. Remove or relocate existing utilities and pipes that obstruct work;

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

8. Provide openings, channels, chases and flues and cut, patch, and finish; if required; or

9. Provide protection for other portions of the Work.

C. Restore existing work to a condition equal to or better than that which existed Prior to cutting and patching, and to standards required by Specifications.

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

E. Provide shoring, bracing and support necessary to maintain structural integrity and to protect adjacent work from damage during cutting and patching. Request written approval from Project Manager, before cutting structural members such as beams, anchors, lintels, or other supports. Follow approved submittals, as applicable.

F. Match new materials to existing materials by bonding, lapping, mechanically tying, anchoring or other effective means in order to prevent cracks and to minimize evidence of patching. Conceal effects of demolition and patching by blending new construction to existing surfaces. Avoid obvious breaks, joints or changes of surface appearance unless shown on Drawings or authorized by Project Manager.

1.04 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Submit a written request to Project Manager for consent to proceed, before conducting cutting operations that might affect structural integrity, design function, City operations, or work of another contractor.

C. 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. Describe the proposed work including:
   a. Scope of cutting and patching
   b. Contractor, Subcontractor or Supplier who will execute the work
   c. Proposed Products
   d. Extent of refinishing
   e. Schedule of operations

6. Alternatives to cutting and patching

D. When work conditions or schedules dictate the need for change of materials or methods, submit a written recommendation to Project Manager that includes:

1. conditions necessitating the change;

2. recommendations for alternative materials or methods; and

3. submittals required for proposed substitutions

E. Notify Project Manager in writing when work will be uncovered for observation. Do not begin cutting or patching operations until authorized by Project Manager.

1.05 CONNECTIONS TO EXISTING FACILITIES

A. Perform construction operations necessary to complete connections and tie-ins to existing facilities. Keep existing facilities in continuous operation unless otherwise permitted in the Specifications or approved in writing by Project Manager.

B. Coordinate interruption of service requiring connection to existing facilities with Project Manager. Do not bypass wastewater or sludge to waterways. Provide temporary pumping facilities to handle wastewater if necessary. Use temporary bulkheads to minimize disruption. Provide temporary power and piping to facilitate construction where necessary.

C. Submit a detailed schedule of proposed connections, including shut-downs and tie-ins. Include proposed time and date as well as anticipated duration of work. Coordinate the connection schedule with the construction schedule.

1. Submit specific times and dates to Project Manager at least 48 hours in advance of proposed work.

D. Procedures and Operations:

1. Operate existing pumps, valves and gates in required sequence under supervision of Project Manager. Do not operate valves, gates or other items of equipment without Project Manager's knowledge.

2. If possible, test equipment under operating conditions before making final tie-ins to connect equipment to existing facility.

3. Coordinate work and schedules. Notify Project Manger at least 48 Hours before shutdowns or bypasses 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 01732

PROCEDURE FOR WATER VALVE ASSISTANCE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Operation of valves. City of Houston employees will operate existing valves. Contractor's employees may operate new valves included in the Project prior to acceptance by the City.

1.02 PROCEDURE

A. Perform activities listed in Exhibit A attached to this Section.

1.03 SUBMITTALS

A. Submit request for work order planning meetings in accordance with Exhibit A. Include information listed in Step 1 of Exhibit A, attached to this Section.

1.04 CANCELLATION

A. Contractor, Project Manager, or Public Utilities Division may cancel a scheduled valve assistance appointment at no extra cost or payment to Contractor. Contractor shall notify City's appointed Project Inspector ("Inspector") 24 hours in advance of cancellation. Inspector shall notify Central Operation Service (COS) immediately upon receipt of cancellation notice. Cancellation may be caused by bad weather, preparation work taking longer than anticipated, or unforeseen delays by one or more of the three parties.

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

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EXHIBIT A

PROCEDURE FOR VALVE ASSISTANCE

The following procedure will be used by Utility Maintenance Branch personnel when completing a service request from individual Contractors, through Inspector, for operation of existing water valves.

ROUTINE VALVE ASSISTANCE REQUEST (NON-EMERGENCY JOBS):

Step 1. a. When notified by Contractor, Inspector will schedule a work order planning meeting by calling Central Operation Service (COS) at **(713) 295-5521** and providing information shown below. The work order planning meeting shall be conducted a minimum of three days after the request; excluding weekends, holidays, inclement weather days, and the day of the call.

Location of Work (Street Intersection)	Project #
Project Description	Contractor (Company Name)
Job Superintendent's Name	Superintendent's Office #/Mobile #/Pager #
Contractor's Emergency Information	Name and Phone #/Mobile #/Pager #
Inspector/Senior Inspector	Name, Phone #/Mobile #/Pager #
Date & Time assistance is requested	

b. COS will create a work order for each wet connection, cut and plug, etc. that will be designated as a "Code 40" (Private Contractor).

c. COS will give Inspector the work order number. This work order number must be used as a reference in all communications regarding this request for Valve Assistance.

d. Valve personnel must have the work order number on their route sheet. When valve personnel arrive at the job site for the Work Order Planning Meeting between Inspector, Contractor, and Utility Maintenance valve personnel, they will verify the street intersection and work order number with the Inspector before beginning Work Order Planning Meeting.

e. During Work Order Planning Meeting, the work to be performed will be outlined and the actual date work will be performed will be mutually determined by Inspector, Contractor and City's Utility Maintenance Division valve personnel, based upon relevant factors such as preparatory work needed, customer requirements, etc.

f. Valve personnel will perform work specifically outlined in the work order requested. Also, Utility Maintenance Branch valve personnel will only operate existing water valves. Inspector must contact COS and request a new work order for additional work.

g. Valve personnel will contact the dispatcher and advise when the job is complete. Valve personnel will list all appropriate information on the Crew Activity Report.

Step 2. Should valve personnel not be able to keep an appointment to provide valve assistance, Utility Maintenance Branch will provide notification to appropriate Inspector by phone at least 24 hours prior, with that fact and rescheduling information, if available.

Step 3. Inspector will notify COS if valve personnel have not arrived at the site within 30 minutes of scheduled appointment. If Contractor is not ready when valve operator arrives to provide valve assistance, the City shall charge Contractor $50.00 per hour, starting 15 minutes after the scheduled appointment time, minimum one hour charge.

Step 4. Contractor will not be due delay claims or downtime if Utility Maintenance Branch has notified Inspector that they will not be able to provide valve assistance as scheduled.

Step 5. Test installed new valves in the presence of Inspector before substantial completion inspection is scheduled. Place new valves in open position on or before the Date of Substantial Completion.

Step 6. Project Manager will notify, in writing, Utility Maintenance Branch two months before the warranty expires to report any problems they have with new water lines. Project Manager will notify Contractor about these problems.

EMERGENCY REQUEST FOR VALVE ASSISTANCE PROCEDURE:

Step 1. When notified by Contractor, Inspector will request emergency Valve Assistance due to a broken line/service, etc. by calling COS at **(713) 295-5521** and providing the following information:

Location of Work (Street Intersection)	Project #
Project Description	Superintendent's Office #/Mobile #/Pager #
Contractor (Company Name)	Name and Phone #/Mobile #/Pager #
Job Superintendent's Name	Name, Phone #/Mobile #/Pager #
Contractor's Emergency Information	
Inspector/Senior Inspector	
Date & Time assistance is requested	

Step 2. COS will create an emergency work order number and describe the work to be performed.

Step 3. COS will give Inspector the emergency work order number. Reference work order number in all communications regarding request for Valve Assistance.

Step 4. COS will contact designated valve personnel and assign emergency work order. Dispatcher will follow standard COS procedures if this situation occurs after normal working hours.

Step 5. Valve personnel must have the emergency work order number on the route sheet. When valve personnel arrive at the job site for emergency work, they will verify the street intersection and emergency work order number with Inspector prior to beginning work requested for operating existing water valves. Valve personnel will coordinate verification of street intersection and work order number with Inspector prior to performing work.

Section 01740

SITE RESTORATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Restoration of site affected by the Work in public or private property, including pavement, esplanades, sidewalks, driveways, fences, lawns and landscaping.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for restoration of Project site disturbed by utility construction operations is on a linear foot basis. Measurement will be as provided for corresponding utility in each Specification section. No separate payment made for branch pipe, valves and, other associated work for utilities. Measurement for restoration with multiple utilities within the same right-of-way will be on a linear foot basis for only one utility.

2. No separate payment made for facility or roadway projects. Include cost in the surface improvements associated with the facility or roadway construction.

3. Payment includes required site restoration within the right-of-way or easement regardless of size or type of pipe, method of construction, paved or unpaved areas or thickness and width of pavement.

4. No separate payment made for site restoration for service connections under this Section. Include cost in appropriate utility section.

5. Refer to Section 01270 – Measurement and Payment for Unit Price procedures.

B. Stipulated Price (Lump Sum) Contracts. If Contract is Stipulated Price Contract, include payment for work under this section in total Stipulated Price.

1.03 DEFINITIONS

A. Phase: Locations identified on the plans and listed in Section 1110 – Summary of Work under Work Sequence.

B. Site Restoration: Replacement or reconstruction of Site Improvements located in rights-of-way, easements, public property, and private property affected or altered by the Work.

C. Site Improvement: Includes pavement, curbs and gutters, esplanades, sidewalks, driveways, fences, lawns, irrigation systems, landscaping, and other improvements in existence at the Project site before commencement of construction operations.

1.04 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Schedule of testing, service connections, abandonment, backfill, and site restoration.

C. Sample of notices to residents outlining their responsibility for maintenance of site improvements adjacent to the Project that are not disturbed by construction operations

1.05 SCHEDULING

A. Schedule testing, service connections, abandonment, backfill and site restoration immediately following completion of pipe laying work or paving within each block or line segment.

B. Phased Construction:

1. Commencement of subsequent Phase will follow scheduling of site restoration of prior Phase. Limit work to a maximum of two Phases of the project.

C. Construction of Projects with no Phases listed in Section 01110- Summary of Work:

1. Complete site restoration prior to disturbing over 50% of total project linear feet or 2,000 linear feet, whichever is greater, of right-of-way or easement.

2. Limit work to a maximum of 50% of total project linear feet or 2,000 linear feet, whichever is greater, of right-of-way and easement. Commence work in additional right-of-way or easement after completion of site restoration.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pavement, Sidewalks and Driveways: Materials specified in Section 02951 - Pavement Repair and Resurfacing.

B. Seeding and Sodding: Sod specified in Section 02922 - Sodding and Seed specified in Section 02921 - Hydromulch Seeding.

C. Trees, Shrubs and Plantings: Conform to requirements of Section 01562 – Tree and Plant Protection.

PART 3 EXECUTION

3.01 Preparatory Work

A. Provide cleanup and restoration crews to work closely behind pipe laying and roadway construction crews, and where necessary, during testing, service restoration, abandonment, backfill and surface restoration.

B. Water Lines: Unless otherwise approved by Project Manager, comply with the following:

1. Once Project Manager approves work within a Phase, immediately begin preparatory work for disinfection effort.

2. No later than three days after completing disinfection preparatory work, submit to City appropriate request for disinfection.

3. If City fails to perform initial disinfection of lines in accordance with Section 2514 - Disinfection of Water Lines, within seven days from submission of appropriate request, and if approved by Project Manager, pipe laying operations may continue beyond approved limits until the City responds.

4. Immediately after transfer of services, begin abandonment of old water lines and site restoration.

C. Wastewater Lines:

1. Once Project Manager approves work within a Line Segment, immediately begin preparatory work for testing effort.

2. No later than three days after completing preparatory work for testing, initiate testing work.

3. Immediately after transfer of service connections, begin abandonment of old wastewater lines, and site restoration.

D. Street Construction and Paving Projects

1. Once Project Manager approves work within a Line Segment or block, immediately begin preparatory work for testing effort.

2. No later than three days after completing preparatory work for testing, initiate testing work.

3. Immediately after testing begin site restoration.

E. Street Construction and Paving Projects

1. Once Project Manager approves work within a block, immediately begin preparatory work for sidewalk construction, sodding and hydromulching and tree planting.

2. No later than seven days after completing preparatory work, initiate construction.

3.02 CLEANING

A. Remove debris and trash to maintain a clean and orderly site in accordance with requirements of General Conditions and Section 01576 - Waste Material Disposal.

3.03 LANDSCAPING AND FENCES

A. Seeding and Sodding.

1. Remove construction debris and level area with bank sand so that new grass surface matches level of existing grass and maintains pre-construction drainage patterns. Level and fill minor ruts or depressions caused by construction operations with bank sand, where grass is still viable.

2. Restore previously existing turfed areas with sod and fertilize in accordance with Section 02922 - Sodding. Sod to match existing turf.

3. Restore unpaved areas not requiring sodding with hydromulch seeding conforming to Section 02921 - Hydromulch Seeding.

B. Trees, Shrubbery and Plants.

1. Remove and replant trees, shrubs, and plants in accordance with requirements of Section 01562 – Tree and Plant Protection.

C. Fence Replacement.

1. Replace removed or damaged fencing to equal or better condition than existed prior to construction, including concrete footings and mow strips. Provide new wood posts, top and bottom railing and panels. Metal fencing material, not damaged by the Work, may be reused.

2. Remove and dispose of damaged or substandard material.

3.04 MAINTENANCE

A. Maintain shrubs, plantings, sodded areas and seeded areas.

B. Replace shrubs, plantings and seeded or sodded areas that fail to become established.

C. Refer to Section 01562 - Tree and Plant Protection, Section 02921 - Hydromulch Seeding and Section 02922 - Sodding for maintenance requirements.

END OF SECTION

Section 01755

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.

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 Project Manager seven 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 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 Project Manager two weeks prior to Date of Substantial Completion.

B. Utilize O&M Manuals as the basis for instruction. Review contents of manual with Project Manager 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, 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 appoint, employ and pay for the services of an independent firm to perform testing, adjusting and balancing.

B. Submit reports by the independent firm to Project Manager describing observations and results of tests and signifying compliance or non-compliance with specified requirements and requirements of the Contract.

END OF SECTION

Section 01770

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures to establish Date of Substantial Completion.

B. Closeout procedures for final submittals, O&M data, warranties, spare parts and maintenance materials.

C. Texas Department of Licensing and Regulation (TDLR) inspection for Texas Accessibility Standards (TAS) compliance.

1.02 SUBSTANTIAL COMPLETION

A. Comply with Document 00700 - General Conditions regarding Date of Substantial Completion when Contractor considers the Work, or portion thereof designated by Project Manager, to be substantially complete.

B. Insure the following items have been completed when included in the Work, prior to presenting a list of items to be inspected by Project Manager for issuance of a Certificate of Substantial Completion:

1. cutting, plugging, and abandoning of water, wastewater, and storm sewer lines, as required by Contract documents for each item;

2. construction of, and repairs to, pavement, driveways, sidewalks, and curbs and gutters;

3. sodding and hydromulch seeding, unless waived by Project Manager in writing;

4. general clean up including pavement markings, transfer of services, successful testing and landscape;

5. additional requirements contained in Section 01110 - Summary of Work.

C. Assist Project Manager with inspection of Contractor's list of items and complete or correct the items, including items added by Project Manager, within specified time period.

D. Should Project Manager's inspection show failure of Contractor to comply with requirements to obtain Date of Substantial Completion, including those items in Paragraph 1.02 B. of this section, Contractor shall complete or correct the items, before requesting another inspection by Project Manager.

1.03 CLOSEOUT PROCEDURES

A. Comply with Document 00700 - General Conditions regarding final completion and final payment when the Work is complete and ready for Project Manager's final inspection.

B. Provide Project Record Documents in accordance with Section 01785 - Project Record Documents.

C. Complete or correct items on punch list, with no new items added. Address new items during warranty period.

D. The City will occupy portions of the Work as specified in other sections.

1.04 FINAL CLEANING

A. Execute final cleaning prior to final inspection.

B. For facilities, clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

C. Clean equipment and fixtures to sanitary condition.

D. Clean or replace filters of operating equipment.

E. Clean debris from roofs, gutters, down spouts, and drainage systems.

F. Clean site; sweep paved areas, and rake clean landscaped surfaces.

G. Remove waste and surplus materials, rubbish, and temporary construction facilities from site following final test of utilities and completion of the Work.

1.05 ADJUSTING

A. Adjust operating equipment to ensure smooth and unhindered operation. Value of this testing and adjusting is five percent of Lump Sum Price in the Schedule of Values for item being tested.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit O&M data as noted in Section 01330 - Submittal Procedures.

B. Five percent of lump sum amount of each piece of equipment as indicated in Schedule of Unit Price Work or Schedule of Values will be paid after the required O&M data submittals are received and approved by Project Manager.

1.07 WARRANTIES

A. Provide one original of each warranty from Subcontractors, Suppliers, and manufacturers.

B. Provide Table of Contents and assemble warranties in a 3-ring/D binder with durable plastic cover.

C. Submit warranties prior to final progress payment.

D. Warranties shall commence in accordance with the requirements in Document 00700 - General Conditions.

1.08 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide Products, spare parts, maintenance and extra materials in quantities specified in individual Specification sections.

B. Deliver to a location within the City limits as directed by Project Manager. Applicable items must be delivered prior to issuance of a final Certificate for Payment.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

Section 01782

OPERATIONS AND MAINTENANCE DATA

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Submittal requirements for equipment and facility Operations and Maintenance (O&M) Manuals

1.02 MEASUREMENT AND PAYMENT

A. Measurement for equipment O&M Manuals is on a lump sum basis equal to five percent of the individual equipment value contained in Schedule of Unit Prices or Schedule of Values. The lump sum amount may be included in the first Progress Payment following approval of the O&M Manuals by Project Manager.

1.03 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures. Submit a list of O&M Manuals and parts manuals for equipment to be incorporated into the Work.

B. Submit documents with 8-1/2 x 11-inch text pages, bound in 3-ring/D binders with durable plastic covers.

C. Print "OPERATION AND MAINTENANCE INSTRUCTIONS", Project name, and subject matter of binder on covers when multiple binders are required.

D. Subdivide contents with permanent page dividers, logically organized according to the Table of Contents, with tab titling clearly printed under reinforced laminated plastic tabs.

E. O&M Manual contents: Prepare a Table of Contents for each volume, with each Product or system description identified.

1. Part 1 - Directory: Listing of names, addresses, and telephone numbers of Design Consultant, Contractor, Subcontractors, and major equipment Suppliers.

2. Part 2 - O&M instructions arranged by system. For each category, identify names, addresses, and telephone numbers of Subcontractors and Suppliers and include the following:
   a. Significant design criteria.
   b. List of equipment.
   c. Parts list for each component.
   d. Operating instructions.
   e. Maintenance instructions for equipment and systems.
   f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

3. Part 3 - Project documents and certificates including:
   a. Shop Drawings and relevant data.
   b. Air and water balance reports.
   c. Certificates.
   d. Photocopies of warranties.

F. Submit two copies of O&M Manuals and parts manuals, for review, within one month prior to placing the equipment or facility in service.

G. Submit one copy of completed volumes in final form 10 days prior to final inspection. One copy with Project Manager comments will be returned after final inspection. Revise content of documents based on Project Manager's comments prior to final submittal.

H. Revise and resubmit three final volumes within 10 days after final inspection.

1.04 EQUIPMENT O&M DATA

A. Furnish O&M Manuals, prepared by manufacturers for all equipment. Manuals must contain, as a minimum, the following:

1. Equipment functions, normal operating characteristics, and limiting conditions.

2. Assembly, Installation, alignment, adjustment, and checking instructions.

3. Operating instructions for start-up, normal operation, regulation and control, normal shutdown, and emergency shutdown.

4. Detailed drawings showing the location of each maintainable part and lubrication point with detailed instructions on disassembly and reassembly of the equipment.

5. Troubleshooting guide.

6. Spare parts list, predicted life of parts subject to wear, lists of spare parts recommended to be on hand for both initial start-up and for normal operating inventory, and local or nearest source of spare parts availability.

7. Outline, cross-section, and assembly drawings with engineering data and wiring diagrams.

8. Test data and performance curves.

B. Furnish parts manuals for all equipment, prepared by the equipment manufacturer, which contain, as a minimum, the following:

1. Detailed drawings giving the location of each maintainable part.

2. Spare parts list with predicted life of parts subject to wear, lists 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.

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 01785

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 Document 00700 - General Conditions.

B. Store record documents and Samples in field office, if a field office is required by the Contract, 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. Do not use permit drawings to record Modifications to the Work.

E. Keep record documents and Samples available for inspection by Project Manager.

F. Bring record documents to progress review meetings for viewing by Project Manager and, if applicable, Design Consultant.

1.03 RECORDING

A. Record information legibly with red ink pen on a set of blueline opaque drawings, concurrently with construction progress. Maintain an instrument on site at all times for measuring elevations accurately. Do not conceal work until required information is recorded

B. Contract Drawings and Shop Drawings: Mark each item to record completed Modifications, or when minor deviations exist, the actual construction including:

1. Measured depths of elements of foundation in relation to finish first floor datum.
2. Measured horizontal locations and elevations of Underground Facilities and appurtenances, referenced to permanent surface improvements.

3. Elevations of Underground Facilities referenced to City of Houston benchmark utilized for the Work.

4. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.

5. Dimensions and details of field changes

6. Changes made by Modifications.

7. Details not on original Drawings.

8. References to related Shop Drawings and Modifications.

C. Survey all joints of water mains at the time of construction. Record on Drawings, water main invert elevation, elevation top of manway, and centerline horizontal location relative to baseline.

D. For large diameter water mains, mark specifications and addenda to record:

1. Manufacturer, trade name, catalog number and Supplier of each Product actually Installed.

2. Changes made by Modification or field order.

3. Other matters not originally specified.

E. Annotate Shop Drawings to record changes made after review.

1.04 SUBMITTALS

A. At closeout of the Contract, deliver Project record documents to Project Manager.

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 02101

SLUDGE/SETTLED DEBRIS REMOVAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Removal and disposal of all debris and grit as necessary to accommodate work in structures/piping installation.

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. If indicated in the Unit Price Schedule as a pay item, the removal and disposal of sludge/settled debris within wastewater channels shall be paid for by the wet ton (2,000 lb) of material removed and disposed of offsite.

B. Dewatering of piping/structures and removal/disposal of all waste, sediment, and debris material is considered incidental to work described in this section, unless otherwise noted, and shall be performed at no additional cost to the City.

C. Solids transportation and disposal - payment shall be made on the basis of per net wet ton (2,000 lbs.) as documented on weight tickets from certified scales for characteristically non-hazardous/special waste (as defined by applicable regulations. This pay item applies to loads that pass project site paint filter testing.

D. Include in unit costs all costs, including but not limited to labor, materials, equipment, mobilization/demobilization, testing, and disposal costs.

E. The City will not pay additional costs associated with material failing the paint filler test upon arrival at the landfill or costs associated with overweight loads.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01330 - Submittal Procedures.

B. Submit written work procedures that include the proposed methods, equipment, materials, construction phases, and operations sequence for cleaning.

C. Submit sketches showing the location, method, and phasing of construction for any temporary work platforms, scaffolds, temporary separation walls, temporary dams, and/or temporary diversion channels that are planned to be used to facilitate debris removal.

D. Submit work procedures and related sketches to the City for review at least 14 days prior to implementation.

E. Submit copies of OSHA confined space entry certificates, Category "C", for all workers that will be entering the structure/pipe during operating conditions.

F. Notify the City Engineer in writing at least 72 hours prior to initiating cleaning.

G. The Contractor shall submit the following information with each invoice:

1. Original top copy of the manifest used to document each load transported and disposed.

2. Legible copy of each load weight ticket(s).

3. Pre-construction and finished photographs (Reference Section 01321).

4. Summary table containing the date each container loaded; load manifest no.; weight ticket no.(s); gross, tare, and net weights; landfill name and permit no.; haul tractor number; haul trailer no., and paint filter test results.

5. Contractor daily log sheet.

6. Summary of equipment found in cleaned process unites and observed equipment damage.

7. Photographs, video footage, and/or profiles to verify that the wet wells and other facilities have been cleaned as specified.

1.04 OWNERSHIP OF MATERIAL

A. All waste material and debris removed shall become the property of the Contractor.

1.05 ENVIRONMENTAL CONTROLS

A. Minimize spread of dust and flying particles. If required by governing regulations, use temporary enclosures and other suitable methods to prevent the spread of dust, dirt, and debris.

B. Use appropriate controls to limit noise to levels designated in City ordinances.

C. Do not use water where it can create dangerous or objectionable conditions, such as localized flooding, erosion, or sedimentation of nearby ditches or streams.

D. Contractor shall be responsible for testing equipment, materials, waste, sediment, and debris removed for classification prior to disposal. Contractor shall dispose of removed equipment, materials, waste, sediment, and debris in a manner conforming to applicable City, State, and Federal laws and regulations.

1.06 DEFINITIONS

A. Net Wet Ton – the difference between the gross weight (wet tonnage) and the tare weight (tonnage) of each load transported to the landfill. Net wet ton consists of removed material that passes the EPA's paint filter test (containing no free draining water) prior to transportation offsite (Reference SW-846 procedures).

B. Solids – includes both floating and settled material such as sand, grit, sludge, Vegetation, grease, hair, plastics, rubble, broken concrete, rags, debris, equipment parts, soil, and other solid or semi-solid materials of all sizes contained within identified structures located at City wastewater facilities.

1.07 QUALITY ASSURANCE

A. The Contractor shall monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality at no additional cost to the City.

B. The Contractor shall comply with specified standards as minimum

requirements for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

C. The Contractor shall have at least five years of previous experience cleaning facilities of the type described. The Contractor shall have completed a minimum of three projects of similar scope to the projects described in this contract in the five year time period. The Contractor shall have been the prime Contractor on at least one project in this time period.

D. The Contractor shall perform the work using persons qualified to produce a specified level of workmanship.

E. The Contractor shall obtain copies of standards and maintain at job site (e.g., SW-846 test procedures).

F. The Contractor shall only utilize labor that is experienced in the removal, loading, transportation, and disposal of solids from municipal WWTPs. The Contractor shall use experienced personnel to operate solids removal equipment and devices.

G. The selected means and methods shall be based on the conditions of the structure at the time work begins. More than one method or type of equipment may be required for a given structure or Work Order.

H. When the City requests, demonstrate the performance capabilities of the removal equipment and methods. If results of the demonstration are not satisfactory to the City, the Contractor shall provide other means and methods that will remove the solids.

I. Prior to transportation, material from each load shall be sampled and analyzed using SW-846 paint filter test procedures, in the presence of a City-designated representative. The results of each test shall be recorded on the manifest associated with each load.

J. The Contractor shall be completely familiar with, and conduct all contract activities in compliance with all applicable City, County, State of Texas and Federal regulations, ordinances, codes, standards, and other requirements.

K. Contractor and a City representative shall meet to discuss the details of each issued Work Order within five working days of the Contractor

receiving a Work Order.

L. The City may select, employ, and pat for the services of an independent testing laboratory to perform testing identified in Part 3 of this section and any additional testing the City deems necessary. Employment of a testing laboratory by the City shall not relieve the Contractor of its obligation to perform work in accordance with the Contract requirements.

M. The Contractor shall notify the City during normal working hours on the day previous to expected time for operations requiring inspection and testing services. When the Contractor fails to make timely prior notification, the Contractor shall not proceed with the operations requiring inspection and testing services.

N. The City will deduct a minimum of two-hour charge from periodic progress payments when operations requiring testing or inspection are canceled without prior notification.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by the manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

B. Diversion Pumps & Piping: Pumps shall be self-priming type or submersible electric, in good working order, with a working pressure gauge on the discharge. Pumps shall meet the requirements of the City of Houston Noise and Sound Level Regulations. Design piping, joints, and accessories to withstand at least twice the maximum system pressure or 50 psi, whichever is greater.

PART 3 EXECUTION

3.01 PERFORMANCE CRITERIA

A. Debris removal shall include the removal of all loose debris of all sizes, including any rubbish, litter, grit, sediments, and any other foreign

substances that may be deposited within the structure/pipe.

B. Debris removal shall include low pressure washing of all surfaces that is sufficient to remove caked-on grit and sediments without causing damage to the existing surface coatings. Cleaning does not include the removal of grime or stains.

3.03 DISPOSAL

A. Collect and dispose of all debris and waste removed. Conform to requirements of Section 01576—Waste Material Disposal.

Contractor shall identify the landfill(s) in which the removed solids shall be disposed.

B. Trash and loose debris shall not be permitted to accumulate at the Project site. All waste materials removed shall be regularly removed and disposed of at an approved site. Follow methods of disposal as required by the applicable regulatory agencies.

C. If on-site dewatering is utilized, the equipment used for such dewatering shall consistently achieve a solids capture rate of at least 95%.

D. While conducting solids removal, loading, transportation, and disposal activities, the Contractor shall always provide a supervisor who is responsible at the project site. This person shall have the authority to make management decisions pertaining to the project. This person shall be equipped with a cell phone and the phone number shall be provided to the City. The Contractor's supervisor shall be able to communicate in English, both verbally and in writing.

E. The Contractor shall also provide an off-site emergency telephone number so contact may be made easily at all times in case of emergencies.

F. The Contractor shall take all necessary precautions to prevent leakage or spills of any kind onto the plant property or into offsite pipeline or other conveyance systems.

G. Project activities shall be conducted in a manner that prevents nuisance conditions from developing.

H. The Contractor shall minimize the spread of dust and airborne particles.

I. Temporary enclosures and other suitable methods to prevent the spread of dust and airborne particles shall be utilized as directed by the City.

J. Appropriate controls shall be utilized to limit noise to levels designated by applicable City ordinances.

K. All project activities shall be conducted in a manner that minimizes the generation of odors and prevents odor complaints from City utility customers.

L. The Contractor shall exercise care to prevent contamination of the City's potable water system. Proper approval shall be obtained and applicable City guidelines shall be followed with drawing water from a hydrant.

M. Solids removal, loading, and transportation tasks shall be coordinated with City plant operations and maintenance activities.

N. The landfill shall have on all-weather access at the point of disposal.

O. The Contractor shall immediately notify the City of failed paint filter test results at the landfill.

P. The Contractor shall be responsible for preparing a waste profile that is representative of the solids to be removed and obtaining approval of this profile by the landfill company.

3.04 SOLIDS TRANSPORTATION

A. Watertight roll off containers and/or watertight end-dump trailers shall be used to transport the removed solids.

B. Each transport container shall be equipped with a tarpaulin cover, excluding enclosed containers. At minimum, the containers shall be covered while not in use and during transportation.

C. End-dump trailers shall have one of three acceptable combinations of manual locking turnbuckles on their tailgate: 1) two turnbuckles on the bottom of the gate; 2) one turnbuckle on the bottom and one on each side for a total of three turnbuckles; or 3) four turnbuckles in total with two on each side.

D. Samples for each load shall be collected and a paint filter test conducted. Test results shall be recorded on the load manifest and submitted with the invoice.

E. Loads shall not be hauled with any visible amount of supernatant water following temporary storage.

F. Transport rigs shall be properly permitted, registered, and/or licensed by the applicable state and local organizations. Associated numbers/tags shall be properly displayed on each transport rig.

G. Tare weights of each rig shall be measured when the rig is initially put into service for a given work order and as directed by the City thereafter.

H. Containers containing removed material shall be transported and disposed within 24 hours. This requirement shall not apply to partially filled transportation containers resulting from work delays; however, the City reserves the right to require transport and disposal of these containers in the event nuisance conditions develop as a result of container storage at the plant site.

I. The Contractor shall prepare and submit a copy (original top copy) of a completely executed five-part paper manifest for each load transported. Written approval of the manifest content and format shall be obtained from the City Health Department and the City Wastewater Operations Branch.

J. Actual gross weights and actual tare weights shall be measured on certified public scales (calibrated by a State of Texas licensed organization) provided by the Contractor.

K. Containers used to transport each load of removed material shall be empty prior to filling. The tare weight of each container shall be measured prior to filling. These tare weights shall be submitted with each invoice.

L. Transportation rigs shall not be allowed to leave the plant site if leakage is observed.

3.05 PROTECTION OF PERSONS AND PROPERTY

A. Provide safe working conditions for employees throughout the cleaning and debris removal operations. Observe safety requirements for work within confined structures.

B. All persons entering the structure/pipe shall have the proper confined space entry certification.

C. The Contractor shall provide the necessary equipment (gas masks, supply air, forced ventilation, etc.) as required by OSHA Federal Regulations Part 29 CFR 1910.146 for entering and working in confined spaces with a hazardous atmosphere. All work performed shall be in accordance with OSHA.

D. Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks, or passageways adjacent to the work.

E. Perform cleaning in a manner to prevent damage to adjacent property. Repair damage made to City property or adjacent property and facilities.

F. Erect and maintain enclosures, barriers, warning lights, and other required protective devices.

G. Schedule cleaning operations to minimize temporary disruption of utilities to existing facilities.

H. Construct temporary flow diversion channels, temporary separation walls, or temporary dams as necessary to facilitate debris removal.

I. In the event of accidental spill or overflow during cleaning operations, immediately take action to clean up and disinfect the spill. Promptly notify the City Engineer.

3.06 CLOSEOUT PROCEDURES

A. All solids removal, loading, transportation, and disposal activities shall be complete prior to the Contractor requesting issuance of a Certificate of Substantial Completion. The Contractor shall provide a punch list of items to be inspected for Substantial Completion.

B. All complete and correct items identified on the punch list shall be completed and corrected by the Contractor in the time period specified on the Certificate of Substantial Completion.

C. The Contractor shall complete or correct all items on the punch list prior to final inspection and no new items shall be added in order to obtain final completion and final payment.

3.07 DEMOBILIZATION

A. The Contractor's equipment, materials, and supplies shall be removed from the project site within 14 calendar days of completing the work.

END OF SECTION

Section 02220

DEMOLITION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Demolishing and removing existing structures, equipment and materials.

B. Disposing of demolished materials and equipment.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices

1. Measurement for demolition is on a lump sum basis for each contiguous area, including submittal of proposed demolition and removal schedule.

2. For removal of pavement, refer to Section 02221 - Removing Existing Pavements and Structures. For abandoned sewers, refer to Section 02222 - Abandonment of Sanitary Sewers.

3. Payment for removing and disposing of existing fence is on a linear foot basis.

4. Refer to Section 01270 - Measurement and Payment for unit price procedures.

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

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01330 - Submittals.

B. Submit proposed methods, equipment, materials and sequence of operations for demolition of structures. Describe coordination for shutting off, capping, and removing temporary utilities. Plan operations to minimize temporary disruption of utilities to existing facilities or adjacent property.

C. Submit proposed demolition and removal schedule for approval. Notify City Engineer in writing at least 48 hours before starting demolition.

D. Submit an approved copy of demolition schedule to Fire Department prior to commencement of demolition operations.

E. Obtain a permit for any and all structure demolition, as required.

1.04 OWNERSHIP OF MATERIAL AND EQUIPMENT

A. The City shall have the right of first refusal on all salvageable or reusable materials and equipment. At the beginning for the contract, the City will identify and mark all desired materials and equipment. All materials and equipment that the City wants to salvage/retain shall be delivered to a designated City facility by the Contractor at no additional cost. Protect items designated for reuse or salvage from damage during demolition, handling and storage. Restore damaged items to satisfactory condition.

B. Materials and equipment not designated for reuse or salvage become the property of the Contractor.

1.05 STORAGE AND HANDLING

A. Store and protect materials and equipment designated for reuse until time of installation.

B. Deliver items to be salvaged to City property storage areas indicated on Drawings. Items will be unloaded by City personnel.

C. Remove equipment and materials not designated for reuse or salvage and all waste and debris resulting from demolition from site. Remove material as work progresses to avoid clutter.

1.06 ENVIRONMENTAL CONTROLS

A. Minimize spread of dust and flying particles. If required by governing regulations, use temporary enclosures and other suitable methods to prevent the spread of dust, dirt and debris.

B. Use appropriate controls to limit noise from demolition to levels designated in City ordinances.

C. Do not use water where it can create dangerous or objectionable conditions, such as localized flooding, erosion, or sedimentation of nearby ditches or streams.

D. Stop demolition and notify City Engineer if underground fuel storage tanks, asbestos, PCB's, contaminated soils, or other hazardous materials are encountered.

E. Dispose of removed equipment, materials, waste and debris in a manner conforming to applicable laws and regulations.

PART 2 P R O D U C T S

2.01 EQUIPMENT AND MATERIALS FOR DEMOLITION

A. Use equipment and materials approved under Paragraph 1.03, Submittals.

B. Fires are not permitted.

C. Do not use a "drop hammer" where the potential exists for damage to underground utilities, structures, or adjacent improvements.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Prior to demolition, make an inspection with City Engineer to determine the condition of existing structures and features adjacent to items designated for demolition.

B. The City of Houston Wastewater Operations personnel will mark or list existing equipment to remain the property of the City. The City of Houston retains the right to first refusal of equipment that will be salvaged.

C. Do not proceed with demolition or removal operations until after the joint inspection and subsequent authorization by City Engineer.

3.02 PROTECTION OF PERSONS AND PROPERTY

A. Provide safe working conditions for employees throughout demolition and removal operations. Observe safety requirements for work below grade.

B. Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks or passageways adjacent to the work.

C. Perform demolition in a manner to prevent damage to adjacent property. Repair damage to City property or adjacent property and facilities.

D. The Contractor shall be responsible for safety and integrity of adjacent structures and shall be liable for any damage due to movement or settlement. Provide proper framing and shoring necessary for support. Cease operations if an adjacent structure appears to be endangered. Resume demolition only after proper protective measures have been taken.

E. Erect and maintain enclosures, barriers, warning lights, and other required protective devices.

3.03 UTILITY SERVICES

A. Follow rules and regulations of authorities or companies having jurisdiction over communications, pipelines, and electrical distribution services.

B. Notify and coordinate with utility company and adjacent building occupants when temporary interruption of utility service is necessary.

3.04 BUILDING DEMOLITION

A. Demolish structure to the lines and grades shown on Drawings. Where no limits are shown, the limits shall be 4 inches outside new items to be installed. Removals beyond these limits shall be at the Contractor's expense; satisfactorily reconstruct excess removals.

B. Proceed with demolition from the top of the structure to the ground. Complete demolition work above each floor or tier before disturbing supporting members of lower levels.

C. Demolish concrete and masonry in small sections.

D. Carefully remove structural framing members and lower them to the ground by means of hoists, derricks or other suitable devices.

E. Do not overload existing roof or structures.

F. Provide temporary coverings for openings through walls and roof to prevent water damage to buildings and structures which are to remain.

G. Where existing concrete must be removed, but will be replaced subsequently:

1. Make initial cut with a concrete saw; do not cut reinforcement.

2. After removing concrete, cut cross bars at center of breakout and protect for subsequent concrete work.

H. Demolish structures to a minimum of 3 feet below finished grade, unless otherwise indicated on Drawings.

3.05 DISPOSAL

A. Remove from the site all items contained in or upon the structure not designated for reuse or salvage. Conform to requirements of Section 01504 - Temporary Facilities and Controls or Section 01576 - Waste Material Disposal.

B. Follow method of disposal as required by regulatory agencies.

3.06 BACKFILL

A. Backfill holes in accordance with specification sections governing materials indicated on Drawings. Where no material is indicated, backfill with approved borrow and compact to a density of 90 percent standard Proctor.

B. Do not backfill with material from demolition unless approved by City Engineer.

3.07 MECHANICAL WORK ITEMS

A. Mechanical removals consist of dismantling and removing existing piping, pumps, motors, water tanks, equipment and other appurtenances. It includes cutting, capping, and plugging required to restore use of existing utilities.

B. Remove existing process, water, chemical, gas, fuel oil and other piping indicated to be removed on Drawings. Take out piping to the limits shown. Piping not indicated on Drawings shall be removed to the nearest solid support, capped, and the remainder left in place even though it does not interfere with new work. Purge chemical and fuel lines and tanks. Verify that such lines are safe prior to removal or capping.

C. Where piping that is to be removed passes through existing walls, cut and cap piping on each side of the wall. Use cap appropriate for pipe material to be capped. Provide fire-rated sealant for walls classified as fire-rated.

D. When underground piping is to be altered or removed, cap the remaining piping. Abandoned underground piping may be left in place unless it interferes with new work or is shown or specified to be removed. Piping less than 15 inches in diameter may be plugged and abandoned in place. For piping 15 inches in diameter and greater to be abandoned, fill with sand, pressure grout or other approved method and plug with concrete or brick masonry bulkhead.

E. Remove waste and vent piping to points shown. Plug pipe and cleanouts and plugs. Where vent stacks pass through an existing roof that is to remain, remove the stack and patch the hole in the roof, making it watertight. Comply with requirements of existing roof installer so as to maintain roof warranty.

F. Conform to applicable codes when making any changes to plumbing and heating systems.

G. For demolition of water line, refer to Section 02516 - Cut, Plug, and Abandonment of Water Lines.

3.08 ELECTRICAL WORK ITEMS

A. Electrical removals consist of disconnecting and removing existing switchgear, distribution switchboards, control panels, bus duct, conduits and wires, panelboards, lighting fixtures, and miscellaneous electrical equipment.

B. Remove existing electrical equipment and fixtures to prevent damage to allow continued operation of existing systems and to maintain the integrity of the grounding systems.

C. Remove poles and metering equipment, if designated for removal on the Drawings. Coordinate electrical removals with the power company, as necessary. Verify that power is properly de-energized and disconnected.

D. Where shown or otherwise required, remove wiring in underground duct systems. Verify function of wiring before disconnecting and removing. Plug ducts which are not to be reused at entry to buildings.

E. Changes to electrical systems shall conform to applicable codes.

END OF SECTION

Section 02233

CLEARING AND GRUBBING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Removing surface debris and rubbish.

B. Clearing site of plant life and grass.

C. Removing trees and shrubs.

D. Removing root system of trees and shrubs.

E. Fence removal.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices

1. Payment for clearing and grubbing is on a lumps sum basis.

2. <u>No separate payment will be made for clearing and grubbing of wastewater projects, include payment in unit prices for related items.</u>

3. Refer to Section 01270 – Measurement and Payment for unit price procedures.

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

1.03 REGULATORY REQUIREMENTS

A. Conform to applicable codes for disposal of debris.

B. Coordinate clearing work with utility companies.

PART 2 P R O D U C T S – Not Used

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that existing plant life and features designated to remain are identified and tagged.

3.02 PROTECTION

A. Protect following from damage or displacement.

1. Living trees located 3 feet or more outside of intersection of side slopes and original ground line.

2. Plants other than trees and landscape features designated to remain.

3. Utilities designated to remain.

4. Bench marks, monuments, and existing structures designated to remain.

3.03 CLEARING

A. Remove stumps, main root ball, and roost system to:

1. Depth of 24 inches below finished subgrade elevation in area bounded by lines two feet behind back of curbs.

2. Depth of 24 inches below finished surface of required cross section for other areas.

B. Clear undergrowth and deadwood without disturbing subsoil.

C. Remove vegetation from top soil scheduled for reuse.

3.04 REMOVAL

A. Remove debris, rubbish, and extracted plant material life from site in accordance with requirements of Section 01576 – Waste Material Disposal.

B. Remove on site fences. Materials generated from removal of fences become property of Contractor. Properly dispose of in accordance with applicable local, state and federal laws.

END OF SECTION

Section 02466

DRILLED PIERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes cast-in-place concrete drilled piers.

1.03 SUBMITTALS

A. Product Data: For each type of product specified. Include reinforcement and admixtures.

B. Design Mixes: For each class of concrete. Include revised mix proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

1. Laboratory Test Reports: For evaluation of concrete materials and mix design test.

C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Record drawings at Project closeout according to Division 1 Section 01770 "Contract Closeout."

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has specialized in installing drilled piers similar to those required for this Project.

B. Drilled-Pier Standard: Comply with provisions of ACI 336.1, "Specification for the Construction of Drilled Piers," unless modified in this Section.

1. The slurry displacement method of installation will not be permitted.

C. Survey Work: Engage a registered surveyor or licensed professional engineer to perform surveys, layouts, and measurements for drilled piers. Lay out each drilled pier to lines and levels required before excavation and record actual measurements of each drilled pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.

1. Record and maintain information pertinent to each drilled pier and cooperate with City of Houston's testing and inspecting agency to provide data for required reports.

D. Testing Agency Qualifications: Qualify and engage an independent testing agency with the experience and capability to conduct the following testing without delaying the Work:

1. Qualify testing agency, according to ASTM E 329 and ASTM C 1077, to perform materials evaluation tests and to design concrete mixes.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section 01312 "Coordination and Meetings."

1.05 PROJECT CONDITIONS

A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.

1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult City Engineer immediately for directions as to procedure. Cooperate with City of Houston and utility companies in keeping services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

B. Site Information: A geotechnical report has been prepared for this Project and is available for information only. The report is not part of the Contract Documents. Opinions expressed in this report are those of the geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by the

geotechnical engineer. City of Houston will not be responsible for interpretations or conclusions drawn from this data by Contractor.

1. Make additional test borings and conduct other exploratory operations as necessary.
2. The geotechnical report is referenced elsewhere in the Project Manual.

PART 2 - PRODUCTS

2.01 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Plain, Cold-Drawn Steel Wire: ASTM A 82.

C. Joint Dowel Bars: Plain steel bars, ASTM A 615 Grade 60. Cut bars true to length with ends square and free of burrs.

2.02 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or II.

B. Aggregates: ASTM C 33, 3/4-inch maximum aggregate size.

C. Water: Potable, complying with ASTM C 94 requirements.

2.03 CONCRETE MIX

A. Prepare design mixes, according to ACI 301, for concrete by either laboratory trial batch or field experience method. For trial batch method, use a qualified independent testing and inspecting agency for preparing and reporting proposed mix designs.

1. Do not use City of Houston's independent testing and inspecting agency.

B. Proportion mixes according to ACI 211.1 and ACI 301 to provide normal-weight concrete with the following properties:

1. Compressive Strength (28-Day): 3000 psi.
2. Maximum Water-Cement Ratio at Point of Placement: 0.50.
3. Slump Limit: Capable of maintaining a slump of 4 inches for 2 hours after placement.

C. Concrete-mix design adjustments may be proposed when characteristics of materials, project conditions, weather, test results, or other circumstances warrant.

2.04 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94. Do not add water after mixing.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

3.02 EXCAVATION

A. Unclassified Excavation: Excavation is unclassified and includes excavation to bearing elevations regardless of character of materials or obstructions encountered.

1. Obstructions: Unclassified excavation includes removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions.

B. Dewatering: Prevent surface and ground water from entering excavated shafts. Dewater excavated shafts before concreting. Conduct water to site drainage facilities.

C. Excavate shafts for drilled piers to indicated elevations.

1. Excavate bottom of drilled piers to level plane.
2. Remove loose material and water from bottom of excavation.

D. Notify and allow testing and inspecting agency to test and inspect bottom of excavation. If unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by City Engineer.

1. Do not excavate shafts deeper than elevations indicated, unless approved by City Engineer.
2. Additional excavation will be paid according to Contract provisions for changes in the Work.

E. Excavate shafts for closely spaced drilled piers and those occurring in fragile or sand strata, only after adjacent drilled piers are filled with concrete and allowed to set.

F. Tolerances: Construct drilled piers to remain within the following tolerances:

1. Maximum Variation from Location: Not more than the lesser of 4.2 percent of pier diameter or 3 inches from design center location.
2. Out-of-Plumb: Not more than 8 percent of pier diameter.
3. Concrete Cutoff Elevation: Plus 1 inch, minus 3 inches.
4. Bottom Area of Pier: Not less than 96 percent of pier area required.
5. Shaft Diameter: Not less than 98 percent or more than 110 percent of shaft diameter indicated.

G. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit design and construction proposals to City Engineer for review before proceeding.

H. Inspection: Each drilled pier must be inspected and tested before placing concrete.

1. Provide and maintain facilities with equipment required for testing and inspecting excavations. Cooperate with testing and inspecting personnel to expedite the Work.
2. Notify City Engineer and testing agency at least 6 hours before excavations are ready for tests and inspection.

3.03 REINFORCEMENT

A. Comply with recommendations of CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.

C. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.

D. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover to reinforcement.

E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.

F. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

3.04 CONCRETE PLACEMENT

A. Place concrete in a continuous operation and without segregation immediately after inspection and approval of the shaft by an independent testing and inspecting agency.

B. Place concrete by means of bottom discharge bucket, flexible drop chute, elephant-trunk hopper, or tremie. Use chutes or tremies for placing concrete where a drop of more than 25 feet is required, or pump concrete into place.

C. Place concrete in a dry shaft, unless placement underwater or by slurry displacement is approved by City Engineer.

D. Screed concrete at cutoff elevation level and apply a scoured, rough finish. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.

E. Protect concrete work, according to ACI 301, from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures.

1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
2. Do not use calcium chloride, salt, or other mineral-containing antifreeze agents or chemical accelerators.

F. When hot-weather conditions exist that would seriously impair quality and strength of concrete, place concrete according to ACI 301 to maintain delivered temperature of concrete without exceeding 90 deg F.

1. Place concrete immediately on delivery. Keep exposed concrete surfaces and formed shaft extensions moist by fog sprays, wet burlap, or other effective means for a minimum of 7 days.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: City of Houston will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during excavation and concrete placement for drilled piers.

B. A drilled pier report will be prepared for each drilled pier as follows:

1. Actual top and bottom elevations.
2. Description of soil materials.
3. Description, location, and dimensions of obstructions.
4. Final top centerline location.
5. Variation of shaft from plumb.
6. Shaft excavating method.
7. Design and tested bearing capacity of bottom.
8. Levelness of bottom and adequacy of cleanout.
9. Ground-water conditions and water-infiltration rate, depth, and pumping.
10. Description, diameter, and top and bottom elevations of temporary or permanent casings.
11. Description of soil or water movement, sidewall stability, loss of ground, and means of control.
12. Date and time of starting and completing excavation.
13. Inspection report.
14. Position of reinforcing steel.
15. Concrete placing method, including elevation of consolidation and delays.
16. Remarks, unusual conditions encountered, and deviations from requirements.
17. Concrete testing results.

C. Soil Testing: Bottom elevations, bearing capacities, and lengths of drilled piers indicated have been estimated from available soil data. Actual elevations and drilled-pier lengths, and bearing capacities will be determined by a qualified independent testing and inspecting agency on excavation. Final evaluations and approval of data will be determined by City Engineer.

D. Concrete: Sampling and testing of concrete for quality control will include the following:

1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

   a. Slump: ASTM C 143; 1 test at point of placement for each compressive-strength test, but no less than 1 test for each concrete load.
   b. Air Content: ASTM C 231, pressure method; 1 test for each compressive-strength test.
   c. Concrete Temperature: ASTM C 1064; 1 test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and 1 test for each set of compressive-strength specimens.
   d. Compression Test Specimens: ASTM C 31; 1 set of 4 standard cylinders for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens, unless field-cured test specimens are required.

e. Compressive-Strength Tests: ASTM C 39; 1 set for each drilled pier, but not more than 1 set for each truck load. One specimen will be tested at 7 days, 2 specimens will be tested at 28 days, and 1 specimen will be retained in reserve for later testing if required.

2. When frequency of testing will provide fewer than 5 strength tests for a given class of concrete, testing will be conducted from at least 5 randomly selected batches or from each batch if fewer than 5 are used.
3. When strength of field-cured cylinders is less than 85 percent of companion laboratory- cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
4. Strength level of concrete will be considered satisfactory if averages of sets of 3 consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.
5. Test results will be reported in writing to City Engineer, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests will contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, concrete type and class, location of concrete batch in drilled pier, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
6. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
7. Additional Tests: Testing and inspecting agency will make additional tests of concrete when test results indicate concrete strengths or other requirements have not been met.

3.06 DISPOSAL OF MATERIALS

A. Remove surplus excavated material and slurry and legally dispose of it off Owner's property.

END OF SECTION

Section 02622

PVC PIPE (SMALL DIAMETER)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section covers the furnishing and installation of smaller than 4-inch inside diameter polyvinyl chloride pipe, fittings, specials and appurtenances necessary for and incidental to the proper completion of the polyvinyl chloride (PVC) pipe systems as shown on the Drawings and as specified herein.

B. General Equipment and Material Stipulation:

1. The Contractor shall follow the Drawings in all matters concerning the location and placement of all PVC Pipe, fittings and supports, and no changes shall be made from the Drawings without approval by the Engineer.

2. The Contractor should familiarize himself with the use of the various lines that are to be installed under this Specification.

3. Workmanship is to be first class in every detail, and equal to the best standards of workmanship for similar types of installations.

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.

1.03 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

1. B1.20.1 – Pipe Threads, General Purpose (Inch)

B. American Standard Testing Methods

1. D2464 -Standard Specification for Threaded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80

2. D2467 - Standard Specification for Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80

C. American Water Works Association

1. A316 – Standard Specification for Stainless Steel

1.04 SUBMITTALS

A. Complete layout drawings, details, specifications, installation schedules and other data showing complete details of the fabrication, construction, joining and installation of PVC pipe, fittings, specials and connections plus complete data covering all materials proposed for use, shall be submitted in accordance with the procedure set forth in Section 01330 - Submittal Procedures.

1.05 PRODUCT HANDLING, DELIVERY AND STORAGE

A. The Contractor shall take precautions to prevent excessive mechanical abuse of PVC pipe. PVC pipe shall not be pushed, dumped or dragged off of trucks delivering the pipe to the jobsite. Standard pipe wrenches shall not be used for making up threaded connections. The use of strap wrenches shall be allowed. When using a pipe vise or chuck, the jaws shall be wrapped with emery cloth or soft metal.

B. Pipe shall be stored on racks that afford continuous support and prevent sagging or draping of longer lengths. Burrs and sharp edges of metal racks should be avoided. Plastic fittings and flanges shall be stored in separate bins or boxes and not mixed with metal piping components. If the storage area is inside, it should be clean and have adequate ventilation. PVC pipe shall not be stored near steam lines or other source of heat.

PART 2 PRODUCTS

2.01 MATERIALS

A. PVC pipe for pressure applications shall be Schedule 80 meeting the requirements of ASTM D1785. Materials for PVC pipe shall meet the requirements of ASTM D1784 Type 1, Grade 1. PVC pipe which is installed above ground shall have on the outside, either as an integral part of its chemical makeup or applied after installation, a chemical coating or ingredient of an ultra-violet inhibitor.

B. Minimum diameters, wall thicknesses and allowable spans for pressure pipe shall be as follows for pipe sized indicated:

Pipe Size	O.D.	Wall Thickness	Allowable Span
3/4"	1.050"	0.154"	3.0'
1'	1.315"	0.179"	3.5'
1 1/2"	1.900"	0.200"	3.5'
2"	2.375"	0.218"	4.0'
2 1/2"	2.875"	0.276"	4.0'
3"	3.500"	0.300"	4.5'

C. PVC fittings shall conform to the requirements of ASTM D2467 for socket type and ASTM D2464 for threaded type. Flange bolting materials shall be of Type 316 stainless steel.

D. PVC pipe used as drain pipe with no operating pressure, in unburied service, 4 inches and smaller shall be minimum Schedule 40. PVC drain pipe with no operating pressure in buried service shall have a minimum stiffness of 46 psi (SDR 35).

E. PVC drain pipe in unburied service shall be supported such that the allowable spans listed above for pressure pipe are not exceeded.

2.02 FABRICATION

A. Joining:

1. All PVC pipe 2 inch and smaller shall have solvent welded connections with unions or flanges at valves and connections to equipment.

2. All PVC pipe 2 1/2 inch and larger, under any operating pressure, shall have flange field connections except in buried service which shall be field solvent welded when specifically allowed by the Engineer.

3. All fittings, couplings and flanges shall be solvent welded to the pipe using a solvent as supplied by the manufacturer and applied according to the manufacturer's recommended procedure. Flange bolting materials shall be Type 316 stainless steel except for flanges exposed in chemical unloading, storage and feed areas which shall be thermoplastic.

4. All PVC pipe used as drain pipe, with no operating pressure, in unburied service, shall be solvent welded. PVC drain pipe in buried service, shall have gasketed push on joints or be solvent welded.

B. Cutting:

1. PVC pipe shall be cut with power or hand hacksaws, circular or band saws with fine tooth blades with relatively little set

2. Circumferential speed of circular saws should be 6000 ft/min. Band saw speeds should be 3000 ft/min. When quantities of PVC pipe are to be cut, carbide tipped blades shall be used. Pipe and tube cutters shall be used only when they have been adapted with special blades for PVC pipe. To ensure square-end cuts, a mitre box, holddown or jig shall be used. Burrs shall be removed with a fine tooth file, deburring tool or sharp knife. Chips, burrs, filings, etc., shall be removed from the pipe I.D. and O.D. before installation.

C. Solvent Welding:

1. Only cement which is recommended by the pipe manufacturer for Schedule 80 PVC and is approved by the Engineer shall be used for PVC Schedule 80 piping joints. Solvent welding shall not take place when it is raining, when atmospheric temperature is below 40°F or under direct exposure to sun at atmospheric temperatures above 90°F.

2. Pipe ends shall be beveled to 12½ plus/minus 2½ for ease in socketing and to minimize the chances of wiping the solvent cement from the inside edge of the fitting as the PVC pipe is socketed. Beveling shall be done with a coarse file or with a beveling tool.

3. All loose dirt and moisture shall be wiped away from the inside edge and outside edge of the pipe end and the inside edge of the fitting using a clean, dry cotton rag.

4. Prior to solvent welding, fittings and couplings shall be removed from their cartons and exposed for at least one hour to the same temperature conditions as the pipe in order to assure thermal balance. During hot weather, joint surfaces shall be shaded from direct exposure to the sun's rays one hour prior to joining and during the joining process.

5. Using an approved bristle brush, a complete coating of primer shall be applied to the entire inside edge surface of the fitting socket and to

an equivalent area on the outside edge of the pipe end. In applying solvent cement to pipe, the cement shall be brushed on once around the entire surface of the pipe outside edge to a width slightly more than the equivalent socket depth of the fitting. A second coating of cement shall be applied onto the pipe outside edge to insure that the cement covers the pipe adequately, no holidays exist, and that any gap in the interference fit of the joint is thoroughly welded. A light but complete coating once around the entire depth of the socket surface shall be brushed on to the fittings. The Contractor shall avoid excessive cement application in order to prevent cement buildup inside the fitting or piping when the pipe is socketed. The pipe and joint shall be held together for a minimum of 15 seconds after inserting the pipe to the full socket depth. The joint shall be of adequate strength at this point to prohibit the pipe from moving or backing out of the socket. After joining, excess cement shall be wiped off the entire circumference of the pipe and fitting and globs of cement that have been dropped onto the pipe or fitting shall be removed.

6. During initial set of the cement, the joint shall not be moved or disturbed for two (2) minutes after application. Pipe shall be moved only after a period of time as specified in the following table.

Nominal Pipe Size	Hot Weather Above 90°F	Mild Weather (Surface Tempe rature)50°-90?F	Cold Weather 40°-50°F
1" – 1 ¼"	12 min.	20 min.	30 min.
1 1/2" – 2	30 min.	45 min.	1 hr.
½"	45 min.	1 hr.	1 hr. &
3" – 4"			30 min.

7. Forced rapid drying by applying heat to the solvent weld joint shall be prohibited.

D. Cement:

1. Cement which has exceeded the recommended manufacturer's shelf life shall not be used. Cement which has dried to the point where it has become lumpy and stringy shall not be used. Thinners and primers used to thin out sluggish cement shall be prohibited. Any cement to which thinners or primer have been added shall not be used. The Contractor shall be responsible for the proper discarding of any used or unsuitable materials.

E. Threaded Joints:

1. Threaded joints shall conform to ANSI B1.20.1, NPT, and shall be full and clearly cut with no gauling or gouging of pipe.

2. Plastic pipe shall be cut as specified herein and have a square end before threading. Thread dies shall be clean, sharp, and shall not be used to cut materials other than PVC/CPVC pipe.

3. PVC pipe shall be restrained securely in a pipe vise prior to threading, protecting pipe at the point of grip. A tapered plug shall be inserted in the end of the pipe to be threaded. The tapered plug shall provide reinforcement for the pipe and prevent distortion of the pipe in the threaded area.

4. Die shall have proper guide that is free of burrs or sharp edges so the die will start and go on square to the pipe axis. Apply a lubricant, as recommended by the manufacturer, while cutting the threads. Advance the die to the point where the thread dimensions are as specified by ANSI. PVC pipe with distorted threads, eccentric threads, non-uniform circumferential thread depth, gauling or gouging and tearing of the pipe wall shall not be used.

5. Brush threads clean of chips and ribbons. Wrap teflon thread tape around threads in the direction of the threads. Thread the fitting onto the pipe and hand tighten. A strap wrench shall be used to further tighten the connection an additional one or two threads past hand tightness. Avoid excessive torque as this may cause thread or fitting damage.

F. Flanged Joints:

1. PVC flanges and flanged fittings shall be attached to pipe by solvent welding. Soft rubber gaskets shall meet the approval of the Engineer and shall be of the full face flat type.

PART 3 EXECUTION

3.01 PREPARATION

A. Trenching:

1. Should trenching be required, the trench shall be of adequate width to allow convenient installation of PVC pipe but at the same time shall be as narrow as possible. Actual trench sizes will vary with the terrain and specific application. The trench bottom shall be

continuous, relatively smooth and free of rocks. All trenching shall conform to the requirements of Section 02260 - Trench Safety System.

3.02 INSTALLATION

A. On plastic flanged valves and fittings, the thermoplastic or stainless steel flange bolts shall be tightened by pulling down on the nuts diametrically opposite each other using a torque wrench. Bolts shall be pulled down gradually to a uniform torque as specified below. Overtightening bolts to obtain a leaktight joint is specifically prohibited

Flange Size	Bolt Diameter	Torque
1" to 1 1/2"	1/2"	10-15 ft-lbs.
2" to 4"	5/8"	20-30 ft-lbs.

B. Open ends of pipe shall be suitable capped or plugged.

C. Backfilling:

1. If possible, backfilling shall take place in the morning during periods of hot weather when the lime is fully concentrated.

2. PVC pipe in the trench shall be first covered with six (6) to eight (8) inches of dirt that is free of rocks, debris or particle size larger than ½-inch. This initial layer shall be tamped so that it will act as a cushion for the subsequent backfill. Backfill with rocks, debris, etc., that could penetrate through the initial layer and damage the pipe shall not be used.

3. PVC pipe shall be run within a metal or concrete casing when it is installed beneath surfaces that are subject to heavy loads and beneath railroad tracks.

4. Backfilling shall conform to the requirements of Section 02317 - Excavation and Backfill for Utilities

3.03 PAINTING

A. Color coding and lettering of scheduled pipelines shall be performed according to Section 09902 of the Specifications.

3.04 FIELD TESTING

A. No working pressure shall be applied to the pipe and fittings until they have been properly tested. A hydrostatic test shall be conducted on the joined pipe and fittings. In the case of buried PVC pipe, the test shall take place before backfilling. The test pressure shall be 50 psi or 1.5 times the maximum working pressure, whichever is greater.

B. The hydrostatic test shall be maintained a minimum of three (3) hours and shall not be taken off of test until the Engineer or his authorized representative is assured of a leak free pipe system. When a leak or leak occur, the pipe shall be taken off of test and repairs made at no additional cost to the Owner. The hydrostatic test shall then be restarted and held for the minimum three (3) hours.

C. Drain lines shall be tested by the exfiltration test with 10 feet of head.

D. The Contractor shall submit test results as per Specification Section 01330 - Submittal Procedures. Test results shall include date and time of test, weather conditions during the test, complete description of pipe tested, test conditions, results of test, and corrective action required if test results are unsatisfactory. The test report shall be signed by the Owner's representative or other authorized representative.

END OF SECTION

Section 2752S

The following supplement modifies Section 02752 Standard Specification. Where a portion of the Specification is modified or deleted by this Supplementary Specification, the unaltered portions of the Specification shall remain in effect.

1.01 SECTION INCLUDES.

Add Part C as follows.
C. Full depth saw cutting of concrete pavement as required by other agency.

1.02 MEASUREMENT AND PAYMENT

Add item 6.
6. Full depth Saw cutting for concrete pavement will be paid on linear foot base, if required by other agency for joining with existing roadway.

Renumber item 6 as 7

END OF SUPPLEMENT

Approved:

John H Kuo, P.E.
Assistant Director
Engineering and Construction Division

12/29/09
Date

Section 02820

BOLLARDS

PART 1 - GENERAL

1.1 SUMMARY

This Section includes the requirements for furnishing and installing chain link fence, gates with barbed wire, including security barbed wire and bollards as indicated on the Plans and as specified herein.

1.2 RELATED SECTIONS

A. Section 03301, *Minor Cast-in-Place Concrete*

1.3 REFERENCES

The following references are incorporated into the requirements of the Work as described herein. The limits and scope of these references will be as per Section 01420, *References and Definitions.*

A. ASTM International (ASTM)

1. ASTM A47, *Ferric Malleable Iron Castings*
2. ASTM A53, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*
3. ASTM A121, *Metallic-Coated Carbon Steel Barbed Wire*
4. ASTM A153, *Zinc Coating (Hot Dip) on Iron and Steel Hardware*
5. ASTM A307, *Carbon Steel Bolts and Studs 60,000-PSI Tensile Strength*
6. ASTM A392, *Zinc-Coated Steel Chain-Link Fence Fabric*
7. ASTM A641, *Zinc-Coated (Galvanized) Carbon Steel Wire*
8. ASTM F669, *Strength Requirements of Metal Posts and Rails for Industrial Chain-Link Fence*

B. *Standard Specifications*, State of California, Business, Transportation, and Housing Agency, Department of Transportation (State Specifications).

1. Section 75-1.05, *Galvanizing*
2. Section 80-3, *Chain Link Fences*
3. Section 90, *Concrete*

C. Federal Specification RR-F-191/3D, *Fencing, Wire and Post Metal*

D. International Standards Organization (ISO) 12944, *Paints and Varnishes -- Corrosion Protection of Steel Structures by Protective Paint Systems -- Part 5: Protective Paint Systems*

1.4 SUBMITTALS

At the request of the Engineer, the Contractor must submit Chain Link Fence Manufacturers' product information in accordance with Section 01330, *Submittals*, at least 10 days prior to installation.

1.5 DELIVERY, STORAGE AND HANDLING

The Contractor must inspect all materials delivered to the Site to ensure that they are in an undamaged condition. The Contractor must store all materials off the ground to prevent oxidation caused by ground contact.

PART 2 - PRODUCTS

2.1 GENERAL FENCE MATERIALS

A. Steel materials must have a minimum galvanized coating conforming to Section 75-1.05, *Galvanizing*, of the State Specifications.

B. Pipe for fencing and gates must meet the requirements of Federal Specification RR-F-191/3D for Class 1 Steel Pipe, Grade A Round. SS40 pipe as manufactured by Allied Tube and Conduit Corporation; standard Schedule 40 pipe meets these requirements.

C. Concrete fence post foundation must be Class A (564 pounds of Portland cement per cubic yard, Type II) as specified in Section 90, *Portland Cement Concrete,* of the State Specifications.

2.2 FENCE COMPONENTS

A. Chain-Link Fabric: Wire fence fabric must be helically wound and interwoven, 1-inch mesh; 9 gauge; barbed selvages on top and bottom. Galvanized material must be per ASTM A392, Class 2, galvanized coating after weaving (2 ounces per square foot). Fabric must be eight feet high.

B. Line Posts: Line posts must be hot-dip galvanized 2.375 inches O.D. standard pipe, weighing 3.65 lbs. per lineal foot.

C. Corner, End, and Gate Posts: End, corner and pull posts must be hot-dip galvanized 2.875 inches O.D. pipe weighing 5.79 lbs. per lineal foot.

D. Bottom Rail: Bottom rail must be hot-dip galvanized pipe, 1.625 inches O.D., weighing 2.27 lbs. per lineal foot.

E. Tension Wire: Tension wire must be 7-gage hot-dip galvanized, coil spring steel, Class 3 coating per ASTM A641 (0.9 ounces per square foot).

F. Braces: Braces must be hot-dip galvanized pipe, 1.625 inches O.D., weighing
2.27 lbs. per lineal foot.

G. Extension Arms: Extension arms must be hot-dip galvanized. Posts must be equipped with 24 inch long, 45 degree angle extension arms with four strands of barbed wire.

H. Barbed Wire: Barbed wire must conform to ASTM A121 and consist of four strands of galvanized 13.5-gage wire, twisted with 2 point barbs.

I. Gate posts and frame: Posts, rails, braces, and gate frames must be cylindrical, no circumferential welds, hot-dip galvanized steel in accordance with ASTM F669, Group 1A or 1C, and conform to the additional requirements of Section 80-3, *Chain Link Fence*, of the State Specifications

J. X-bracing: Adjustable truss rods must be 3/8" diameter hot-dip galvanized steel, Class B1 per ASTM A153 (2 ounces per square foot).

K. Locking Devices: Locking devices must be galvanized malleable iron per ASTM A47. Drop rods may be tubular or bar steel, galvanized per ASTM A153 (2 ounces per square foot).

L. Sleeves: Sleeves for drop rod must be 1.695-inch I.D. by 0.078-inch wall, drawn tube, 6 inches long. Sleeve must be self-centering type and galvanized per ASTM A153 (1.8 ounces per square foot)

M. Gate Hinges: Heavy-duty gate hinges must be malleable iron per ASTM A47 and galvanized per ASTM A153, Class A (2 ounces per square foot).

1. Bottom hinges must be ball and socket type designed to carry the weight of the gate on the post footing.
2. Top hinges must be a wrap around adjustable type.

2.3 FENCE ACCESSORIES

A. Tension Bands: 1/8 inch x 1 inch

B. Tension Bars: 1/4 inch x 3/4 inch

C. Brace Bands: 1/8 inch x 1 inch

D. Ties: Ties must be 9-gage, hot-dipped galvanized steel, Class B3 coating per ASTM A641 (0.8 ounces per square foot)

E. Hog Rings: Hog rings must be 9-gage, hot-dipped galvanized steel, Class 3 coating per ASTM A641 (0.8 ounces per square foot)

F. Turnbuckles: Turnbuckles for truss rods must be wrought iron per ASTM A47, galvanized drop forged steel, Class A per ASTM A153 (2 ounces per

square foot).

G. Nuts and Bolts: Nuts and bolts must be steel ASTM A307 with zinc coating per
ASTM A153, Class C (1.25 ounces per square foot).

2.4 BOLLARD PIPE

Bollard Pipe shall conform to ASTM A53, Grade B, Standard (schedule 40) weight class, unless otherwise indicated on the Plans.

PART 3 - EXECUTION

3.1 GENERAL

Whenever practical, the Contractor must reuse existing fence materials. Construct new fencing of hot-dip galvanized steel conforming to Section 80-3.02, *Chain Link Fence*, *Materials*, of the State Specifications and ASTM F1712, except as otherwise specified in this Section or as shown on the Plans. For requirements not described here, refer to Section 05050, *Basic Metal Materials and Methods*.

3.2 FENCE INSTALLATION

The Contractor must construct all fencing as per Section 80-3.03, *Chain Link Fence*, *Construction*, of the State Specifications and ASTM F1712, except as otherwise specified in this Section or as shown on the Plans.

A. Install fencing and gates in strict accordance with manufacturer's latest specifications and recommendations, with posts on the inside of the fence.

B. Equally space line posts at ten feet on center maximum.

C. Set posts in concrete as per Section 03300, *Cast-in-Place Concrete.*

D. Set posts plumb. Allow concrete and grout to cure a minimum of 72 hours before performing other work on posts.

E. Brace all corners and ends of fence to adjacent line posts. Install a mid-rail at all corners and end panels.

F. Install bottom rails before installing chain-link fabric.

G. Install top tension wires before installing chain-link fabric, and pull wires taut.
Place top tension wires within 6 inches of top of fabric line.

H. Install supporting arms facing outward at 45 degrees angle as shown on

the Plans and as recommended by manufacturer. In addition to manufacturer's standard connection, permanently secure supporting arms to post by peening or welding.

I. Install barbed wire on supporting arms above fence posts. Extend each end member of gate frames above top member to carry four strands of barbed wire equally spaced in horizontal alignment with barbed wire strands on the fence. Pull each strand taut and securely fasten to each supporting arm or extended member. Secure wires in accordance with fence manufacturer's recommendations.

J. Install swing gates to swing 90 degrees from closed to open.

3.2 FIELD PAINTING AND GALVANIZING REPAIRS

A. Prepare and paint any metal materials that are not shop galvanized as per Article 2.01 A above as per ISO 12944, Corrosion Class C4.

B. Clean and coat all field welding and damage surfaces with galvanized coating as per the requirements of ASTM A780.

3.3 BOLLARDS

Fabricate removable bollards from pipe of the length, diameter, and weight shown on the Plans.

END OF SECTION

Section 02821

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fence framework, fabric, and accessories.

B. Excavation for post bases, concrete foundation for posts, center drop for gates and gate track concrete grade beams.

C. Manual Gate and Related Hardware

D. Related Sections: Coordinate the requirements of the Work in this Section with the requirements of the Section listed below which includes, but is not limited to, Work that is directly related to this Section.

1. Section 03300 Cast in Place Concrete

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for Chain Link Fence shall be per linear foot of fence, complete in place.

2. Measurement and payment for Vehicle slide and Man Swing Access Gates are to be combined together as one unit, where each unit is paid for by the each, complete in place.

3. Refer to Section 01270 - Measurement and Payment.

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

1.03 REFERENCES

A. ANSI/ASTM A 123 - Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.

B. ANSI/ASTM F 567 - Installation of Chain-Link Fence.

C. ASTM A 116 - Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric.

D. ASTM A 120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized) Welded and Seamless, for Ordinary Uses.

E. ASTM A 153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

F. ASTM A 392 - Zinc-Coated Steel Chain-Link Fence Fabric.

G. ASTM A 428 - Weight of Coating on Aluminum-Coated Iron or Steel Articles.

H. ASTM C 94 - Ready-mixed Concrete.

I. ASTM F 573 - Residential Zinc-Coated Steel Chain Link Fence Fabric.

J. ASTM F 668 - Poly (Vinyl Chloride) (PVC) Coated Steel Chain Link Fence Fabric.

K. Chain Link Fence Manufacturers Institute (CLFMI) - Product Manual.

L. FS RR-F-191 - Fencing, Wire and Post Metal (Chain Link Fence Fabric, and Accessories).

M. ASTM F 1184 – Industrial and Commercial Horizontal Slide Gates.

N. ASTM A 853 – Steel Wire, Carbon, for General Use.

1.04 SYSTEM DESCRIPTION

A. Fence height shall be as indicated on Drawings or as noted to match height of existing.

B. Provide hot dipped galvanized welded steel wire wall fabric v-track type slide gate for vehicular access control. Provide a similar swing type gate for pedestrian access control.

C. Extension arms for barbed wire shall match existing.

D. Line post spacing shall not exceed 10 feet, or as shown on Drawings.

1.05 SUBMITTALS

A. Submit following Section 01330 - Submittal Procedures.

B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.

1. Submittal shall identify all materials, dimensions, sizes, weights, and finishes of rails, posts, braces, supports and other fencing and gate components.

2. Show fence heights, and locations of gates.

3. Show gate position in the open and closed position relative to associated hardware and accessories.

C. Product Data: Provide data on fabric, posts, accessories, fittings, and hardware that indicates items match or exceed the quality of existing items.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 5 years experience.

1.07 FIELD MEASUREMENTS

A. Verify that field measurements match and conform to approved shop drawings prior to construction.

B. Take measurements at the site and verify layout information and dimensions for fencing and gates in relation to property surveys and existing conditions prior to construction.

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 fence fabric.

B. Framework shall be hot-dipped galvanized with a minimum coating of 2 ounces per square foot, or one ounce per square foot plus 30 micrograms per square inch of chromate conversion coating.

C. Line posts shall conform to ASTM A 570 Grade 45 steel or ASTM A 569, cold rolled steel.

D. End corner, angle, and pull posts shall conform to ASTM A 570 Grade 45 steel or ASTM A 569 for steel pipe.

E. Top rails shall be 1.65 x 1.25-inch formed C-section; or 1.6-inch round ASTM A 569, 1.35 pounds per foot; or 1-5/8-inch outside diameter steel pipe, 2.27 pounds per foot. 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 gauge with a zinc coating of not less than 1.2 ounces per square foot.

G. Bolts and nuts shall be in conformance with ASTM A 307 and shall be galvanized in accordance with AASHTO M 232.

H. Install horizontal braces fabricated of 1-5/8-inch, 2.27-pound copper bearing steel pipe at all corner and end posts.

2.02 VEHICLE SLIDE ACCESS GATES

A. Vehicle slide access gates shall be provided for the control of vehicular traffic entering and exiting the site as shown on the drawings.

1. Slide gates shall be V-groove track type rolling gates complete with appropriate guide post(s), receiving post, pinch rollers, support rollers and accessories as defined by the manufacturer and shown on the shop drawings.

2. Slide gates shall comply with the requirements of ASTM F-1184 and shall be custom made to meet the requirements specified herein and shown on the drawings.

3. Fabricate gate frames of tubular steel members (cold formed). Assemble gate frame members by welding for rigid connection. Completed sliding gate frames shall be hot dip galvanized.

4. Provide horizontal and vertical members to ensure gate security, rigidity, operation and for attachment of wire wall fence fabric cladding and accessories. Install diagonal cross bracing as necessary to eliminate sag or twist.

5. Exterior side of the gate shall be clad with wire wall fence fabric from top to bottom, preventing reach in and climbing.

6. Extend end-members of gate frame one foot above top member to accommodate the use of barbed wire. Provide necessary clips for securing wire to extensions.

7. Provide chain and a lock to control access. Project manager to specify the type of lock (keyed or combination) to be provide.

2.03 MAN SWING ACCESS GATES

A. Man swing gates shall be provided for the control of pedestrian traffic entering and exiting the secured site as shown on the drawings.

1. Swing gates shall be a hinged swing type pedestrian gate complete with appropriate guide post(s), receiving post and accessories as defined by the manufacturer and shown on the shop drawings.

2. Fabricate gate frames of tubular steel members (cold formed). Assemble gate frame members by welding for rigid connection. Completed gate frames shall be hot dip galvanized.

3. Provide horizontal and vertical members to ensure gate security, rigidity, operation and attachment of wire wall fence fabric cladding and accessories. Install diagonal cross bracing as necessary to eliminate sag or twist.

4. Exterior side of the gate shall be clad with wire wall fence fabric from top to bottom, preventing reach in and climbing.

5. Extend end-members of gate frame one foot abor top member to accommodate the used of barbed wire. Provide necessary clips for securing wire to extensions.

6. Provide chain and a lock to control access. Project manager to specify the type of lock (keyed or combination) to be provide.

2.04 PRIVACY SLATS

A. Slats within the chain link fence and gates shall be provided for the privacy of the site. Slat properties, including but not limited to, colors, materials and sizes are to be provided by the manufacturer for the project managers approval.

PART 3 EXECUTION

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-foot 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. Erect gates so they swing or slide in the appropriate direction. Provide gate stops. Secure hardware, adjust and leave in acceptable working order. Adjust hinges and diagonal bracing so gates will hang level. Adjust rollers and guides of sliding gates so gates are level.

D. 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 every 100 feet or less.

E. At small natural or drainage ditches where it is not practical for fence to conform to 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. Install three parallel lines of barbed wire on each extension arm. Pull wire taut to remove all sag and firmly install in the slots of extension arms to prevent movement or displacement. Secure wire to terminal posts utilizing terminal post band arms or brace bands. Extend vertical members of gates to receive the barbed wire.

H. Install privacy slats according to the manufacturer's specifications.

END OF SECTION

Section 02830

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.

C. Refer to Section 01270 - Measurement and Payment for Unit Price Procedures.

1.03 REFERENCES

A. ANSI/ASTM A 123- Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.

B. ANSIIASTM F 567- Installation of Chain-Link Fence.

C. ASTM A 116- Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric.

D. ASTM A 120- Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized) Welded and Seamless, for Ordinary Uses.

E. ASTM A 153- Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

F. ASTM A 392- Zinc-Coated Steel Chain-Link Fence Fabric.

G. ASTM A 428- Weight of Coating on Aluminum-Coated Iron or Steel Articles.

H. ASTM C 94 - Ready-mixed Concrete.

I. ASTM D 412- Test Methods for Rubber Properties in Tension

J. ASTM D 1499- Recommended Practice for Operating Light- and Water-Exposure Apparatus (Carbon-Arc Type) for Exposure of Plastics.

K. ASTM D 2240 Test Method for Rubber Property- Durometer Hardness

L. ASTM F 573- Residential Zinc-Coated Steel Chain Link Fence Fabric.

M. ASTM F 668 - Poly (Vinyl Chloride) (PVC) Coated Steel Chain Link Fence Fabric.

N. Chain Link Fence Manufacturers Institute (CLFMI)- Product Manual.

O. FS RR-F-191- Fencing, Wire and Post Metal (and Gates, Chain Link Fence Fabric, and Accessories).

1.04 SYSTEM DESCRIPTION

A. Fence height shall 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.

D. Fence material shall match existing.

E. All material shall be of the same color vinyl coating. Painted finishes are not acceptable.

F. Proposed gates shall match existing fence material and fence height.

G. Padlocks: One for each gate with 3 keys each. Padlocks keyed for the City of Houston Standard Key.

1.05 SUBMITTALS

A. Submit under provisions of Specification Section 01330 - Submittal Procedures.

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 items.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years experience.

1.07 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 fence fabric.

B. The vinyl coating shall conform to FS RR-F-19111C. Colors shall be stabilized, and shall have a light fastness to withstand a minimum Weather-0-Meter exposure of at least 1500 hours without any deterioration when tested in accordance with ASTM D 1499. Specific gravity shall be between 1.26 and 1.30 in accordance with ASTM D792. Hardness shall be A90 +/- 5 in accordance with ASTM D 2240. Tensile strength shall be between 2600 to 3000 psi in accordance with ASTM D412. Vinyl coating shall be exposure-resistant to dilute solutions of most common mineral acids, sea-water, salts, and alkali. Vinyl coating shall be continuously bonded to the wire under 5000 psi pressure before the wire is woven into fabric. The fabric shall contain 90% privacy slats as required.

C. 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.

D. Line posts shall conform to ASTM A 570 Grade 45 steel or ASTM A 569, cold rolled steel.

E. End comer, angle, and pull posts shall conform to ASTM A 570 Grade 45 steel or ASTM A 569 for steel pipe.

F. Top rails shall be 1.65 x 1.25-inch formed C-section; or 1.6-inch round ASTM A 569, 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.

G. 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.

H. Bolts and nuts shall be in conformance with ASTM A 307 and shall be galvanized in accordance with AASHTO M 232.

I. Install horizontal braces fabricated of 1-5/8-inch, 2.27-lb copper bearing steel pipe at all comer, gate, and end posts.

J. Bottom tension wire shall not less than 9-gauge galvanized same as ties.

K. 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 filted with vertical extension arms or shall have frame end number extended to carry barbed wire. Gate posts for gates shall be 4- inch, 9.1lb pipe. Gate frames shall be made of2-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.

2.02 WOOD POSTS AND PICKETS

A. All wood posts and pickets shall be southern yellow pine pressure treated with creosote according to the American Wood Preservers Association specifications with a minimum absorption of 8 pcf.

B. 2-inch by 4-inch braces shall be southern yellow pine pressure treated same as posts.

C. Wood post domes to be dome or cut on 45-degree angle downwards toward the site.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install fence in accordance with the directions of the manufacturer, these Specifications and ASTM Practice 567. PVC Coated Material shall be handled with care. If PVC coating is damaged during installation, contractor must replace or repair the material at own expense.

B. Install fence posts at not more than 10-foot 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. For chain link fence, 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. Stretches offence more than 250 feet in length shall have one intermediate pull post with braces in two directions for every 250 feet.

E. 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.

F. 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 fence at several points between posts.

G. Where new fence joins an existing fence, set a comer post and brace post at the junction and brace as directed. If the connection is made at other than the comer of the new fence the last span of the old fence shall contain a brace.

H. Tack weld all bolted connections.

END OF SECTION

Section 03100

CONCRETE FORMWORK

PART 1 - GENERAL

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.

B. Refer to Section 01270 – Measurement and Payment for unit price procedures.

1.03 REFERENCE STANDARDS

A. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials.

B. ACI 347 - Guide to Formwork for Concrete.

C. U.S. Product Standard PS 1 Structural Plywood.

D. U.S. Product Standard PS 20 American Softwood Lumber Standard.

1.04 SUBMITTALS

A. Conform to Section 01330 – Submittal Procedures.

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. Form gaskets.

D. Detailed Layout for Slipforming: 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 - PRODUCTS

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 City Engineer of sufficient strength and thickness to withstand pressure of newly placed concrete without bow or deflection.

C. Plywood: Conform to PS 1, Class I.

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 feet 6 inches. For columns over 7 feet 6 inches, use 7-foot 6-inch sections and filler sections as needed. To facilitate removal of pan joist forms, taper sides one 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 one 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 one 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 feet 0 inches 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 City Engineer. 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, one-inch diameter.

2.02 DESIGN OF FORMWORK

A. Conform to ACI 117, ACI 347 and City 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 City Engineer. Contractor shall demonstrate suitability of method proposed.

PART 3 - EXECUTION

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 03350 – Concrete Finishing.

8. Rough forms may be used on formed concrete surfaces indicated to have rough form finish as specified in Section 03350 – 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 2 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 City Engineer'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 arises	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 arises (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 03350
	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 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"

END OF SECTION

Section 03151

JOINTS IN CONCRETE STRUCTURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Joints in concrete structures, including waterstops and joints 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.

B. Refer to Section 01270 – Measurement and Payment for unit price procedures.

1.03 REFERENCES

A. ASTM A 775 - Standard Specification for Epoxy-Coated Steel Reinforcing Bars.

B. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants.

C. ASTM D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.

D. ASTM D 624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.

E. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics.

F. ASTM D 746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.

G. ASTM D 747 - Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.

H. ASTM D 1056 - Standard Specification for Flexible Cellular Materials – Sponge or Expanded Rubber.

I. ASTM D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

J. ASTM D 1752 - Standard Specification for Preformed Sponge Rubber, Cork, and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

K. ASTM D 2000 - Standard Classification System for Rubber Products in Automotive Applications.

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

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

N. Federal Specification SS-S-210A - Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints.

O. U.S. Army Corps of Engineers Specification CRD-C 572 - PVC Waterstop.

1.04 DEFINITIONS

A. The following definitions refer to joints in concrete structures. Unless otherwise indicated, all such joints in water-retaining structures and other structures intended to withstand hydrostatic pressure 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.

1.05 SUBMITTALS

A. Submit under provisions of Section 01330 – Submittal Procedures.

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.

1.06 QUALITY ASSURANCE

A. Waterstop Inspection: Notify City Engineer 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 pen knife. If, while probing the joint with the point of a pen knife, 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 City for testing by a laboratory at the City's expense; they shall have a tensile strength across the joints equal to at least 600 psi when tested in accordance with ASTM D 638. 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. 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.

1.07 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 City, for a period of 5 years.

1.08 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 - PRODUCTS

2.01 EPA POTABLE CLASSIFICATION

A. For joints in water retaining structures and other structures intended to withstand hydrostatic pressures, 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 City Engineer, 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 City Engineer. 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:

1. Work Life: 45 – 180 minutes.

2. Time to Reach 20 Shore A Hardness (at 77 degrees F, 200 gr quantity): 24 hours, maximum.

3. Ultimate Hardness (ASTM D 2240): 20 – 45 Shore A.

4. Tensile Strength (ASTM D 412): 200 psi, minimum.

5. Ultimate Elongation (ASTM D 412): 400 percent, minimum.

6. Tear Resistance (Die C ASTM D 624): 75 pounds per inch of thickness, minimum.

7. Color: Light Gray.

C. Polyurethane Sealants for Waterstop Joints in Concrete:

1. Sealant: 2-part polyurethane; when cured, sealant shall meet or exceed ASTM C 920.

2. Vertical and overhead horizontal joints: Use only "non-sag" compounds meeting ASTM C 920, Class 25, Grade NS.

3. Plane horizontal joints: Self-leveling compounds meeting ASTM C 920, Class 25, Grade P. 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 City Engineer.

E. Sealants for non-waterstop joints: Conform to Section 07920 – Caulking and Sealants.

2.04 MISCELLANEOUS MATERIALS

A. Bearing Pad: ASTM D 2000 neoprene, Grade 2 or 3, Type BC, tensile strength 1450 psi, 60 durometer hardness, unless otherwise indicated.

B. Neoprene Sponge: ASTM D 1056, Type 2C3-E1 closed-cell expanded neoprene.

C. Preformed Joint Filler: For joints in water-retaining structures and other structures intended to withstand hydrostatic pressure, use ASTM D 1752 Type I non-extruding type; neoprene sponge or polyurethane of firm texture, except as otherwise specified. For joints in other structures, use non-extruding and resilient bituminous fiber type conforming to ASTM D 1751.

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 approved equal acceptable to the City Engineer. 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 A 775.

H. PVC Tubing: ASTM D 2241, Schedule SDR 13.5.

2.05 RESILIENT WATERSTOP

A. Resilient waterstop, where called for on the Drawings, shall be either a bentonite, adhesive, or hydrophilic 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 °F; in service, -40 to 212 °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 approved 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.

D. Hydrophilic Waterstop:

1. Hydrophilic waterstop shall be Adeka Ultra Seal preformed rubber (MC-2010M), paste type (P-201), and accessories as manufactured by Asahi Denka Kogyo K.K. and distributed by Mitsubishi International Corporation USA, or approved equal.

2. The hydrophilic waterstop material shall have independent laboratory tests verifying that the material has a volume expansion coefficient of at least 1.9 for the premolded rubber type and at least 1.8 for the paste type.

3. Provide other accessories not specifically described, but required for a complete and proper installation as directed by the manufacturer and approved by the City Engineer.

PART 3 - EXECUTION

3.01 WATERSTOP 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 City Engineer, 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 centerbulb waterstop intersects and is joined to a non-centerbulb waterstop, take care to seal the end of the centerbulb, 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 centerbulb 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 City Engineer.

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 sand-blast 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 City Engineer, provide technical assistance by manufacturer's representative in the field at no additional cost to the City.

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.

8. Hydrophilic Waterstop:

a. All methods of installation require a minimum of two (2) inches concrete coverage.

b. Smooth Concrete Surface: Clean debris from the surface of the concrete. Apply adhesive, 3M-2141 (product of 3M Company) bonding agent or CA3200 (product of Hilti, Corp.) construction adhesive, and allow to set approximately 15 minutes or until tacky. Press MC-2010M firmly into place. Overlap ends a minimum of 2 inches when joining. Cut the strip to fit the corners closely and apply P-201 over joint.

c. Alternate Method: Nail MC-2010M in place using concrete nails placed 10-12 inches apart. Apply tension to the strip while nailing to obtain close adhesion to the concrete. Use the nailing method when working with wet concrete.

d. Rough Surface: Clean debris from the surface. Apply a continuous bead of P-201 and allow to semi-cure, approximately one day. Place MC-2010M on the P-201 and nail to hold in place if necessary.

e. Alternate Method: Nail MC-2010M in place. Apply a continuous bead of P-201 along both sides of the MC-2010M.

G. Control Joints:

1. Where indicated, form in slabs by sawcutting, preformed plastic inserts or other means acceptable to the City Engineer. Minimum insert or sawcut: ¼ 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 03211

REINFORCING STEEL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Structural concrete reinforcement and anchoring of reinforcement dowel bars into hardened concrete.

1.02 UNIT PRICES

A. 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.

B. Measurement for reinforcing steel installed as extra work is on a per-pound basis.

C. Refer to Section 01270 – Measurement and Payment for unit price procedures.

1.03 REFERENCES

A. ACI 315 - Details and Detailing of Concrete Reinforcement.

B. ACI 318 - Building Code Requirements for Structural Concrete.

C. ASTM A 36 - Standard Specification for Carbon Structural Steel.

D. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

E. ASTM A 185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.

F. ASTM A 497 - Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.

G. ASTM A 615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

H. ASTM A 675 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.

I. ASTM A 775 - Standard Specification for Epoxy-Coated Steel Reinforcing Bars.

J. ASTM C 881 – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

K. AWS D1.4 - Structural Welding Code – Reinforcing Steel.

L. WRI - Manual of Standard Practice for Structural Welded Wire Reinforcement.

M. CRSI - Manual of Standard Practice.

1.04 SUBMITTALS

A. Conform to Section 01330 – Submittal Procedures.

B. 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 using bar bends in accordance with ACI 315, Figure 10.

4. Submit shop drawings showing location of proposed additional construction joints as required under Section 03151 – Joints in Concrete Structures, and obtain approval of the City Engineer, prior to submitting reinforcing steel shop drawings.

C. Bill of Materials: Submit with shop drawings.

D. Product Data:

1. Mechanical Bar Splices: Submit manufacturer's technical literature, including specifications and installation instructions.

2. Epoxy grout or other adhesive anchoring system proposed for anchoring reinforcing dowels to hardened concrete: Submit manufacturer's technical literature including recommended installation procedures and certified test reports showing compliance with specified performance characteristics and physical properties of the anchoring system.

E. Certificates:

1. 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.

2. 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.

1.05 HANDLING AND STORAGE

A. 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 or other corrosion-producing conditions. Protect epoxy-coated reinforcing from formation of any amount of rust.

B. Store epoxy grout and other adhesive anchoring system components in accordance with manufacturer's recommendations.

1.06 QUALITY ASSURANCE

A. Notify the City Engineer at least 48 hours before concrete placement so that reinforcement may be inspected, and errors corrected, without delaying Work.

B. .Concrete Anchor Installer Training: Conduct a thorough training by the concrete anchor manufacturer or manufacturer's representative for the concrete anchor installer on the project. Training shall consist of a review of the complete installation process for epoxy grout, drilled-in cartridge injection adhesive anchors, capsule anchors, or other adhesive anchoring system, to include but not limited to:

1. Hole drilling procedure.

2. Hole preparation and cleaning technique.

3. Adhesive injection technique and dispenser training/maintenance.

4. Rebar dowel preparation and installation.

PART 2 - PRODUCTS

2.01 MATERIAL

A. Reinforcing Bars: Deformed bars conforming to ASTM A 615, 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.

B. Smooth Bars: Where indicated on Drawings, use smooth bars conforming to ASTM A 36; ASTM A 615, Grade 60; or ASTM A 675, Grade 70.

C. Column Spirals: Bars conforming to ASTM A 615, Grade 60, or wire conforming to ASTM A 82.

D. Epoxy-Coated Deformed Bars, Column Spirals and Smooth Bars: Conform to ASTM A 775.

E. Welded Wire Reinforcement:

1. Welded Smooth Wire Reinforcement: Conform to ASTM A 185.

2. Welded Deformed Wire Reinforcement: Conform to ASTM A 497.

3. Provide wire size, type and spacing as shown. Where type is not shown on Drawings, use welded smooth wire reinforcement.

4. Furnish welded wire reinforcement in flat sheets only.

F. Tie Wire: 16-1/2 gage or heavier annealed steel wire. Use plastic-coated tie wire with epoxy-coated reinforcing steel.

G. Bar and Welded Wire Reinforcement Supports: Provide chairs, bolsters, standees, spacers, riser bars, ties and other accessories made of plastic or metal, except as otherwise specified. Use 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. Wire bar supports and accessories shall have Class 1 or 2 protection conforming to the CRSI Manual of Standard Practice. Welded wire reinforcement supports and accessories shall conform to the WRI Manual of Standard Practice for Structural Welded Wire Reinforcement. Use epoxy-coated bar supports with epoxy-coated reinforcing bars.

H. Precast Concrete Block Bar Supports: Precast concrete blocks of size 3 inches wide, 6 inches long, and thick enough to allow required cover. Embed tie wires in 3-inch by 6-inch side. The nominal compressive strength of the precast concrete blocks shall be no less than the nominal compressive strength of the concrete in which they are to be embedded.

I. Mechanical Bar Splices:

1. 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.

2. Regardless of chemical composition of steel, any heat effect shall not adversely affect performance of reinforcing bar.

J. Welded Splices:

1. Provide welded splices where shown and where approved by the City Engineer. Welded splices of reinforcing steel shall develop a tensile strength exceeding 125 percent of the yield strength of the reinforcing bars connected.

2. Provide materials for welded splices conforming to AWS D1.4.

K. Epoxy Grout: High-strength rigid epoxy adhesive, conforming to ASTM C 881, 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.

L. Cartridge Injection Adhesive Anchors: Reinforcing dowels, complete with polymer or hybrid mortar adhesive injection system, manufactured for purpose of anchoring dowels into hardened concrete. Type and size as indicated on Drawings. Where anchor manufacturer is not indicated, subject to compliance

with requirements and acceptance by the City Engineer, provide Hilti HIT-HY 150 MAX Adhesive Anchoring System or approved equal considering load resistance, in-service and installation temperature, availability of comprehensive installation instructions, and creep.

M. Capsule Anchors: Reinforcing dowels with 45-degree chisel point at embedded end, complete with glass or foil capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, manufactured for purpose of anchoring dowels into hardened concrete. Type and size as indicated on Drawings. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the City Engineer, provide Hilti HVA Capsule Adhesive Anchoring System with HVU capsules or approved equal considering load resistance, in-service and installation temperature, availability of comprehensive installation instructions, and creep.

2.02 FABRICATION

A. 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 A 775.

B. Splices:

1. Locate splices as indicated on Drawings. Do not locate splices at other locations without approval of the City Engineer. 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.

C. Construction Joints: Unless otherwise shown, continue reinforcing through construction joints.

D. Bar Fabrication Tolerances: Conform to tolerances listed in ACI 315, Figures 8 and 9.

E. Standard Hooks: Conform to the requirements of ACI 318.

F. 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 - EXECUTION

3.01 PREPARATION

A. Clean reinforcement of scale, loose or flaky rust and other foreign material, including dirt, mud, oil, grease, or coating that will reduce bond to concrete. Reinforcement shall be free from cracks, splits, and laminations.

3.02 INSTALLATION

A. 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.

B. 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 City Engineer. Do not cut reinforcement to install inserts, conduit, mechanical openings or other items without the approval of the City Engineer.

C. 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.

D. 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, spacing, 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.

E. Placement for Concrete on Ground: Unless otherwise indicated, support bar and welded wire reinforcement on chairs with sheet metal bases or precast concrete blocks spaced at approximately 3 feet on centers each way, using minimum of one support for each 9 square feet. Tie supports to reinforcing bars and wires. Use supports having bases large enough to rest firmly and stably on top of the subbase materials without penetrating into the subbase or subgrade materials during concrete placement. When a polyethylene vapor retarder or other sheeting material is used, use supports that will not puncture the sheeting. Individual chairs or bolsters without base plates may be used if a concrete seal slab or mudmat foundation is first installed.

F. Placement for Concrete on Metal Decks: Unless otherwise indicated, support bar and welded wire reinforcement on chairs spaced at approximately 3 feet on centers each way. Tie supports to reinforcing bars and wires. Locate bar and welded wire reinforcement supports directly over top the members supporting the metal deck.

G. 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.

H. Splices:

1. Do not splice bars, except at locations indicated on Drawings or reviewed shop drawings, without approval of the City Engineer.

2. Lap Splices: Unless otherwise shown or noted, Class B, conforming to

ACI 318-05, 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 City Engineer. 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.

I. Construction Joints: Place reinforcing continuous through construction joints, unless noted otherwise.

J. Welded Wire Reinforcement: Install welded wire reinforcement 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. Provide and install supports to securely hold the reinforcement in the proper vertical position within the slab during placement of the concrete. The spacing of supports for welded wire reinforcement shall comply with the recommendations given in the WRI Manual of Standard Practice for Structural Welded Wire Reinforcement. The practice of placing the reinforcement on the base surface and pulling it up during concrete placement is prohibited, as well as the practice of placing the reinforcement on top of the freshly placed concrete and depressing it into the concrete by walking on it.

K. 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 City Engineer. Do not bend reinforcement after it is embedded in concrete, except as shown on Drawings or permitted by the City Engineer.

L. Epoxy-Coated Reinforcing Steel: Install in accordance with Paragraph 3.02K, 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.

M. Field Cutting: Cut reinforcing bars by shearing or sawing using bolt cutters or diamond blade saws. Do not cut bars with flame cutting torch. Coated reinforcement shall not be field cut unless permitted by the City Engineer.

N. Welding of reinforcing bars is prohibited, except where shown on Drawings.

3.03 ANCHORING OF REINFORCING DOWEL BARS INTO HARDENED CONCRETE

A. Drilling Holes: Drill holes with rotary impact hammer drills using carbide-tipped bits or with core drills using diamond core bits. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on Drawings, all holes shall be drilled perpendicular to the concrete surface.

1. Cored Holes: Where anchors are to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. HIT HY-150 MAX shall not be installed in core drilled holes.

2. Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the City Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines.

3. Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

B. Epoxy Grout Anchoring: Use epoxy grout for anchoring reinforcing dowel steel to existing concrete only where indicated on Drawings or approved by the City Engineer. Install in accordance with epoxy manufacturer's instructions. Drill hole not more than ¼ inch larger than steel bar diameter (including height of deformations for deformed bars) into 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.

C. Cartridge Injection Adhesive Anchors: Unless indicated otherwise on Drawings, use cartridge injection adhesive anchors for anchoring reinforcing dowel steel to existing concrete. Clean all holes per anchor manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Holes may be dry, damp, or wet. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow anchor manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive shall be injected into the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

D. Capsule Anchors: Use capsule anchors for anchoring reinforcing dowel steel to existing concrete only where indicated on Drawings or approved by the City Engineer. Perform drilling and setting operations in accordance with anchor manufacturer instructions. Clean all holes to remove loose material and drilling dust prior to installation of adhesive. Remove water from drilled holes in such a

manner as to achieve a surface dry condition. Capsule anchors shall be installed with equipment conforming to manufacturer recommendations. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

E. Repair of Defective Work: Remove and replace misplaced or malfunctioning anchors. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, nonmetallic grout. Anchors that fail to meet proof load requirements shall be regarded as malfunctioning.

F. Testing: 2% of each type and size of drilled-in reinforcing bar concrete anchor shall be proof loaded by the independent testing laboratory unless otherwise directed by the City Engineer. If more than 10% of the tested anchors fail to achieve the specified proof load within the limits as defined on the Drawings, all reinforcing bar anchors of the same diameter and type as the failed anchor shall be tested, unless otherwise instructed by the City Engineer.

1. Proof loads shall be applied with a calibrated hydraulic ram. Displacement of adhesive and capsule anchors at proof load shall not exceed D/10, where D is the nominal anchor diameter.

2. Minimum anchor embedments and proof loads shall be as shown on the Drawings.

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):	±2
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:	±2
Discontinuous ends of members:	±1/2
Length of bar laps:	-1-1/2
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:	
At unformed surfaces and bottoms in contact with earth:	2
Over top of piles:	3
Top of footings -- same as slabs	2

END OF SECTION

Section 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcement, Related Sections include the following:

1. Division 2 Section "Earthwork" for drainage fill under slabs-on-grade.

2. Division 2 Section "Cement Concrete Pavement" for concrete pavement and walks.

3. Division 3 Section "Concrete Toppings" for metallic and nonmetallic concrete floor toppings.

1.03 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.04 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mix water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork. Design and engineering of formwork are Contractor's responsibility.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.

E. Welding Certificates: Copies of certificates for welding procedures and personnel.

F. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

1. Cementitious materials and aggregates
2. Form materials and form-release agents
3. Steel reinforcement and reinforcement accessories
4. Fiber reinforcement
5. Admixtures
6. Waterstops
7. Curing materials
8. Floor and slab treatments
9. Bonding agents
10. Adhesives
11. Vapor retarders
12. Epoxy joint filler
13. Joint-filler strips
14. Repair materials

G. Minutes of preinstallation conference.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this

Project and whose work has resulted in construction with a record of successful in-service performance.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for formwork and shoring and reshoring installations that are similar to those indicated for this Project in material, design, and extent.

C. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

1. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.

D. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

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

G. ACI Publications: Comply with the following, unless more stringent provisions are indicated:

1. ACI 301, "Specification for Structural Concrete."

2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1. Before submitting design mixes, review concrete mix design and examine procedures for ensuring quality of concrete materials.

Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent

b. Independent testing agency responsible for concrete design mixes

c. Ready-mix concrete producer

d. Concrete subcontractor

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Avoid damaging coatings on steel reinforcement.

2. Repair damaged epoxy coatings on steel reinforcement according to ASTM D 3963/D 3963M.

PART 2 - PRODUCTS

2.01 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.

2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

a. High-density overlay, Class 1, or better.

b. Medium-density overlay, Class 1, or better, mill-release agent treated and edge sealed.

c. Structural 1, B-B, or better, mill oiled and edge sealed.

d. B-B (Concrete Form), Class 1, or better, mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

G. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

H. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of the exposed concrete surface.

2. Furnish ties that, when removed, will leave holes not larger than 1 inch (25 mm) in diameter in concrete surface.

3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.02 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

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

C. Galvanized Reinforcing Bars: ASTM A 767/A 767M, hot-dip galvanized after fabrication and bending, of reinforcement type and zinc coating as follows:

1. Steel Reinforcement: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

2. Steel Reinforcement: ASTM A 706/A 706M , deformed.

3. Zinc Coating: Class I.

4. Zinc Coating: Class II.

D. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M.

E. Epoxy-Coated Fabricated Reinforcing Bars: ASTM A 934/A 934M, and as follows:

1. Steel Reinforcement: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

2. Steel Reinforcement: ASTM A 706/A 706M, deformed.

F. Steel Bar Mats: ASTM A 184/A 184M, assembled with clips.

1. Steel Reinforcement: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars.

2. Steel Reinforcement: ASTM A 706/A 706M, deformed bars.

G. Plain-Steel Wire: ASTM A 82, as drawn.

H. Plain-Steel Wire: ASTM A 82, galvanized.

I. Deformed-Steel Wire: ASTM A 496.

J. Epoxy-Coated Wire: ASTM A 884/A 884M, Class A coated, plain-steel wire.

K. Epoxy-Coated Wire: ASTM A 884/A 884M, Class A coated, deformed-steel wire.

L. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

M. Galvanized Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from galvanized steel wire into flat sheets.

N. Deformed-Steel Welded Wire Fabric: ASTM A 497, flat sheet.

O. Epoxy-Coated Welded Wire Fabric: ASTM A 884/A 884M, Class A, plain steel.

P. Epoxy-Coated Welded Wire Fabric: ASTM A 884/A 884M, Class A, deformed steel.

2.03 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place.

Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.

2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

B. Joint Dowel Bars: Plain-steel bars, ASTM A 615/A 615M, Grade 60 (Grade 420). Cut bars true to length with ends square and free of burrs.

C. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars.

D. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 755M.

E. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.

2.04 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I.

B. Portland Cement: ASTM C 150, Type I/II.

C. Portland Cement: ASTM C 150, Type II.

D. Portland Cement: ASTM C 150, Type III.

E. Portland Cement: ASTM C 150, Type V.

1. Fly Ash: ASTM C 618, Class C or F.

2. Fly Ash: ASTM C 618, Class F.

3. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

F. Blended Hydraulic Cement: ASTM C 595M, Type IS, portland blast-furnace slag cement.

G. Blended Hydraulic Cement: ASTM C 595M, Type IP, portland-pozzolan cement.

H. Blended Hydraulic Cement: ASTM C 595M, Type I (PM), pozzolan-modified portland cement.

I. Blended Hydraulic Cement: ASTM C 595M, Type I (SM), slag-modified portland cement.

J. Silica Fume: ASTM C 1240, amorphous silica.

K. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:

1. Class: Severe weathering region, but not less than 3S.

2. Class: Moderate weathering region, but not less than 3M.

3. Class: Negligible weathering region, but not less than 1N.

4. Nominal Maximum Aggregate Size: 1-1/2 inches (38 mm).

5. Nominal Maximum Aggregate Size: 1 inch (25 mm).

6. Nominal Maximum Aggregate Size: 3/4 inch (19 mm).

7. Combined Aggregate Gradation: Well graded from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 (0.3-mm) sieve, and less than 8 percent may be retained on sieves finer than No. 50 (0.3 mm).

L. Lightweight Aggregate: ASTM C 330.

1. Nominal Maximum Aggregate Size: 1 inch (25 mm).

2. Nominal Maximum Aggregate Size: 3/4 inch (19 mm).

3. Nominal Maximum Aggregate Size: 1/2 inch (13 mm).

4. Nominal Maximum Aggregate Size: 3/8 inch (10 mm).

M. Water: Potable and complying with ASTM C 94.

2.05 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.

B. Air-Entraining Admixture: ASTM C 260.

C. Water-Reducing Admixture: ASTM C 494, Type A.

D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.

E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.

F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

G. Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:

a. Catexol 1000CL; Axim Concrete Technologies.

a. MCI 2000 or MCI 2005; Cortec Corporation.

b. DCI or DCI-S; W. R. Grace & Co., Construction Products Div.

c. Rheocrete 222+; Master Builders, Inc.

d. FerroGard-901; Sika Corporation.

2.06 FIBER REINFORCEMENT

A. Carbon-Steel Fiber: ASTM A 820, deformed, minimum 2.4 inches (60 mm) long, and of diameter or effective diameter indicated.

1. Fiber: Type 1, cold-drawn wire.

2. Fiber: Type 2, cut sheet.

3. Fiber: Type 1, cold-drawn wire, or Type 2, cut sheet.

B. Synthetic Fiber: Fibrillated polypropylene fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, 1/2 to 1 inch (13 to 25 mm) long.

C. Synthetic Fiber: Fibrillated or monofilament polypropylene fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, 1/2 to 1 inch (13 to 25 mm) long.

D. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

E. Products: Subject to compliance with requirements, provide one of the following:

1. Carbon-Steel Fibers:

   a. Dramix; Bekaert Corporation.

   b. Fibercon; Fibercon International.

   c. Zorex; Novocon International Inc.

2. Fibrillated Fibers:

   a. Fibrasol F; Axim Concrete Technologies.

   b. Fibermesh; Fibermesh, Div. of Synthetic Industries.

   c. Forta CR; Forta Corporation.

   d. Grace Fibers; W. R. Grace & Co., Construction Products Div.

3. Monofilament Fibers:

   a. Fibrasol IIP; Axim Concrete Technologies.

   b. Fiberstrand 100; Euclid Chemical Co.

   c. Fibermix Stealth; Fibermesh, Div. of Synthetic Industries.

   d. Forta Mono; Forta Corporation.

   e. Grace MicroFiber; W. R. Grace & Co., Construction Products Div.

   f. Hi-Tech PPM Fiber; Hi-Tech Fibers, Div. of Martin Color-Fi, Inc.

   g. Polystrand 1000; Metalcrete Industries.

2.07 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Profile: Flat, dumbbell with center bulb.

2. Profile: Flat, dumbbell without center bulb.

3. Profile: Ribbed with center bulb.

4. Profile: Ribbed without center bulb.

5. Profile: As indicated.

B. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Profile: Flat, dumbbell with center bulb.

2. Profile: Flat, dumbbell without center bulb.

3. Profile: Ribbed with center bulb.

4. Profile: Ribbed without center bulb.

5. Profile: As indicated.

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Rubber Waterstops:

a. Greenstreak.

b. Progress Unlimited Inc.

c. Westec Barrier Technologies; Div. of Western Textile Products, Inc.

d. Williams Products, Inc.

2. PVC Waterstops:

a. Greenstreak.

b. Meadows: W. R. Meadows, Inc.

c. Murphy: Paul Murphy Plastics Co.

d. Progress Unlimited Inc.

e. Sternson Group.

f. Tamms Industries Co.; Div. of LaPorte Construction Chemicals North America, Inc.

g. Vinylex Corporation.

h. Westec Barrier Technologies; Div. of Western Textile Products, Inc.

D. Self-Expanding Strip Waterstops: Manufactured rectangular or trapezoidal strip, sodium bentonite or other hydrophylic material for adhesive bonding to concrete.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:

a. Volclay Waterstop-RX; Colloid Environmental Technologies Co.

b. Conseal CS-231; Concrete Sealants Inc.

c. Swellseal Joint; De Neef Construction Chemicals (U.S.) Inc.

d. Hydrotite; Greenstreak.

e. Mirastop; Mirafi Moisture Protection, Div. of Royal Ten Cate (USA), Inc.

f. Adeka Ultra Seal; Mitsubishi International Corporation.

g. Superstop; Progress Unlimited Inc.

2.08 VAPOR RETARDERS

A. Vapor Retarder: ASTM E 1745, Class C, of one of the following materials; or polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick:

1. Nonwoven, polyester-reinforced, polyethylene coated sheet; 10 mils (0.25 mm) thick.

2. Three-ply, nylon- or polyester-cord-reinforced, laminated, high-density polyethylene sheet; 7.8 mils (0.18 mm) thick.

B. Vapor Retarder: ASTM E 1745, Class B, five-ply, nylon- or polyester-cord-reinforced, high-density polyethylene sheet; 10 mils (0.25 mm) thick.

1. Available Product: Subject to compliance with requirements, a product that may be incorporated into the Work includes, but is not limited to, "Griffolyn T-85" by Reef Industries Inc.

2. Product: Subject to compliance with requirements, provide "Griffolyn T-85" by Reef Industries Inc.

C. Vapor Retarder: ASTM E 1745, Class A, three-ply, nylon- or polyester-cord-reinforced, high-density polyethylene sheet; laminated to a nonwoven geotextile fabric, 30 mils (0.76 mm) thick.

1. Available Product: Subject to compliance with requirements, a product that may be incorporated into the Work includes, but is not limited to, "Griffolyn T-65G" by Reef Industries Inc.

2. Product: Subject to compliance with requirements, provide "Griffolyn T-65G" by Reef Industries Inc.

D. Vapor Retarder: 110-mil- (2.8-mm-) thick, semiflexible, seven-ply sheet membrane consisting of reinforced core and carrier sheet with fortified asphalt layers, protective weathercoating, and removable plastic release liner. Furnish manufacturer's accessories including bonding asphalt, pointing mastics, and self-adhering joint tape.

1. Water-Vapor Permeance: 0.00 grains/h x sq. ft. x inches Hg (0.00 ng/Pa x s x sq. m); ASTM E 154.

2. Tensile Strength: 140 lbf/in. (24.5 kN/m); ASTM E 154.

3. Puncture Resistance: 90 lbf (400 N); ASTM E 154.

4. Available Product: Subject to compliance with requirements, a product that may be incorporated into the Work includes, but is not limited to, "Premoulded Membrane Vapor Seal" by W. R. Meadows, Inc.

5. Product: Subject to compliance with requirements, provide "Premoulded Membrane Vapor Seal" by W. R. Meadows, Inc.

E. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a No. 4 (4.75-mm) sieve and 10 to 30 percent passing a No. 100 (0.15-mm) sieve; meeting deleterious substance limits of ASTM C 33 for fine aggregates.

F. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch (38-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

2.09 FLOOR AND SLAB TREATMENTS

A. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate containing not less than 50 percent aluminum oxide and not less than 25 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

B. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, and plasticizing admixture.

C. Pigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, coloring pigments, and plasticizing admixture. Use coloring pigments that are finely ground, nonfading mineral oxides interground with cement.

1. Colors: Match A-E's samples.

2. Colors: As indicated by referencing manufacturer's designations.

3. Colors: As selected by A-E from manufacturer's full range for these characteristics.

D. Penetrating Liquid Floor Treatment: Chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.

E. Products: Subject to compliance with requirements, provide one of the following:

1. Unpigmented Mineral Dry-Shake Floor Hardener:

a. Non-Metallic Floor Hardener; Burke Group, LLC (The).

b. Concolor; ChemMasters.

c. Conshake 500; Conspec Marketing & Manufacturing Co., Inc.

d. Quartz Tuff; Dayton Superior Corporation.

e. Surflex; Euclid Chemical Co.

f. Tycron; Kaufman Products, Inc.

g. Colorhard; Lambert Corporation.

h. Quartzplate; L&M Construction Chemicals, Inc.

i. Maximent; Master Builders, Inc.

j. Floor Quartz; Metalcrete Industries.

k. Hard Top; Richmond Screw Anchor Co.

l. Lithochrome Color Hardener; L. M. Scofield Co.

m. Harcol; Sonneborn, Div. of ChemRex, Inc.

n. Durag Premium; Sternson Group.

o. Hard Top; Symons Corporation.

2. Pigmented Mineral Dry-Shake Floor Hardener:

a. Non-Metallic Floor Hardener; Burke Group, LLC (The).

b. Concolor; ChemMasters.

c. Conshake 600; Conspec Marketing & Manufacturing Co., Inc.

d. Quartz Tuff; Dayton Superior Corporation.

e. Surflex; Euclid Chemical Co.

f. Tycron; Kaufman Products, Inc.

g. Colorhard; Lambert Corporation.

h. Quartzplate; L&M Construction Chemicals, Inc.

i. Maximent; Master Builders, Inc.

j. Floor Quartz; Metalcrete Industries.

k. Lithochrome Color Hardener; L. M. Scofield Co.

l. Harcol; Sonneborn, Div. of ChemRex, Inc.

m. Colorplete; Sternson Group.

3. Penetrating Liquid Floor Treatment:

a. Titan Hard; Burke Group, LLC (The).

b. Chemisil Plus; ChemMasters.

c. Intraseal; Conspec Marketing & Manufacturing Co., Inc.

d. Ashford Formula; Curecrete Chemical Co., Inc.

e. Day-Chem Sure Hard; Dayton Superior Corporation.

f. Euco Diamond Hard; Euclid Chemical Co.

g. Seal Hard; L&M Construction Chemicals, Inc.

h. Vexcon Starseal PS; Vexcon Chemicals, Inc.

2.10 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.

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

D. Water: Potable.

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

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

G. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

H. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

I. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

J. Products: Subject to compliance with requirements, provide one of the following:

1. Evaporation Retarder:

a. Cimfilm; Axim Concrete Technologies.

b. Finishing Aid Concentrate; Burke Group, LLC (The).

c. Spray-Film; ChemMasters.

d. Aquafilm; Conspec Marketing & Manufacturing Co., Inc.

e. Sure Film; Dayton Superior Corporation.

f. Eucobar; Euclid Chemical Co.

g. Vapor Aid; Kaufman Products, Inc.

h. Lambco Skin; Lambert Corporation.

i. E-Con; L&M Construction Chemicals, Inc.

j. Confilm; Master Builders, Inc.

k. Waterhold; Metalcrete Industries.

l. Rich Film; Richmond Screw Anchor Co.

m. SikaFilm; Sika Corporation.

n. Finishing Aid; Symons Corporation.

o. Certi-Vex EnvioAssist; Vexcon Chemicals, Inc.

2. Clear, Solvent-Borne, Membrane-Forming Curing Compound:

a. AH Clear Cure; Anti-Hydro International, Inc.

b. Spartan-Cote; Burke Group, LLC (The).

c. Spray-Cure & Seal 15; ChemMasters.

d. Conspec #1-15 percent solids; Conspec Marketing & Manufacturing Co., Inc.

e. Day-Chem Cure and Seal; Dayton Superior Corporation.

f. Diamond Clear; Euclid Chemical Co.

g. Nitocure S; Fosroc.

h. Lambco 120; Lambert Corporation.

i. L&M Dress & Seal 18; L&M Construction Chemicals, Inc.

j. CS-309; W. R. Meadows, Inc.

k. Seal N Kure; Metalcrete Industries.

l. Rich Seal 14 percent UV; Richmond Screw Anchor Co.

m. Kure-N-Seal; Sonneborn, Div. of ChemRex, Inc.

n. Flortec 14; Sternson Group.

o. Cure & Seal 14 percent; Symons Corporation.

p. Clear Seal 150; Tamms Industries Co., Div. of LaPorte Construction Chemicals of North America, Inc.

q. Acrylic Cure; Unitex.

r. Certi-Vex AC 309; Vexcon Chemicals, Inc.

3. Clear, Waterborne, Membrane-Forming Curing Compound:

a. AH Clear Cure WB; Anti-Hydro International, Inc.

b. Spartan Cote WB; Burke Group, LLC (The).

c. Safe-Cure & Seal 20; ChemMasters.

d. High Seal; Conspec Marketing & Manufacturing Co., Inc.

e. Safe Cure and Seal; Dayton Superior Corporation.

f. Diamond Clear VOX; Euclid Chemical Co.

g. SureCure; Kaufman Products Inc.

h. Glazecote Sealer-20; Lambert Corporation.

i. Dress & Seal WB; L&M Construction Chemicals, Inc.

j. Vocomp-20; W. R. Meadows, Inc.

k. Metcure; Metalcrete Industries.

l. Cure & Seal 100E; Nox-Crete Products Group, Kinsman Corporation.

m. Rich Seal 14 percent E; Richmond Screw Anchor Co.

n. Kure-N-Seal W; Sonneborn, Div. of ChemRex, Inc.

o. Florseal W.B.; Sternson Group.

p. Cure & Seal 14 percent; Symons Corporation.

q. Horncure 100; Tamms Industries Co., Div. of LaPorte Construction Chemicals of North America, Inc.

r. Hydroseal; Unitex.

s. Vexcon Starseal 309; Vexcon Chemicals, Inc.

4. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound:

a. Spray-Cure & Seal Plus; ChemMasters.

b. UV Super Seal; Lambert Corporation.

c. Lumiseal Plus; L&M Construction Chemicals, Inc.

d. CS-309/30; W. R. Meadows, Inc.

e. Seal N Kure 30; Metalcrete Industries.

f. Rich Seal 31 percent UV; Richmond Screw Anchor Co.

g. Cure & Seal 31 percent UV; Symons Corporation.

h. Certi-Vex AC 1315; Vexcon Chemicals, Inc.

5. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound:

a. Klear-Kote Cure-Sealer-Hardener, 30 percent solids; Burke Group, LLC (The).

b. Polyseal WB; ChemMasters.

c. UV Safe Seal; Lambert Corporation.

d. Lumiseal WB Plus; L&M Construction Chemicals, Inc.

e. Vocomp-30; W. R. Meadows, Inc.

f. Metcure 30; Metalcrete Industries.

g. Vexcon Starseal 1315; Vexcon Chemicals, Inc.

2.11 RELATED MATERIALS

A. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Joint-Filler Strips: ASTM D 1752, cork or self-expanding cork.

C. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

D. Epoxy Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Shore A hardness of 80 per ASTM D 2240.

E. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

F. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:

1. Type: Class II, non-load bearing, for bonding freshly mixed concrete to hardened concrete.

2. Type: Class I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

3. Type: Class IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

G. Reglets: Fabricate reglets of not less than 0.0217-inch- (0.55-mm-) thick galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

H. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.12 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.

2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand as recommended by underlayment manufacturer.

4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Topping: Traffic-bearing, cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6 mm).

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.

2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand as recommended by topping manufacturer.

4. Compressive Strength: Not less than 5700 psi (39 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.13 CONCRETE MIXES

A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:

1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.

2. Proportion lightweight structural concrete according to ACI 211.2 and ACI 301.

B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.

C. Footings and Foundation Walls: Proportion normal-weight concrete mix as follows:

1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).

2. Maximum Slump: 4 inches (100 mm).

3. Maximum Slump for Concrete Containing High-Range Water-Reducing Admixture: 8 inches (200 mm) after admixture is added to concrete with 2- to 4-inch (50- to 100-mm) slump.

D. Slab-on-Grade: Proportion normal-weight concrete mix as follows:

1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).

2. Compressive Strength (28 Days): 3500 psi (24.1 MPa).

3. Compressive Strength (28 Days): 3000 psi (20.7 MPa).

4. Maximum Slump: 4 inches (100 mm).

E. Cementitious Materials: For concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements.

F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.

2. Combined Fly Ash and Pozzolan: 25 percent.

3. Ground Granulated Blast-Furnace Slag: 50 percent.

4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.

5. Silica Fume: 10 percent.

6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent portland cement minimum, with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

G. Maximum Water-Cementitious Materials Ratio: 0.50 for concrete required to have low water permeability.

H. Maximum Water-Cementitious Materials Ratio: 0.45 for concrete exposed to deicers or subject to freezing and thawing while moist.

I. Maximum Water-Cementitious Materials Ratio: 0.40 for corrosion protection of steel reinforcement in concrete exposed to chlorides from deicing chemicals, salt, saltwater, brackish water, seawater, or spray from these sources.

J. Maximum Water-Cementitious Materials Ratio: 0.50 for concrete subject to moderate sulfate exposure.

K. Maximum Water-Cementitious Materials Ratio: 0.45 for concrete subject to severe or very severe sulfate exposure.

L. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 2 to 4 percent, unless otherwise indicated.

M. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus 1 or minus 1.5 percent, unless otherwise indicated:

1. Air Content: 5.5 percent for 1-1/2-inch- (38-mm-) nominal maximum aggregate size.

2. Air Content: 6 percent for 1-inch- (25-mm-) nominal maximum aggregate size.

3. Air Content: 6 percent for 3/4-inch- (19-mm-) nominal maximum aggregate size.

N. Do not air entrain concrete to trowel-finished interior floors and suspended slabs. Do not allow entrapped air content to exceed 3 percent.

O. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

P. Steel-Fiber Reinforcement: Add to concrete mix, according to manufacturer's written instructions, at a rate of 50 lb/cu. yd. (29.7 kg/cu. m).

Q. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1 lb/cu. yd. (0.60 kg/cu. m).

R. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd. (0.90 kg/cu. m).

S. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

4. Use corrosion-inhibiting admixture in concrete mixes where indicated.

2.14 FABRICATING REINFORCEMENT

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

2.15 CONCRETE MIXING

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

B. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

C. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least one and one-half minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.

2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).

3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.01 FORMWORK

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

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

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3 mm).

2. Class B, 1/4 inch (6 mm).

3. Class C, 1/2 inch (13 mm).

4. Class D, 1 inch (25 mm).

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

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.

1. Do not use rust-stained steel form-facing material.

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

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

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

I. Do not chamfer corners or edges of concrete.

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

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

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

M. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 EMBEDDED ITEMS

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

1. Install anchor bolts, accurately located, to elevations required.

2. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3. Install dovetail anchor slots in concrete structures as indicated.

3.03 REMOVING AND REUSING FORMS

A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.

B. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:

1. 28-day design compressive strength.

2. At least 70 percent of 28-day design compressive strength.

3. Determine compressive strength of in-place concrete by testing representative field- or laboratory-cured test specimens according to ACI 301.

4. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

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

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

3.04 SHORES AND RESHORES

A. Comply with ACI 318 (ACI 318M), ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and reshoring.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.05 VAPOR RETARDERS

A. Vapor Retarder: Place, protect, and repair vapor-retarder sheets according to ASTM E 1643 and manufacturer's written instructions.

B. Fine-Graded Granular Material: Cover vapor retarder with fine-graded granular material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch (0 mm) or minus 3/4 inch (19 mm).

C. Granular Fill: Cover vapor retarder with granular fill, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch (0 mm) or minus 3/4 inch (19 mm).

1. Place and compact a 1/2-inch- (13-mm-) thick layer of fine-graded granular material over granular fill.

3.06 STEEL REINFORCEMENT

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

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

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.

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

1. Shop- or field-weld reinforcement according to AWS D1.4, where indicated.

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

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

F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

G. Zinc-Coated Reinforcement: Use galvanized steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

3.07 JOINTS

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

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

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.

2. Form from preformed galvanized steel, plastic keyway-section forms, or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.

3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

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

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

2. Terminate full-width joint-filler strips not less than 1/2 inch (12 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.

3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.

1. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.08 WATERSTOPS

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

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, bonding or mechanically fastening and firmly pressing into place. Install in longest lengths practicable.

3.09 CONCRETE PLACEMENT

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

B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by A-E.

C. Before placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mix.

D. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.

E. Deposit concrete in forms in horizontal layers no deeper than 24 inches (600 mm) and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.

1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.

2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Maintain reinforcement in position on chairs during concrete placement.

3. Screed slab surfaces with a straightedge and strike off to correct elevations.

4. Slope surfaces uniformly to drains where required.

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

G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

H. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch (3 mm) in height.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.

2. Do not apply rubbed finish to smooth-formed finish.

C. Rubbed Finish: Apply the following to smooth-formed finished concrete:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

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

3.11 FINISHING FLOORS AND SLABS

A. General: Comply with recommendations in ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes.

1. Apply scratch finish to surfaces indicated and to surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, portland cement terrazzo, and other bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system

2. Finish surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155/E 1155M for a randomly trafficked floor surface:

a. Specified overall values of flatness, F(F) 25; and levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and levelness, F(L) 15.

b. Specified overall values of flatness, F(F) 35; and levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and levelness, F(L) 17; for slabs-on-grade.

c. Specified overall values of flatness, F(F) 30; and levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and levelness, F(L) 15; for suspended slabs.

d. Specified overall values of flatness, F(F) 45; and levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and

levelness, F(L) 24.

3. Finish and measure surface so gap at any point between concrete surface and an unleveled freestanding 10-foot- (3.05-m-) long straightedge, resting on two high spots and placed anywhere on the surface, does not exceed the following:

   a. 1/4 inch (6.4 mm).

   b. 3/16 inch (4.8 mm).

   c. 1/8 inch (3.2 mm).

E. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

   1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with A-E before application.

G. Slip-Resistive Aggregate Finish: Before final floating, apply slip-resistive aggregate finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:

   1. Uniformly spread 25 lb/100 sq. ft. (12 kg/10 sq. m) of dampened slip-resistive aggregate over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.

   2. After broadcasting and tamping, apply float finish.

   3. After curing, lightly work surface with a steel wire brush or an abrasive stone, and water to expose slip-resistive aggregate.

H. Mineral Dry-Shake Floor Hardener Finish: After initial floating, apply mineral dry-shake materials to surfaces according to manufacturer's written instructions and as follows:

   1. Uniformly apply mineral dry-shake materials at a rate of 100 lb/100 sq. ft. (49 kg/10 sq. m), unless greater amount is recommended by manufacturer.

2. Uniformly distribute approximately two-thirds of mineral dry-shake materials over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second mineral dry-shake application, uniformly distributing remainder of material, and embed by power floating.

3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake material manufacturer and apply immediately after final finishing.

3.12 MISCELLANEOUS CONCRETE ITEMS

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

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

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

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.13 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.

   b. Continuous water-fog spray.

   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.

2. Do not apply to concrete that is less than seven days old.

3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least six months. Do not fill joints until construction traffic has permanently ceased.

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

C. Install semirigid epoxy joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by A-E. Remove and replace concrete that cannot be repaired and patched to A-E's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.2-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by A-E.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch (19 mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to A-E's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to A-E's approval.

3.17 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Article.

B. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.

C. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.

2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mix placed each day.

   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mix, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.

4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.

5. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.

6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.

7. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.

   a. Cast and field cure one set of four standard cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C 39; test two laboratory-cured specimens at 7 days and two at 28 days.

   a. Test two field-cured specimens at 7 days and two at 28 days.

b. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.

D. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

E. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

F. Test results shall be reported in writing to A-E, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.

G. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by A-E but will not be used as sole basis for approval or rejection of concrete.

H. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by A-E. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by A-E.

END OF SECTION

Section 03301

MINOR CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

This Section includes the requirements for furnishing and installing cast-in-place concrete for fence posts and bollards and other security fencing related items.

1.2 RELATED SECTIONS

A. Section 02820, *Bollards*

1.3 REFERENCES

The following references are incorporated into the requirements of the Work as described herein. The limits and scope of these references will be as per Section 01422, *Reference Standards.*

A. ASTM International (ASTM)

1. A615, *Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement*
2. C42, *Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete*
3. C94, *Standard Specification for Ready-Mixed Concrete*
4. C143, *Standard Test Method for Slump of Hydraulic-Cement Concrete*
5. C172, *Standard Practice for Sampling Freshly Mixed Concrete*
6. C173, *Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method*
7. C231, *Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method*

B. American Concrete Institute (ACI)

1. 304, *Measuring, Mixing, Transporting, and Placing Concrete*
2. 318, *Building Code Requirements for Structural Concrete and Commentary*
3. 347, *Guide to Formwork for Concrete*

1.4 SUBMITTALS

At the request of the Engineer, the Contractor must submit concrete mix design results as per Section 01330, *Submittal Procedures.*

PART 2 - PRODUCTS

2.1 CEMENTITIOUS MATERIAL

Portland Cement: ASTM C 150, Type II, unless Type III is authorized by Project Manager; or ASTM C 595, Type IP.

2.2 REINFORCING STEEL

Unless otherwise noted, rebar must be Grade 40 steel as per ASTM A615.

2.3 CONCRETE MIXING AND DELIVERY

Concrete mixing and delivery must be as per the requirements of ASTM C94. Concrete quantities less than 1.5 cubic yards may be hand mixed.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

A. Ensure that the subgrade upon which concrete is to be placed is firm and clear of loose material.

B. Where indicated on the Plans, or as directed by the Engineer, compact the subgrade, excavate additional soft soils and place and compact aggregate base.

C. Moisten the subgrade prior to placing concrete so that the soil will not absorb excessive moisture from the fresh concrete.

D. Ensure that all cast-in-drilled-hole pier excavations are clean and free of excess water before placing concrete.

3.2 EMBEDDED ITEMS

A. Install items to be embedded in concrete prior to concrete placement. The Contractor must notify the Engineer at least 24 hours in advance of concrete placement when all items are in place, ready for his inspection.

B. Position embedded items accurately and rigidly secured against movement during concrete placement, at tolerances not exceeding + 1/2 inch in location and
+ 1/4 inch in depth from face of concrete, unless a more stringent tolerance is established elsewhere in these Technical Specifications or on the Plans.

3.3 PLACING CONCRETE

A. Place concrete conforming to ACI 304.

B. Schedule concrete placement to be continuous between construction joints. The Contractor must schedule and make every effort so as to place concrete without interruptions until the scheduled placement has been completed.

C. Prior to concrete placement, clean forms and reinforcing with compressed air.

D. Where concrete is to be placed on grade, do not place in standing water.

E. Place concrete in cast-in-drilled-hole piers through suitable tremie or other means to prevent segregation of concrete materials and splashing of reinforcing steel cage.

F. Compact concrete with suitable mechanical vibrators operating within the concrete. When necessary, supplement vibrating by hand spading with suitable tools to assure proper and adequate compaction. Manipulate vibrating equipment so as to work the concrete thoroughly around the reinforcement and embedded fixtures and into corners and angles of the forms without segregating the mix.

3.4 COLD JOINTS

Make necessary provisions when the suspending placement of concrete, for joining future Work before the placed concrete takes its initial set. For the proper bonding of old and new concrete, make such provisions for grooves, steps, keys, dovetails, reinforcing bars or other devices as may be prescribed. Before depositing new concrete on or against concrete which has hardened, clean the surface of the hardened concrete with a heavy steel broom, roughened slightly, wetted, and covered with a neat coating of cement paste or grout.

3.5 CONCRETE FINISH

If required as per other Technical specifications, the Work Authorization, or the Plans, finish new concrete surfaces.

A. Do not mortar finish, spread dry cement or sand-cement mortar over the concrete during the finishing of horizontal plane surfaces.

B. Ensure that:

1. All exposed concrete surfaces are true, smooth, free from open or rough spaces, depressions, or projections.

2. The concrete in horizontal plane surfaces is brought flush with the finished top surface at the proper elevation and is struck-off with a

straightedge and floated.

3.6 CURING AND PROTECTION

A. Protect freshly deposited concrete from premature drying and excessively hot or cold temperatures, and maintain with minimal moisture loss at a relatively constant temperature for the time necessary for hydration of the cement and hardening of the concrete.

B. Commence concrete curing immediately following the finish operation. Keep exposed concrete continuously moist for a minimum of seven (7) days by absorbent mat or keep fabric continuously wet.

C. During the curing period, protect the concrete from damaging mechanical disturbances, particularly load stresses, shock and excessive vibration. Protect all finished concrete surfaces from damage caused by construction equipment, materials, methods, and by frost, rain or running water.

D. Protect the concrete from damage, from whatever cause, until its acceptance by the Engineer.

3.7 REPAIR OF CONCRETE AND DEFECTIVE WORK

A. Immediately after curing is completed, repair surface defects. During repair Work, the Contractor must not delay or interrupt the curing of adjoining surfaces. Repair procedures as follows:

1. Remove fins and other projections not acceptable to the Engineer, and grind the concrete to an even surface. The City will accept individual small surface defects such as air bubbles, voids, and fissures without repair, if the voids or air bubbles are less than 1/2 inch in diameter and 3/8 inch in depth and if fissures do not penetrate more than 3/8 inch in depth.

2. For cavities exceeding three (3) inches in depth or 1/4 cubic ft in volume, employ concrete and not dry-pack mortar. Apply a coating of the approved epoxy bonding agent to the surface immediately after removing all loose material. Completely fill the cavity with concrete of the required strength and composition and finish flush. The concrete must be just plastic enough to permit effective placement. If necessary, the Contractor must fix a form to prevent concrete sagging.

3. Repair surfaces in the same manner as the surrounding concrete.

B. Remove areas of structures that are outside the tolerance limits listed in ACI 347 to the specified limits, if the Engineer so requires. Finish or grind the surface smooth to a finish comparable to the surrounding area.

3.8 STRENGTH TESTS

A. The Engineer may sample and test concrete determine compressive strength at a frequency as required by the Engineer.

B. The Contractor may make additional tests at Contractor's expense at earlier stages to obtain advance information on the adequacy of strength development and to determine when forms may be removed.

C. If strength tests fail to meet the minimum requirements, the concrete represented by such tests will be considered questionable, and will be subjected to additional testing at the direction of the Engineer, and at the expense of the Contractor, as follows:

1. The Engineer will take core samples of the questionable concrete and test for compressive strength in accordance with ASTM C42.

2. If core tests fail to demonstrate strengths adequate for the intended purpose of the member or members in question, as determined by the Engineer, or if failure to meet specified strength requirements occurred in members from which it is impracticable to secure test specimens by the method of ASTM C42, the Engineer will conduct load tests and will evaluate their results in accordance with Chapter 20 of ACI 318.

3. If the results of the load tests fail to meet the requirements of Chapter 20 of ACI 318, the Contractor must demolish the low-strength portions of the structure and the rebuild, or adequately reinforce the portions as directed by the Engineer, all at the Contractor's expense.

3.9 ADDITIONAL QUALITY CONTROL TEST

The Engineer may perform quality control tests during concrete placement, and, as such may collect samples of fresh concrete as per ASTM C172 to perform the following tests:

A. Slump Tests: Performed per ASTM C143, the Engineer at its discretion may test samples for slump during concrete placement. The maximum allowed slump may be increased as specified with the addition of an approved admixture provided that the water-cement ratio is not exceeded, and weather may factor into the Engineer's judgment of slump test results. The Engineer may perform tests at commencement of concrete placement and for each batch (minimum) or every 10 cubic yards (maximum) of concrete.

B. Air Content: Performed per ASTM C173 or ASTM C231, the Engineer at its discretion may test air-entrained concrete for air content at the same frequency as specified for slump tests.

END OF SECTION

Section 03310

STRUCTURAL CONCRETE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Cast-in-place 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.

C. Refer to Section 01270 – Measurement and Payment for unit price procedures.

1.03 REFERENCES

A. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials.

B. ACI 301 - Specifications for Structural Concrete.

C. ACI 302.1R - Guide for Concrete Floor and Slab Construction.

D. ACI 304.2R - Placing Concrete by Pumping Methods.

E. ACI 305R - Hot Weather Concreting.

F. ACI 306.1 - Standard Specification for Cold Weather Concreting.

G. ACI 309R - Guide for Consolidation of Concrete.

H. ACI 318 - Building Code Requirements for Structural Concrete.

I. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures.

J. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

K. ASTM C 33 - Standard Specification for Concrete Aggregates.

L. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

M. ASTM C 42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

N. ASTM C 88 - Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

O. ASTM C 94 - Standard Specifications for Ready-Mixed Concrete.

P. ASTM C 127 - Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate.

Q. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

R. ASTM C 136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

S. ASTM C 143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.

T. ASTM C 150 - Standard Specification for Portland Cement.

U. ASTM C 157 – Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.

V. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.

W. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

X. ASTM C 192 – Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.

Y. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

Z. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.

AA. ASTM C 330 - Standard Specification for Lightweight Aggregates for Structural Concrete.

AB. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.

AC. ASTM C 535 - Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

AD. ASTM C 567 - Standard Test Method for Determining Density of Structural Lightweight Concrete.

AE. ASTM C 1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.

AF. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.

AG. ASTM E 1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

AH. Concrete Plant Manufacturers Bureau (CPMB), Plant Mixer Manufacturers Division: Concrete Plant Mixer Standards.

AI. National Ready-Mixed Concrete Association (NRMCA): Certification of Ready-Mixed Concrete Production Facilities (checklist with instructions).

AJ. John Wiley and Sons, Interscience Publishers Division, "Encyclopedia of Industrial Chemical Analysis," Vol. 15, Page 230 (alkalinity test procedure).

1.04 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.

1.05 SUBMITTALS

A. Conform to Section 01330 – Submittal Procedures.

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 that are concealed from view.

1.06 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 water conveying structures shall conform to ACI 350. Where this Specification conflicts with ACI 318 or ACI 350, 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 City in accordance with Section 01454 – Testing Laboratory Services.

2. Provide material for and cooperate fully with the City's testing laboratory technician in obtaining samples for required tests.

3. Standard Services: The following testing and quality control services will be provided in accordance with Section 01454 – 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 C 172, 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. For location of samples for pumped concrete, comply with Paragraph 3.04F.

(2). Molding four specimens from each sample according to ASTM C 31, and curing under standard moisture and temperature conditions as specified in Sections 7(a) and (b) of ASTM C 31.

(3). Testing two specimens at 7 days and two specimens at 28 days according to ASTM C 39, 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 C 231. For pumped concrete, comply with Paragraph 3.04F.

g. Slump: For each strength test, and whenever consistency of concrete appears to vary, conducting slump test in accordance with ASTM C 143. For pumped concrete, comply with Paragraph 3.04F.

h. Temperature: For each strength test, checking concrete temperature in accordance with ASTM C 1064.

i. Lightweight concrete: For each strength test, or more frequently when requested by the City Engineer,

determination of air content by ASTM C 173 and unit weight by ASTM C 567.

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 C 157, modified as follows:

(a) 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.

(b) Measure within 30 minutes after first 30 minutes of immersion to determine original length (not to be confused with "base length").

(c) Then submerge in saturated limewater, at 73 degrees F ±3 degrees F, for 7 days.

(d) Then measure at age 7 days to establish "base length" for drying shrinkage calculations ("zero" days drying age).

(e) Calculate expansion (base length expressed as a percentage of original length).

(f) 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.

(g) 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 (at "zero" days drying age) 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.

(h) Report shrinkage separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.

D. Additional Testing and Quality Control Services: The following will be performed by an independent commercial testing laboratory employed and paid by the City in accordance with Section 01454 – Testing Laboratory Services, when requested by the City Engineer.

1. Checking of batching and mixing operations.

2. Review of manufacturer's report of each cement shipment and conducting laboratory tests of cement.

3. Molding and testing reserve 7-day cylinders or field cylinders.

4. Conducting additional field tests for slump, concrete temperature and ambient temperature.

5. 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.

6. Contractor shall provide the following testing and quality control services:

a. Employ an independent commercial testing laboratory, acceptable to the City, 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 the City 24 hours prior to placing concrete.

7. 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 City Engineer.

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 City Engineer, or the independent commercial testing laboratory selected by the City.

c. Replace concrete work judged inadequate by core tests, structural analysis or load tests at no additional cost to the City.

d. Core Tests:

(1). Obtain and test cores in accordance with ASTM C 42. 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 C 42.

(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 City's Designated 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 03350 – Concrete Finishing.

8. Structural Analysis: When core tests are inconclusive or impractical to obtain, the City Engineer may perform additional structural analysis at the Contractor's expense to confirm safety of structure.

9. 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

10. Testing by impact hammer, sonoscope, probe penetration tests (Windsor probe), or other nondestructive device may be permitted by the City Engineer 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.

1.07 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 that 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 - PRODUCTS

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 C 150, Type I or Type II, gray in color. Use Type III only when specifically authorized by the City Engineer in writing. Use Type II, including the requirements of ASTM C 150 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 C 260, compatible with other admixtures used.

3. Chemical Admixtures: Polymer type, nonstaining, chloride-free admixtures conforming to ASTM C 494, Type A, C, D or E.

4. High-Range Water Reducer (Superplasticizer): ASTM C 494, 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 C 94.

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 C 33.

2. Fine Aggregate: Natural sand complying with ASTM C 33.

3. Limestone aggregate shall conform to ASTM C 33 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 C 131 or ASTM C 535. Test aggregate for soundness in accordance with ASTM C 88; maximum loss shall not exceed 18 percent after 5 cycles of magnesium sulfate test.

4. Nominal 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 C 330. Grading limits: 3/4 inch to No. 4.

6. Abrasive Aggregate: Conform to requirements of Section 03350 – Concrete Finishing.

E. Calcium Chloride: Not permitted.

F. Evaporation Retardant: "Confilm" by BASF Construction Chemicals (formerly Master Builders), "EucoBar" by Euclid Chemical Company, or approved equal.

G. Miscellaneous Materials:

1. Bonding Agent: Two-component modified epoxy resin.

2. Vapor Retarder: Clear polyethylene film of type recommended for below-grade application with minimum thickness of 10 mils and permeance of less than 0.3 US perms as determined by ASTM E 96.

3. Seam Tape for Vapor Retarder: Compatible with vapor retarder, with vapor transmission rate of 0.3 US perms or lower as determined by ASTM E 96.

4. Nonshrink 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 the City, 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 C 192 and ASTM C 39. 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 C 136. 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 City, 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 City Engineer, 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 and normal weight concrete for interior slabs-on-grade that are to receive a trowel finish. Total air content in accordance with ASTM C 173: 4 to 6 percent.

H. Minimum Cementitious Materials Content Requirement: For concrete floor slabs, comply with the following ACI 302.1R requirement:

1. For nominal maximum aggregate size of 1-1/2 inch: 470 lb/cu.yd.

2. For nominal maximum aggregate size of 1 inch: 520 lb/cu.yd.

3. For nominal maximum aggregate size of 3/4 inch: 540 lb/cu.yd.

4. For nominal maximum aggregate size of 1/2 inch: 590 lb/cu.yd.

5. For nominal maximum aggregate size of 3/8 inch: 610 lb/cu.yd.

I. 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 that can be worked properly into place without segregation, and that 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.

J. 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.

K. 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.

L. 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 Cubic Yard)
Concrete for Structures Containing Water or Wastewater		

Class (Normal Weight)	Minimum 28-Day Compressive Strength (psi)	Minimum Cement Content (Pounds per Cubic Yard)
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)
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 C 567. Correlate air-dry unit weight with fresh unit weight of the same concrete as a basis for acceptance during construction.

M. 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: Unreinforced 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: Unreinforced 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 C 94. Plant equipment and facilities shall conform to NRMCA "Certification of Ready Mixed Concrete Production Facilities".

2. Provide batch tickets with information specified in ASTM C 94. Deliver batch ticket with concrete and give to the City's on-site testing laboratory representative.

C. Batch Mixing at Site:

1. Mix concrete in batch mixer conforming to requirements of CPMB "Concrete Plant Mixer Standards". Use mixer equipped with suitable charging hopper, water storage tank and water measuring device. Batch mixer shall be capable of mixing aggregates, cement and water into uniform mass within specified mixing time, and of discharging mix without segregation. Operate mixer

according to rated capacity and recommended revolutions per minute printed on manufacturer's rating plate.

2. Charge batch into mixer so some water will enter before cement and aggregates. Keep water running until one-fourth of specified mixing time has elapsed. Provide controls to prevent discharging until required mixing time has elapsed. When concrete of normal weight is specified, provide controls to prevent addition of water during mixing. Discharge entire batch before mixer is recharged.

3. Mix each batch of 2 cubic yards or less for not less than 1 minute and 30 seconds. Increase minimum mixing time 15 seconds for each additional cubic yard or fraction of cubic yard.

4. Keep mixer clean. Replace pick-up and throw-over blades in drum when they have lost 10 percent of original depth.

D. 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.

E. 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 C 127.

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 C 94. 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 - EXECUTION

3.01 SPECIAL CONSIDERATIONS

A. Concreting Under Water: Not permitted except where shown otherwise on Drawings or approved by the City Engineer. When shown or permitted, deposit concrete under water by methods acceptable to the City Engineer 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 City Engineer'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.

C. Tolerances for Concrete Construction and Materials: Comply with ACI 117.

3.02 PREPARATION OF SURFACES FOR CONCRETING

A. Earth Surfaces:

1. Under interior slabs-on-grade, install vapor retarder in accordance with manufacturer's instructions and ASTM E 1643. Unroll vapor retarder with longest dimension parallel with the direction of the concrete placement. Lap vapor retarder over footings and seal to foundation walls or grade beams. Lap joints at least 6 inches and seal watertight with seam tape, or sealant applied between overlapping edges and ends. Seal all pipe and other penetrations per manufacturer's instructions. 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 on all sides.

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 City's Designated 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 City Engineer.

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 amplitude measured between high and low points with use of a 3-foot long straightedge, 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 City Engineer'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 City Engineer. 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 that is greater than 60 days of age), thoroughly clean and roughen the surface of the old concrete by hydro-blasting or sandblasting (exposing aggregate), no more than 48 hours before placement of new concrete. 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 City Engineer'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 City.

C. Unauthorized Placement: Place no concrete except in the presence of the City's Designated Representative. Notify the City's Designated 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 City Engineer. 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. Concrete Temperature: When placed, not more than 90 degrees F nor less than 55 degrees F for sections less than 12 inches thick, nor less than 50 degrees for all other sections. Do not heat concrete ingredients to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. 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. 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.

H. Cold Weather Placement: Conform to ACI 306.1 – Standard Specification for Cold Weather Concreting, and the following.

1. Remove snow, ice and frost from surfaces, including reinforcement, against which concrete is to be placed. Before beginning concrete placement, thaw the subgrade to a minimum depth of 6 inches. Warm reinforcement and embedded items to above 32 degrees F prior to concrete placement.

2. Maintain concrete temperature above 50 degrees F for at least 3 days after placement.

3.04 PUMPING OF CONCRETE

A. If pumped concrete does not produce satisfactory results, in the judgment of the City Engineer, 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 City Engineer. 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 City Engineer 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 03350 – Concrete Finishing.

3.09 CURING

A. Conform to Section 03390 – Concrete Curing.

3.10 PROTECTION

A. Protect concrete against damage until final acceptance by the City.

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 City Engineer.

END OF SECTION

Section 03350

CONCRETE FINISHING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Repairing surface defects.

B. Finishing concrete surfaces, including both formed and unformed surfaces.

C. Sealing concrete surfaces.

D. Installation of concrete fill and installation of concrete topping in bottoms of clarifiers and thickeners for wastewater treatment plants.

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 REFERENCES

A. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar.

B. ASTM C 881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

C. ASTM C 1059 - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.

D. ASTM D 4587 - Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings.

E. ASTM E 1155 - Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers.

1.04 SUBMITTALS

A. Conform to Section 01330 – Submittal Procedures.

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/dustproofer.

3. Epoxy floor topping.

4. Abrasive aggregate.

5. Epoxy penetrating sealer.

6. Latex bonding agent.

7. Bond agent used in lieu of bonding grout.

8. Compounds used in lieu of or addition to patching mortar.

9. Epoxy adhesive.

10. Spray-applied coating.

11. Evaporation retardant.

12. High strength concrete topping.

13. Ferrous concrete topping.

C. Submit clarifier or thickener equipment manufacturer's recommendations for use of equipment during concrete topping screeding operations, including details of any temporary screed blades that may be attached to the sludge scraper arms.

PART 2 - PRODUCTS

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 D 4587. Conform to local, state, and federal solvent emission requirements.

B. Epoxy Floor Topping: Two-component epoxy resin meeting ASTM C 881, 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 Nonslip 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 nonglazing, 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, nonslip.

E. Latex Bonding Agent: Non-redispersable latex base liquid conforming to ASTM C 1059. 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 C 144 but with 100 percent passing No. 30 mesh sieve. Mix with water to consistency of thick cream. At the 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 C 881, Type VI. Epoxy used as a bonding agent for fresh concrete shall meet ASTM C 881, Type V.

I. Nonshrink Grout: See Section 03600 – Structural Grout.

J. Spray-Applied Coating: "Thoroseal Plaster Mix" by BASF Construction Chemicals (formerly Thoro System Products) or approved 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" by BASF Construction Chemicals (formerly Master Builders), "EucoBar" by Euclid Chemical Company, or approved equal.

N. High Strength Concrete Topping: "Emaco T430" by BASF Construction Chemicals (formerly Master Builders).

O. Ferrous Concrete Topping: "Mastertop Anvil-Top 300" by BASF Construction Chemicals (formerly Master Builders).

PART 3 - EXECUTION

3.01 AGGREGATE CONCEALMENT

A. Unless indicated otherwise on Drawings or approved by the City Engineer, 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. Remove honeycombed and other defective concrete down to sound concrete but in no case to a depth less than one 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 that 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 Section 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 nonshrink 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 prior to making repairs.

D. Structural Repair: When required, make structural repairs after prior approval of the City Engineer 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 that 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 that 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.

3.04 HOT WEATHER FINISHING

A. When hot weather conditions exist, as defined by Section 03310 – Structural Concrete and as judged by the City Engineer, 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. Unless indicated otherwise, use Class B finish for all slab surfaces.

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
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 amplitude measured between high and low points with use of a 3-foot long straightedge. Notify the City Engineer 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. 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 that is relatively free of defects but that 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 that might show through covering by grinding.

3. Provide trowel finish for floors that 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: Independent testing laboratory will 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 that is relatively free of defects but that 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 that 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. Where topping or fill is to be cast against old concrete (any concrete that is greater than 60 days of age), thoroughly clean and mechanically profile the entire surface of the old concrete to a 1/4-inch amplitude roughened surface measured between high and low points with use of a 3-foot long straightedge. Pressure water blast areas to receive concrete topping no more than 48 hours before placement of concrete topping. Mechanically remove oil, grease, asphalt, paint, clay stains, or other contaminants, leaving clean surface.

2. Saturate roughened slab surface for 24 hours prior to placement of topping or fill. Surface shall be damp but free of standing water at time of application of concrete topping. 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. In hot or windy weather, coat surface with evaporation retardant as needed between finishing operations to prevent plastic shrinkage cracks.

3. Apply concrete topping manually to approximate thickness required, and screed topping to true surface using installed equipment in accordance with the approved recommendations of the manufacturer of the clarifier or thickener equipment. Temporary screed blades may be installed on sludge scraper arms to facilitate screeding operations, and weight may be added to sludge scraper arms to prevent them from riding up during the screeding operation. Protect equipment from damage during sweeping-in process and clean equipment of deposits of fresh concrete after screeding operation is completed. Perform sweeping-in process under supervision of equipment manufacturer's factory representative. Continue screeding operations until surface conforms accurately to blade profiles on sludge raking arm. 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. Unless otherwise approved by the City Engineer, after the topping is set and sufficiently hard to the point that damage will not occur, fill the clarifier or thickener with sufficient water to cover the entire floor for 14 days of water curing.

5. Provide bonded concrete topping in bottom of all clarifiers and thickeners.

6. Prevent fresh concrete topping materials from entering the sludge removal opening in the bottom of the clarifier or thickener. Remove any materials that fall into the sludge removal opening or any fresh concrete topping materials deposited on the walls of the clarifier or thickener.

7. Follow hot weather or cold weather concreting procedures as required in according with Section 03310 – Structural Concrete.

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 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. 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 nonslip 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 the City 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 E 1155.

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."

$$F_F = \frac{4.57}{\text{Maximum difference in elevation, in decimal inches, between successive 12-inch elevation differences.}}$$

b. FL defines relative conformity of floor surface to horizontal plane as measured over 10-foot distance. FL 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 City Engineer): 2/3 of specified

tolerance.

4. Tolerance for floated finish: FF20/FL17, unless otherwise shown on Drawings.

5. Tolerance for troweled finish: FF25/FL20 for slabs-on-grade, and FF25/FL17 for elevated slabs, unless otherwise shown on Drawings.

3.13 CURING

A. Conform to requirements of Section 03390 – Concrete Curing.

END OF SECTION

Section 03390

CONCRETE CURING

PART 1 - GENERAL

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 REFERENCES

A. ACI 308.1 - Standard Specification for Curing Concrete.

B. ASTM C 171 - Standard Specification for Sheet Materials for Curing Concrete.

C. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

D. ASTM C 1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

E. ASTM D 4587 - Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings.

1.04 DEFINITIONS

A. Mass Concrete: Concrete sections 4 feet or more in least dimension.

1.05 SUBMITTALS

A. Conform to Section 01330 – Submittal Procedures.

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 - PRODUCTS

2.01 MATERIALS

A. Membrane-Forming Curing Compound: Conform to ASTM C 309 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 ASTM C 309, Type 2, Class B, white-pigmented. For all other applications, curing compound shall be ASTM C 309, Type 1D, Class B, clear with fugitive dye.

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 C 1315, 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 D 4587. Sodium silicate compounds are not permitted. Conform to local, state, and federal solvent emission requirements.

C. Sheet Material for Curing Concrete: ASTM C 171; 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 - EXECUTION

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. When applying, apply two coats with the second coat

applied at right angles to the first coat. 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 City Engineer.

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. If recommended by the manufacturer, use mechanical means to remove the curing compound prior to application of any type of concrete topping, flooring, roofing, or coating.

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 days. 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 03410

PRECAST CONCRETE HOLLOW-CORE PLANKS

PART 1 – GENERAL

1.01. SECTION INCLUDES

A. Structural precast, prestressed hollow-core concrete slab units.

B. Related Sections include the following:

1. Section 03310 "Cast-in-Place Concrete" for installing connection anchors and reinforcing steel in concrete and structural topping.
2. Section 05501 "Metal Fabrications" for furnishing and installing loose hardware items.
3. Section 07920 "Caulking and Sealants" for elastomeric joint sealants and sealant backings between slab edges at exposed underside of floor and roof members and/or perimeter of members.

1.02. MEASUREMENT AND PAYMENT

A. Unit Prices

1. No separate payment will be made for railing under this section. Include payment in Lump Sum with price breakdown included in the Schedule of Values.
2. Refer to Section 01270 – Measurement and Payment and Section 01292 – Schedule of Values.

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

1.03. PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide structural precast concrete members and connections capable of withstanding the following design within limits and under conditions indicated:

1. Dead Load: 10 pounds per square foot in addition to weight of precast concrete hollow-core planks. Includes weight of roofing materials on top of planks plus suspended collateral loads at bottom of planks.

2. Roof Live Load: 20 pounds per square foot, reducible.
3. Basic Ground Snow Load: 5 pounds per square foot.
4. Wind Loads: Per ASCE 7-05 Minimum Design Loads for Buildings, Basic Wind Speed = 110 mph, Occupancy Category III, Importance Factor = 1.15, Surface Roughness Category C, Wind Exposure Category C, Topographic Factor = 1.0, Internal Pressure Coefficient = ±0.18.
5. Seismic Loads: Per ASCE 7-05 Minimum Design Loads for Buildings, Occupancy Category III, Importance Factor = 1.25, Mapped Accelerations S_S = 0.10g and S_1 = 0.04g, Design Accelerations S_{DS} = 0.11g and S_{D1} = 0.06g, Site Class D, Seismic Design Category A.
6. Design structural precast concrete framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements. Maintain structural precast concrete deflections within limits of ACI 318.
7. Thermal Movements: Provide for thermal movements noted.
   a. The precast system design shall consider the maximum seasonal climatic temperature change based on the latest edition of PCI MNL 120.
   b. Member and connection design shall consider through thickness thermal gradients as appropriate.

1.04. SUBMITTALS

A. Product Data: For each type of product indicated. Retain quality control records and certificates of compliance for 5 years after completion of structure.

B. Design Mixtures: For each precast concrete mixture. Include compressive strength.

C. Shop (Erection) Drawings:

1. Detail fabrication and installation of structural precast concrete units including connections at member ends and to each adjoining member.
2. Indicate locations, plan views, elevations, dimensions, shapes, and cross sections of each unit, openings, support conditions and types of reinforcement, including special reinforcement.
3. Indicate aesthetic intent including joints, rustications or reveals, and extent and location of each surface finish.

4. Indicate welded connections by AWS standard symbols. Show size, length, and type of each weld.
5. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.

6. Indicate locations, tolerances and details of anchorage devices to be embedded in or attached to structure or other construction.
7. Include and locate openings larger than 10 in. Where additional structural support is required for openings include header design.
8. Coordinate and indicate openings and inserts required by other trades.
9. Indicate location of each structural precast concrete member by same identification mark placed on unit.
10. Indicate relationship of structural precast concrete members to adjacent materials.
11. Indicate locations and details of joint treatment.
12. Indicate multiple wythe connection devices.
13. Indicate shim sizes and grouting sequence.
14. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, notify the Engineer and submit design calculations and Shop Drawings. Do not affect the appearance, durability or strength of members when modifying details or materials. Maintain the general design concept when altering size of members and alignment.

D. Provide handling procedures, erection sequences, and for special conditions provide temporary bracing and shoring plan.

E. Comprehensive engineering design signed and sealed by a qualified professional engineer responsible for its preparation licensed in the State of Texas.

1.05. INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include list of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. Welding Certificates: Copies of certificates for welding procedure specifications (WPS) and personnel certification.

C. Material Test Reports for aggregates: From an accredited testing agency, indicating and interpreting test results for compliance with requirements indicated.

D. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements.

1. Cementitious materials.
2. Reinforcing materials and prestressing tendons.
3. Admixtures.
4. Bearing pads.
5. Structural-steel shapes and hollow structural sections.
6. Insulation.
7. Other components specified in Contract Documents with applicable standards.

1.06. QUALITY ASSURANCE

A. Erector Qualifications: A precast concrete erector Qualified by the Precast/Prestressed Concrete Institute (PCI) prior to beginning work at the jobsite. Submit a current Certificate of Compliance furnished by PCI designating qualification in Category S1 (Simple Structural Systems) for horizontal decking members and single-lift wall panels.

B. Erector Certification: A precast concrete erector with erecting organization and all erecting crews Certified and designated, prior to beginning work at project site, by PCI's Certificate of Compliance to erect Category S1 (Simple Structural Systems) for horizontal decking members and single-lift wall panels.

C. Fabricator Qualifications: A firm that complies with the following requirements and is experienced in producing structural precast concrete units similar to those indicated for this Project and with a record of successful in-service performance.

1. Assumes responsibility for engineering structural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
2. Professional Engineer Qualifications: A professional engineer licensed in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are

defined as those performed for installations of structural precast concrete that are similar to those indicated for this Project in material, design, and extent.

3. Participates in PCI's Plant Certification program at the time of bidding and is designated a PCI-certified plant for Group C, Category C2 – Prestressed Hollow-Core and Repetitive Products.
4. Has sufficient production capacity to produce required members without delaying the Work.
5. Certification shall be maintained throughout the production of the precast concrete units. Production shall immediately stop if at any time the fabricator's certification is revoked, regardless of the status of completion of contracted work. Production will not be allowed to re-start until the necessary corrections are made and certification has been re-established. In the event certification(s) can not be re-

   established in a timely manner, causing project delays, the fabricator, at no additional cost, will contract out the remainder of the units to be manufactured at a PCI certified plant.
6. Is registered with and approved by authorities having jurisdiction.

D. Testing Agency Qualifications: An independent accredited testing agency, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated.

E. Design Standards: Comply with ACI 318 (ACI 318M) and the design recommendations of PCI MNL 120, "PCI Design Handbook – Precast and Prestressed Concrete," applicable to types of structural precast concrete members indicated.

F. Quality-Control Standard: For manufacturing procedures and testing requirements and quality control recommendations for types of members required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Concrete Products."

   1. Comply with camber and dimensional tolerances of PCI MNL 135, "Tolerance Manual for Precast and Prestressed Concrete Construction."

G. Product Options: Drawings indicate size, profiles and dimensional requirements of precast concrete members and are based on the specific types of members indicated. Other fabricators' precast concrete members complying with requirements may be considered. Refer to Division 1 Section "Substitutions."

H. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code – Steel"; AWS D1.4, "Structural Welding Code – Reinforcing Steel"; and AWS D1.6, "Structural Welding Code-Stainless".

1.07. DELIVERY, STORAGE, AND HANDLING

A. Deliver all structural precast concrete members in such quantities and at such times to assure compliance with the agreed upon project schedule and setting sequence to ensure continuity of installation.

B. Handle and transport members in a manner to avoid excessive stresses that could cause cracking or other damage.

C. Store units with adequate dunnage and bracing, and protect units to prevent contact with soil, staining, and to control cracking, distortion, warping or other physical damage.

D. Unless otherwise specified or shown on Shop Drawings, store members with dunnage across full width of each bearing point.

E. Place stored members so identification marks are clearly visible, and units can be inspected.

F. Place dunnage of even thickness between each member.

G. Lift and support members only at designated points indicated on the Shop Drawings.

1.08. SEQUENCING

A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 – PRODUCTS

2.01. FORM MATERIALS

A. Forms: Rigid, dimensionally stable, nonabsorptive material, warp and buckle free, that will provide precast concrete surfaces within fabrication tolerances

indicated; nonreactive with concrete and suitable for producing required surface finishes.

1. Form-Release Agent: Commercially produced form-release agent that will not bond with, stain or affect hardening of precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

2.02. REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Steel Bar Mats: ASTM A 184, fabricated from ASTM A 615, Grade 60, deformed bars, assembled with clips.

C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, or ASTM A 1064, fabricated from as-drawn steel wire into flat sheets.

D. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, or ASTM A 1064, flat sheet.

E. Supports: Use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

2.03. PRESTRESSING TENDONS

A. Prestressing Strand: ASTM A 416, Grade 250 or Grade 270, uncoated, 7-wire, low-relaxation strand or ASTM A 886, Grade 270, indented, 7-wire, low-relaxation strand (including supplement).

B. Unbonded Post-Tensioning Strand: ASTM A 416, Grade 270, 7-wire, low-relaxation strand with corrosion inhibitor conforming to ACI 423.7, with polypropylene tendon sheathing. Include anchorage devices.

C. Prestressing Strand: ASTM A 910, Grade 270, uncoated, weldless, 2-and 3-wire, low relaxation strand.

D. Post-Tensioning Bars: ASTM A 722, uncoated high strength steel bar.

2.04. CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or III.

1. For surfaces exposed to view in finished structure, use same type, brand, and mill source throughout the precast concrete production.

B. Supplementary Cementitious Materials

1. Fly Ash: ASTM C 618, Class C or F with maximum loss on ignition of 3%.

C. Normalweight Aggregates: Except as modified by PCI MNL 116, ASTM C 33, with coarse, non-reactive aggregates complying with Class 4S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

D. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.

E. Air Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

1. Water-Reducing Admixture: ASTM C 494, Type A.
2. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
3. Water-Reducing and Accelerating Admixture ASTM C494, Type E.
4. High Range, Water-Reducing Admixture: ASTM C 494, Type F.

2.05. GROUT MATERIALS

A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144, or ASTM C 404. Mix at ratio of 1 part cement to 2 ½ to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content of grout less than 0.06 percent chloride ion by weight of cement when tested in accordance with ASTM C 1218.

B. Nonshrink Grout: Premixed, prepackaged ferrous and non-ferrous aggregate shrink-resistant grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents,

complying with ASTM C 1107, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application with a 30-minute working time. Water-soluable chloride ion content of grout less than 0.06 percent chloride ion by weight of cement when tested in accordance with ATM C1218.

C. Epoxy-resin grout: Two-component mineral-filled epoxy-resin: ASTM C 881 of type, grade, and class to suit requirements.

2.06. CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.

1. Limit use of fly ash to 25 percent replacement of portland cement by weight.

B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at structural precast concrete fabricator's option.

C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 116 when tested in accordance with ASTM C 1218.

D. Normalweight Concrete Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normalweight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi (34.5 Mpa) minimum.
2. Release Strength: as required by design.
3. Maximum Water-Cementitious Materials Ratio: 0.45.

E. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.

F. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

G. Concrete Mixture Adjustments: Concrete mixture design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.07. FORM FABRICATION

A. Form: Accurately construct forms, mortar tight, of sufficient strength to withstand pressures due to concrete placement and vibration operations and temperature changes, and for prestressing and detensioning operations. Coat contact surfaces of forms with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.

B. Maintain forms to provide completed structural precast concrete members of shapes, lines, and dimensions indicated in Contract Documents, within fabrication tolerances specified.

1. Edge and Corner Treatment: Uniformly chamfered or as built-in on standard forms.

2.08. FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement. Do not relocate bearing plates in members unless approved by Architect.

1. Weld headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, hangers, and other hardware shapes for securing precast concrete members to supporting and adjacent construction.

C. Cast-in reglets, slots, and other accessories in structural precast concrete members as indicated on Contract Drawings.

D. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings or prestressing strand without Engineer's approval.

E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy coated reinforcing exceeds limits specified in ASTM A 775, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Locate and support reinforcement by plastic tipped or corrosion resistant metal or plastic chairs, runners, bolsters, spacers, hangers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.
3. Place reinforcing steel and prestressing tendons to maintain at least ¾ in. (19 mm) minimum concrete cover. Provide cover requirements in accordance with ACI 318 when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
4. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces in accordance with ACI 318 and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.

F. Reinforce structural precast concrete members to resist handling, transportation, and erection stresses, and specified in-place loads, whichever governs.

G. Prestress tendons for structural precast concrete members by either pretensioning or post-tensioning methods. Comply with PCI MNL 116.

1. Delay detensioning or post-tensioning of precast prestressed concrete members until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under the same conditions as concrete member.
2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat-cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.

3. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
4. Protect strand ends and anchorage not exposed to view with bitumastic, zinc-rich or epoxy paint.

H. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

I. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete members.

1. Place backup concrete to ensure bond with face-mixture concrete.

J. Thoroughly consolidate placed concrete by vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 116.

1. Place self-consolidating concrete without vibration in accordance with PCI TR-6 "Interim Guidelines for the Use of Self-Consolidating Concrete." If face and backup concrete is used, ensure adequate bond between concrete mixtures.

K. Comply with PCI MNL 116 procedures for hot and cold-weather concrete placement.

L. Identify pickup points of precast concrete members and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast concrete member on a surface that will not show in finished structure.

M. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using live steam or radiant heat and moisture. Cure members until compressive strength is high enough to ensure that stripping does not have an effect on the performance or appearance of final product.

2.09. FABRICATION TOLERANCES

A. Fabricate structural precast concrete members of shapes, lines and dimensions indicated, so each finished member complies with PCI MNL 135 product tolerances as well as position tolerances for cast-in items.

2.10. FINISHES

A. Commercial (Structural) Finishes

1. Commercial Grade: Remove fins and protrusions larger than 1/8 inch (3 mm) and fill holes with a diameter larger than ½ inch (13 mm). Rub or grind ragged edges. Faces shall be true, well-defined surfaces. Air holes, water marks, and color variations are acceptable. Allowable form joint offsets are limited to 3/16 in. (5mm).

B. Screed or float finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish, float finish, if required. Hand screed at projections. Normal color variations, minor indentations, minor chips, and spalls are permitted. No major imperfections, honeycombing, or defects are permitted.

2.11. SOURCE QUALITY CONTROL

A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 116 requirements. If using self-consolidating concrete also test and inspect according to PCI TR-6 "Interim Guidelines for the Use of Self-Consolidating Concrete" and ASTM C 1611, ASTM C 1712, ASTM 1610, and ASTM C 1621.

B. In addition to PCI Certification, Owner will employ an accredited independent testing agency to evaluate structural precast concrete fabricator's quality-control and testing methods.

1. Allow Owner's testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with Owner's testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.

C. Strength of precast concrete members will be considered deficient if units fail to comply with ACI 318 concrete strength requirements.

D. Testing: If there is evidence that strength of precast concrete members may be deficient or may not comply with ACI 318 requirements, fabricator shall employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42 and ACI 318.

1. Test results shall be reported in writing on the same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports shall include the following:

a. Project identification name and number.
b. Date when tests were performed.
c. Name of precast concrete fabricator.
d. Name of concrete testing agency.
e. Identification letter, name, and type of precast concrete member(s) represented by core tests; design compressive strength; type of failure; actual compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

E. Patching: If core test results are satisfactory and precast concrete members comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

F. Acceptability. Structural precast concrete members that do not comply with acceptability requirements in PCI MNL 116, including concrete strength, and manufacturing tolerances, are unacceptable. Chipped, spalled or cracked members may be repaired. Replace unacceptable units with precast concrete members that comply with requirements.

PART 3 – EXECUTION

3.01. PREPARATION

A. Furnish loose connection hardware and anchorage devices for precast concrete members to be embedded in or attached to the building structural frame or foundation before starting that Work. Provide locations, setting diagrams, templates and instructions for the proper installation of each anchorage device.

3.02. EXAMINATION

A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting precast concrete performance.

B. Proceed with precast concrete installation only after unsatisfactory conditions have been corrected.

C. Contractor shall notify precast concrete erector that supporting cast-in-place concrete foundation and building structural framing has attained minimum allowable design compressive strength or supporting steel or other structure is structurally ready to receive loads from precast concrete members prior to proceeding with installation.

3.03. ERECTION

A. Install loose clips, hangers, bearing pads, and other accessories required for connecting structural precast concrete members to supporting members and backup materials.

B. Erect structural precast concrete level, plumb and square within the specified allowable erection tolerances. Provide temporary structural framing, shoring and bracing as required to maintain position, stability, and alignment of members until permanent connections are completed.

1. Install temporary steel or plastic spacing shims or bearing pads as precast concrete members are being erected. Surface weld steel shims to each other to prevent shims from separating.
2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
3. Remove projecting lifting devices and use plastic patchcaps or sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast concrete surfaces when recess is exposed.
4. Unless otherwise indicated provide uniform joint widths of ¾ in.
5. Provide and install headers of structural-steel shapes for openings larger than one slab width according to hollow-core slab fabricator's written recommendations.

C. Connect structural precast concrete members in position by bolting, welding, grouting, or as otherwise indicated on approved Shop (Erection) Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and/or grouting are completed.

1. Disruption of roof flashing continuity by connections is not permitted; concealment within roof insulation is acceptable.

D. Welding: Comply with applicable AWS D1.1, AWS D1.4 and AWS D1.6 requirements for welding, welding electrodes, appearance of welds, quality of welds, and methods used in correcting welding work.

1. Protect structural precast concrete members and bearing pads from damage during field welding or cutting operations and provide noncombustible shields as required.
2. Welds not specified shall be continuous fillet welds, using not less than the minimum fillet as specified by AWS D1.1, D1.4 or D1.6.
3. Clean-weld-affected metal surfaces with chipping hammer followed by brushing or power tool cleaning and then reprime damaged painted surfaces in accordance with manufacturer's recommendations.
4. Visually inspect all welds critical to precast concrete connections. Visually check all welds for completion and remove, reweld or repair all defective welds, if services of AWS-certified welding inspector are not furnished by Owner.

E. At bolted connections, use upset threads, thread locking compound or other approved means to prevent loosening of nuts after final adjustment.

1. Where slotted connections are used, verify bolt position and tightness at installation. For sliding connections, properly secure bolt but allow bolt to move within connection slot.
2. For slip critical connections, one of the following methods shall be used to assure proper bolt pretension:
   a. Turn-of-Nut – in accordance with AISC.
   b. Calibrated Wrench – in accordance with AISC.
   c. Twist-off Tension Control Bolt – meeting ASTM F 1852.
   d. Direct-Tension Control Bolt – meeting ASTM F 1852.
3. For slip critical connections, the method to be used and the inspection procedure to be used shall be approved by the Architect and coordinated with the inspection agency.

F. Grouting or Dry-Packing Connections and Joints: Indicate joints to be grouted and any critical grouting sequences on Shop (Erection) Drawings. Grout open spaces at keyways, connections and joints where required or indicated. Provide reinforcing steel where indicated. Retain flowable grout in place until it gains sufficient strength to support itself. Fill joints completely without seepage to other surfaces. Alternatively, pack spaces with stiff dry pack grout material, tamping until voids are completely filled. Place grout and finish smooth, level,

and plumb with adjacent concrete surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens. Keep grouted joints damp for at least 24 hours after initial set.

1. Trowel top of grout joints on roofs smooth to prevent any unevenness that might interfere with placing of, or cause damage, to insulation and roofing. Finish transitions due to different surface levels not steeper than 1 to 12.
2. At Hollow-Core Slab Ends (where shown on Drawings): Provide suitable end cap or dam in voids as required.

G. Field cutting of precast, prestressed concrete members is not permitted without approval of the Engineer.

H. Fasteners: Do not use drilled or power-actuated fasteners for attaching accessory items to precast, prestressed concrete members unless approved by Precast Engineer and Engineer of Record.

3.04. ERECTION TOLERANCES

A. Erect structural precast concrete members level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135. Level out variations between adjacent members by jacking, loading, or any other feasible method as recommended by the fabricator and acceptable to the Engineer.

3.05. FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections and prepare reports:

1. Erection of loadbearing precast concrete members.

B. Testing: Owner will engage accredited independent testing and inspecting agency to perform field tests and inspections and prepare reports.

1. Field welds will be subject to visual inspections and dye penetrant or magnetic particle testing in accordance with ASTM E 165 or ASTM E 1444. Testing agency shall be qualified in accordance with ASTM E543.
2. Testing agency will report test results promptly and in writing to Contractor and Engineer.

C. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Erector's expense, will be performed to determine compliance of corrected work with specified requirements.

3.06. REPAIRS

A. Repairs will be permitted provided structural adequacy, serviceability and durability of members and appearance are not impaired.

B. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.

C. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

D. Remove and replace damaged structural precast concrete members when repairs do not comply with specified requirements.

3.07. CLEANING

A. Clean mortar, plaster, fireproofing, weld slag, and any other deleterious material from concrete surfaces and adjacent materials immediately.

B. Clean exposed surfaces of precast concrete members after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Protect adjacent work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION

Section 03411

STRUCTURAL PRECAST CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Precast concrete for wet wells, junction structures, valve vaults, and meter vaults as shown on the Drawings. Also includes supporting and connecting devices necessary for proper installation and embedded items shown on the Drawings.

1.02 REFERENCES

A. ACI 301 - Structural Concrete for Buildings.

B. ACI 318 - Building Code Requirements for Structural Concrete

C. ACI 350R - Environmental Engineering Concrete Structures.

D. ANSI/AWS D1.1 - Structural Welding Code.

E. ANSI/AWS D1.4 - Structural Welding Code - Reinforcing Steel.

F. ASTM A 497 - Welded Deformed Steel Wire Fabric for Concrete Reinforcement.

G. ASTM A 36 - Structural Steel.

H. ASTM A 153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

I. ASTM A 615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

J. ASTM A 666 - Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications.

K. City of Houston, Design Guidelines Manual.

L. City of Houston, Engineering Design Manual.

M. PCI MNL-116 - Manual for Quality Control for plans and production of precast and prestressed concrete products.

1.03 DESIGN REQUIREMENTS

A. Design structural precast concrete to conform with City of Houston, Engineering Design Manual, Section 3, Structural Design Criteria.

B. For members exposed to weather, design for movement of components without damage, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to seasonal or cyclic, day/night temperature ranges.

C. Design system to accommodate construction tolerances, deflection of other building structural members, and clearances of intended openings.

D. Design structural precast concrete members in accordance with ACI 350R.

1.04 SUBMITTALS

A. Conform to Section 01330 – Submittal Procedures.

B. Shop Drawings: Indicate layout, unit locations, fabrication details, reinforcement, connection details, support items, dimensions, openings, and relationship to adjacent materials and design calculations signed and sealed by a Professional Structural Engineer licensed in the State of Texas.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with the requirements of PCI MNL-116 and ACI 301.

1.06 QUALIFICATIONS

A. Fabricator: Company specializing in manufacturing precast concrete components with minimum 5 years documented experience.

B. Erector: Company specializing in erecting precast concrete components with 5 years documented experience and approved by manufacturer.

C. Welder: Qualified within previous 12 months in accordance with AWS D1.1 and AWS 1.4.

D. Design precast concrete members under direct supervision of a Professional Structural Engineer experienced in design of structural precast concrete components and licensed in the State of Texas.

1.07 REGULATORY REQUIREMENTS

A. Conform to ACI 318, ACI 350R and City of Houston Design Guidelines and Engineering Design Manual for design load and construction requirements applicable to work of this section.

1.08 DELIVERY, STORAGE, AND PROTECTION

A. Deliver, store, protect, and handle products at the site under provisions of Section 01600 - Material and Equipment.

B. Handle precast members in position consistent with their shape and design. Lift and support only from support points.

C. Lifting or Handling Devices: Capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.

D. Protect members to prevent staining, chipping, or spalling of concrete.

E. Mark each member with date of production and final position in structure.

PART 2 P R O D U C T S

A. Cement, Gray Portland, conforming to ASTM C 150 Type II.

B. Aggregate, Sand, Water, Admixtures: Determined by precast fabricator as appropriate to design requirements and PCI MNL-116 and Section 03310 - Structural Concrete.

2.01 REINFORCEMENT

A. Reinforcing Steel: ASTM A 615 Grade 60, deformed steel bars.

B. Welded Steel Wire Fabric: ASTM A 497 Welded Deformed Type; in flat sheets; unfinished.

2.02 ACCESSORIES

A. Connecting and Supporting Devices: ASTM A 666 stainless steel plates, angles, items cast into concrete.

B. Grout: Non-shrink, non-metallic, minimum compressive strength of 7000 psi at 28 days conforming to Section 03600 - Structural Grout.

2.03 FABRICATION

A. Fabrication procedure to conform to PCI MNL-116 and ACI 318.

B. Maintain plant records and quality control program during production of precast members. Make records available upon request.

C. Ensure reinforcing steel, anchors, inserts, plates, angles, and other cast-in items are embedded and located as indicated on shop drawings.

D. Provide required openings with a dimension larger than 10 inches and embed accessories, provided by other Sections, at indicated locations.

2.04 FINISHES

A. Finish members to PCI MNL-116 Commercial Finish A grade.

2.05 FABRICATION TOLERANCES

A. Conform to PCI MNL-116.

B. Maximum Out-of-Square: 1/8 inch/10 feet, non-cumulative.

C. Maximum Out of-Round: 1/8 inch/10 feet diameter, non-cumulative.

D. Maximum Misalignment of Anchors, Inserts, Openings: 1/8 inch.

2.06 SOURCE QUALITY CONTROL AND TESTS

A. Test samples in accordance with applicable ASTM standard and as required by Section 03310 - Structural Concrete.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify that site conditions are ready to receive work and field measurements are as shown as on shop drawings.

3.02 PREPARATION

A. Prepare support equipment for the erection procedure, temporary bracing, and induced loads during erection.
B. Prepare a means of protection of PVC liner and embeds from damage during construction, transportation, and erection.

3.03 ERECTION

A. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.

B. Align and maintain uniform horizontal and vertical joints, as erection progresses.

C. Provide continuous resilient waterstop or ASTM C 443 rubber gasket to obtain watertight joint between precast units.

D. Set vertical units dry, without grout, attaining joint dimension with lead or plastic spacers.

E. Grout joints between precast units before caisson sinking proceeds.

F. Secure units in place with connection plates before caisson sinking proceeds.

G. Perform welding in accordance with AWS D1.1.

3.04 ERECTION TOLERANCES

A. Erect members level and plumb within allowable tolerances.

B. Conform to PCI MNL-116.

3.05 PROTECTION

A. Protect members from damage caused by field welding or erection operations.

B. Provide non-combustible shields during welding operations.

3.06 CLEANING

A. Clean weld marks, dirt, or blemishes from surface of exposed members.

END OF SECTION

Section 03600

STRUCTURAL GROUT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Nonshrink grout used wherever grout is shown in the Documents, unless another type is specifically referenced. Two classes of nonshrink grout (Class I and II) and areas of application are specified.

1.02 UNIT PRICES

A. Include the cost for grout in the lump sum for each structure in which it will be used. No separate payment will be made for grout.

B. Measurement for extra grout (Class I and II) is on cubic foot basis. Payment includes associated work performed in accordance with related sections included in the Contract Documents.

C. Refer to Section 01270 – Measurement and Payment for unit price procedures.

1.03 REFERENCES

A. ASTM C 109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or 50-mm Cube Specimens).

B. ASTM C 230 - Standard Specification for Flow Table for Use in Tests of Hydraulic Cement.

C. ASTM C 939 - Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Mehod).

D. ASTM C 1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

1.04 SUBMITTALS

A. Conform to Section 01330 – Submittal Procedures.

B. Quality Control:

1. The Contractor shall submit manufacturer's literature certifying compliance with the specified properties for Class I and II grouts.

2. The Contractor shall submit manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the work.

C. The Contractor shall submit manufacturer's written warranty as specified.

1.05 QUALITY ASSURANCE

A. Field Tests:

1. Compression test specimens will be taken during construction from the first placement of each type of grout, and at intervals thereafter as selected by the City Engineer to ensure continued compliance with these Specifications. The specimens will be made by the City Engineer or the City's Designated Representative.

2. Compression tests and fabrication of specimens for nonshrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the City Engineer. A set of three specimens will be made for testing at 7 days, 28 days, and each additional time period as appropriate.

3. Grout already placed which fails to meet the requirements of these Specifications is subject to removal and replacement no additional cost to the City.

4. The cost of laboratory tests on grout will be borne by the City, but the Contractor shall assist the City Engineer in obtaining specimens for testing. However, the Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. The Contractor shall supply materials necessary for fabricating the test specimens.

B. Warranty:

1. Provide one-year warranty for work provided under this Section.

2. Manufacturer's warranty shall not contain a disclaimer limiting responsibility to only the purchase price of products or materials furnished.

3. Manufacturer shall warrant participation with the Contractor in replacing or repairing grout found to be defective due to faulty materials, as determined by industry standard test methods.

PART 2 - PRODUCTS

2.01 APPLICATION

A. The following is a listing of typical applications and the corresponding type of grout which is to be used. Unless indicated otherwise, grouts shall be provided as listed below whether or not called for on the Drawings.

Application:	Type of Grout
Structural member base plates	Nonshrink Class II
Storage tanks and other equipment	Nonshrink Class I
Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.	Nonshrink Class II (Class I where placement time exceeds 15 minutes)
Under precast concrete elements	Nonshrink Class I
Toppings and concrete fill less than 3 inches thick	Concrete Topping per Section 03310 and Section 03350
Toppings and concrete fill greater than 3 inches thick	Concrete Fill per Section 03310 and Section 03350
Any application not listed above, where grout is called for on the Drawings	Nonshrink Class I, unless noted otherwise

B. PREPACKAGED GROUTS

A. Basic Requirements for Cementitious Nonshrink Grout:

1. Provide prepackaged nonshrink grout that is inorganic, flowable, non-gas-liberating, non-metallic, and cement-based, requiring only the addition of water.

2. Deliver grout in original packaging with manufacturer's instructions printed on each container.

3. Select the specific formulation for each class of nonshrink grout specified to conform to that recommended by the manufacturer for the particular application.

4. Compressive strength at 28 days: 7,000 psi minimum.

5. Do not use a grout for which the nonshrink property is based on a chemically generated gas or gypsum expansion.

B. Class I Nonshrink Grout:

1. Supply Class I Grout conforming to these specifications and to ASTM C 1107 Grade C and B (as modified below) when tested using the amount of water needed to achieve the following properties:

a. Fluid consistency (20 to 30 seconds) per ASTM C 939 at initial testing.

b. Fluid consistency (45 seconds) per ASTM C 939 at 30 minutes after mixing.

c. At temperatures of 45, 73.4, and 95 degrees F.

2. To satisfy nonshrink requirements, the length change from placement to time of final set shall not have a shrinkage greater than the amount of expansion measured after final set at 3 and 14 days. The expansion at 3 and 14 days shall not exceed the 28-day expansion.

3. Fluid grout shall pass through the flow cone, with a continuous flow, 1 hour after mixing.

4. Demonstrate in tests that grout maintains contact with the baseplate to provide an minimum effective bearing area of 95 percent of the gross contact area after final set.

5. The grout packaging shall list weight, maximum amount of mixing water to be used, maximum usable working time (pot life) at flowable consistency, and temperature restrictions for preparation and placement within which grout will meet specified requirements.

C. Class II Nonshrink Grout:

1. Supply Class II Grout confirming to ASTM C 1107 and the following requirements when tested using the amount of water needed to achieve the following properties:

a. Flowable consistency: 140 percent flow on ASTM C 230, five drops in 30 seconds.

b. Fluid working time: 15 minutes, minimum.

c. Flowable duration: 30 minutes, minimum.

2. When tested, the grout shall not bleed at maximum allowed water.

C. CURING MATERIALS

A. Curing materials: As specified in Section 03390 – Concrete Curing and as recommended by the manufacturer of prepackaged grouts.

D. CONSISTENCY

A. Mix grouts to the consistency necessary to completely fill the space to be grouted. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as specified herein for the particular application.

PART 3 - EXECUTION

3.01 PREPARATION

A. Verify that base concrete or masonry has attained design strength before grout is placed.

B. When cementitious grouts are used on concrete surfaces, saturate the concrete surface with water for 24 hours prior to placement of cement-based grout. Upon completion of saturation period remove excess water prior to grouting.

3.02 GROUTING PROCEDURES

A. Prepackaged Grouts: Perform mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts according to the written instructions of the manufacturer. Use prepackaged materials in the quantities and proportions as directed by the manufacturer unless there is certified test data verifying that the specified properties are attained by modified mix.

3.03 CONSOLIDATION

A. Place grout in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

END OF SECTION

Section 03931

CONCRETE REPAIR AND REHABILITATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Repair of concrete cracks, holes, and surface defects, and repair of deteriorated concrete surfaces.

B. Installation of embedded items into existing concrete.

1.02 UNIT PRICES

A. Measurement for repair materials is on a lump-sum basis for each structure as bid. Payment includes work performed on these structures in accordance with related sections included in the Contract Documents.

B. Measurement for extra removal of deteriorated concrete and placement of repair mortar is on a cubic-foot basis. Measurement for other repair materials is as defined in the appropriate related sections. Payment includes associated work performed in accordance with related sections included in the Contract Documents.

C. Refer to Section 01270 – Measurement and Payment for unit price procedures.

1.03 REFERENCE STANDARDS

A. ASTM C 109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens).

B. ASTM C 881 – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

C. ASTM C 882 – Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.

1.04 SUBMITTALS

A. Under provisions of Section 01330 – Submittal Procedures, submit manufacturer's product information, installation instructions and recommendations, and certification of compliance with required properties for all repair materials.

1.05 REPAIR SCOPE

A. Patch and fill openings in existing concrete indicated to be patched or filled.

B. Patch, fill holes in, and otherwise repair damage to concrete and concrete surfaces resulting from removal of penetrating pipes and other embedded items, from installation of pipes or other items embedded in or passed through concrete, and from other construction activities.

C. Crack Repair: Repair the full length of cracks in concrete members in new structures, and in existing structures as indicated on Drawings.

D. Deteriorated Concrete:

1. Repair interior concrete surfaces showing signs of deterioration in existing structures as indicated on Drawings.

2. The level of deterioration of the concrete varies within each of the indicated structures. For bidding purposes, average depth of deteriorated concrete walls and undersides of top slabs is assumed to be one inch. Repair for the portion exceeding one inch in depth, as measured from the existing wall surface, will be paid as extra work as defined above.

E. Make other repairs to existing structures as indicated on Drawings.

1.06 QUALITY ASSURANCE

A. Field Tests of Cement-based Grouts:

1. Compression test specimens will be prepared during construction by the City Engineer, or the City's Authorized Representative, from the first placement of each type of mortar or grout, and at intervals thereafter as determined by the City Engineer, to ensure continued compliance with these specifications.

2. Specimen preparation and compression testing for repair mortar and nonshrink grout will be performed as specified in ASTM C 109. A set of three specimens will be made for testing at 7 days, 28 days, and additional testing as appropriate.

3. Material failing to meet Contract requirements is subject to removal, and replacement with new material meeting requirements, at no additional cost to the City.

4. Cost of laboratory tests on mortar and grout will be borne by the City, except Contractor shall pay for tests failed, and additional testing and investigation work performed because of work not meeting Contract requirements.

5. Contractor shall supply all materials necessary for fabricating test specimens and assist the City Engineer in obtaining specimens for testing.

B. Repair concrete shall be tested as required in Section 03310 – Structural Concrete.

C. Epoxy grout shall be tested as required in Section 03600 – Structural Grout.

D. Chemical Grout:

1. Repair interior concrete surfaces showing signs of deterioration in existing structures as indicated on Drawings.

2. The level of deterioration of the concrete varies within each of the indicated structures. For bidding purposes, average depth of deteriorated concrete walls and undersides of top slabs is assumed to be one inch. Repair for the portion exceeding one inch in depth, as measured from the existing wall surface, will be paid as extra work as defined above.

E. Construction Tolerances: As specified in Section 03100 – Concrete Formwork, and Section 03350 – Concrete Finishing, except as otherwise indicated.

1.07 WEATHER LIMITATIONS

A. Halt work when weather conditions detrimentally affect the quality of patching or bonding concrete. Apply epoxy resin materials only when the contact surfaces are completely dry and if the atmospheric and surface temperature ranges are suitable for the specified epoxy material. Follow manufacturer's instructions for weather conditions and temperature ranges.

PART 2 PRODUCTS

2.01 REPAIR MORTAR

A. Repair Mortar: Prepackaged polymer-modified cement-based product specifically formulated for repair of surface defects in concrete, having the following properties:

Physical Property	Value	ASTM Standard
Compressive Strength (minimum)		C 109
1 day	2000 psi	
28 days	6000 psi	
Bond Strength (minimum)		C 882 (modified)
1 day	1200 psi	
7 days	2000 psi	

B. Manufacturer and Product: "Emaco" by BASF Construction Chemicals (formerly Master Builders), "Euco" by Euclid Chemical Company, "Sikacem" by Sika Corporation, "Five Star Structural Concrete" by Five Star Products, Inc., or equal. Where the manufacturer offers products in formulations intended for specific application conditions such as overhead and shotcrete application, use the formulation recommended by the manufacturer for the condition required.

C. Minimum Repair Thickness: 0.50 inch.

2.02 NONSHRINK GROUT

A. Nonshrink Grout: Comply with requirements of Section 03600 – Structural Grout.

2.03 CONCRETE MATERIALS

A. Cement: Type II Portland cement, unless indicated otherwise. Where repairs are made on wall surfaces exposed to view and above normal water surface

elevation, blend white Portland cement with Type II cement as needed to match the color of adjacent existing concrete surface.

B. Repair Concrete: Class A (4000 psi) concrete with one-inch maximum coarse aggregate, complying with Section 03310 – Structural Concrete; minimum repair thickness, 2 inches.

C. Cement Grout: Comply with Section 03600 – Structural Grout; minimum repair thickness, one inch.

D. Curing Materials, Bonding Agents, and Other Miscellaneous Materials: Comply with Section 03310 – Structural Concrete and Section 03390 – Concrete Curing.

2.04 AGGREGATE

A. Aggregate for Extending Repair Mortar and Nonshrink Grout Products: 3/8 inch clean washed gravel or crushed stone complying with Section 03390 – Concrete Curing.

2.05 CHEMICAL GROUT

A. Chemical Grout: Hydrophobic urethane or polyurethane material of low viscosity suitable for pumped injection into cracks, which reacts with water to form a closed-cell foam material that completely fills and seals all cracks against leakage. Cured material shall remain elastic and maintain an expansive pressure through repeated wet-dry cycles.

B. Manufacturer and Product: "Scotch-Seal 5600" by the Adhesives, Coatings, and Sealers Division of 3M Products, "Hydro Active Flex LV" by De Neef America, Inc., "SikaFix" by Sika Corporation, or equal. Use different formulations in the same family of materials, accelerators, and other materials necessary for installation where recommended by the manufacturer for specific application conditions.

C. Reacted and cured chemical grout shall be resistant to organic solvents, mild acids, alkali, and micro-organisms. Cured material shall be approved for use with potable water by the appropriate federal, state, or local government agency.

2.06 EPOXY PRODUCTS

A. Epoxy Grout: Comply with Section 03600 – Structural Grout, modified as specified herein.

B. Epoxy for Crack Injection: ASTM C 881, Type IV; low viscosity, moisture-insensitive material specifically formulated for that use; 2500 psi minimum bond strength when tested in accordance with ASTM C 882 at 14 days, moist cured.

2.07 SEALANT

A. Sealant: 2-part polyurethane.

2.08 FORMWORK

A. Formwork, Where Needed: Comply with Section 03100 – Concrete Formwork.

2.09 REINFORCEMENT

A. Reinforcement, Where Required: Comply with Section 03211 – Reinforcing Steel.

2.10 RESILIENT WATERSTOP

A. Resilient Waterstop.

PART 3 EXECUTION

3.01 PREPARATION AND CURING

A. Where repairs are made on wall surfaces exposed to view and above normal water surface elevation, installed repair material shall match adjacent concrete surface in color.

B. Surface Preparation:

1. Clean entire area to be repaired of laitance, foreign material, and loose or deteriorated concrete by chipping, hydroblasting, or sandblasting; further roughen surfaces as specified herein. Where nonshrink grout or repair mortar is used, perform any additional surface preparation steps recommended by the manufacturer.

2. Where cementitious repair materials are used, maintain surfaces to be repaired in a saturated surface dry condition and prevent concrete from drying until repair operations are completed. Re-wet surfaces to be repaired by water spray on at least a daily basis. Remove standing water in areas to be repaired prior to placement of repair material. Provide means to remove excess water from the structure.

3. Where repair material manufacturer recommends use of an epoxy bonding agent, follow recommendations of both the repair material and epoxy bonding agent manufacturers.

C. Fully consolidate repair material, completely filling all portions of areas to be filled.

D. Bring repair surfaces into alignment with adjacent existing surfaces to provide uniform, even surfaces. Unless indicated otherwise, repair surfaces shall match adjacent existing surfaces in texture and receive coatings or surface treatments provided for adjacent existing surfaces.

E. Curing:

1. Cure repair mortar and nonshrink grout according to manufacturer's recommendations, except that minimum cure period shall be 3 days.

2. Cure other materials in accordance with Section 03390 – Concrete Curing.

3. If manufacturer recommends use of a curing compound, use no material that would interfere with the bond of any coating or adhesive required to be applied to the surface.

3.02 TREATMENT OF SURFACE DEFECTS

A. Definition - Surface Defects: Depressions in concrete surfaces not extending all the way through a member, caused by physical damage, unrepaired rock pockets created during original placement, spalling due to corroded reinforcing steel or other embeds, or removal of embedded items or intersecting concrete members.

B. Preparation:

1. Remove loose, damaged concrete by chipping to sound material.

2. Where existing reinforcing bars are exposed, remove concrete at least one inch deep all around the exposed bars. If the existing bars are cut through, cracked, or cross-sectional area is reduced by more than 25 percent, notify the City Engineer immediately.

C. Repair Material:

1. Use only repair mortar to repair surface defects in members normally in contact with water or soil, and defects in interior surfaces of structures that are intended to contain water.

2. Repair of other surface defects may be by application of repair mortar, repair concrete, or cement grout, as appropriate.

3.03 PATCHING OF HOLES IN CONCRETE

A. General:

1. Definition - Holes: For the purposes of this section, holes are defined as penetrations completely through a concrete member, with interior surfaces approximately perpendicular to the surface of the existing member. Chip interior surface areas that are inclined and do not meet this criterion as necessary to meet this requirement.

2. Perimeter of holes at the surface shall form a regular shape composed of curved or straight-line segments. Provide at least the minimum placement depth specified for the material used at all locations. Score existing concrete by sawcutting and chip as needed to meet this requirement.

3. Roughen the interior surface of holes less than 12 inches in diameter to at least 0.125-inch amplitude. Roughen larger holes to at least 0.25-inch amplitude.

4. At holes not filled with repair mortar or nonshrink grout, and where otherwise recommended by the repair material manufacturer, coat existing surfaces to be repaired with epoxy bonding agent.

5. Where a surface of a member is exposed to view and the repair material cannot be adjusted to match the color of the existing concrete, hold back the repair material 2 inches from the surface. Fill the remaining 2 inches with color-adjusted cement grout. Roughen the surface of the repair material when placed to improve bond with the cement grout.

B. Patching Small Holes:

1. Fill holes less than 12 inches in least dimension and extending completely through concrete members with repair mortar or nonshrink grout.

2. Fill holes in members normally in contact with water or soil with Class I nonshrink grout in accordance with Section 03600 – Structural Grout.

C. Patching Large Holes:

1. Fill holes larger than 12 inches in least dimension with repair concrete, repair mortar or nonshrink grout.

2. Provide large holes normally in contact with water or soil and not filled with Class I nonshrink grout with resilient waterstop placed in a groove approximately 0.25 inch deep ground into the interior edge of the hole at the center of the wall providing a smooth surface in which to place the resilient waterstop. Alternatively, bond bentonite waterstop to the surface using an epoxy grout that completely fills all voids and irregularities beneath the waterstop material.

3. Provide reinforcing steel in layers matching existing reinforcement locations, except provide concrete cover required by the Contract Documents for the applicable service condition.

4. For holes smaller than 48 inches, reinforcement shall be at least #5 bars on 12-inch centers in each layer required. At all holes larger than 30 inches, drill and grout the reinforcement into the existing concrete.

5. For holes larger than 48 inches, see the drawings for reinforcement details.

3.04 PATCHING OF LINED HOLES

A. These provisions apply to openings which have embedded material over all or a portion of the inside edge. Requirements for repairing holes in concrete specified above shall apply as modified herein. The City Engineer will determine when the embedded material is allowed to remain.

B. Where embedded material is allowed to remain, trim it back a minimum of 2 inches from the concrete surface. Roughen or abrade the embedded material to promote good bonding to the repair material. Completely remove any substance that interferes with good bonding.

C. Completely remove embedded items not securely and permanently anchored in the concrete.

D. Completely remove embedded items larger than 12 inches in least dimension unless composed of a metal to which reinforcing steel can be welded. Where reinforcement is required, weld it to the embedded metal.

E. The following additional requirements apply to concrete in contact with water or soil.

1. Fill lined openings less than 4 inches in least dimension with epoxy grout.

2. Coat lined openings greater than 4 inches but less than 12 inches in least dimension with an epoxy bonding agent prior to filling with Class I nonshrink grout.

3. Coat lined openings greater than 12 inches in least dimension with an epoxy bonding agent and bond bentonite waterstop to the interior of the opening prior to filling with approved repair material.

3.05 INSTALLATION OF PIPES AND FRAMES

A. The following applies to installation of permanent pipes and frames in openings cut into existing concrete members.

B. Cut opening to a size that is a minimum of one inch and a maximum of 3 inches larger than the outside edge of the embedded item. At openings with sharp corners, take care not to sawcut beyond the opening so as to damage existing reinforcing bars. At openings that are greater than 24 inches in least dimension, chip a keyway into the center of the wall. Keyway shall be at least 1.5 inches in depth and from 3 inches to 1/3 the member thickness in width. All surfaces except at the keyway shall be perpendicular to the member surface as specified herein for patching holes.

C. Provide embedded items with a flange or other positive means of anchorage to repaired members. At members in contact with soil or water, provide continuous waterstop flanges around embeds. Where concrete pipe will be embedded, provide resilient waterstop around pipe at wall centerline.

D. Roughen the interior surface of openings to at least 1/4-inch amplitude. Sandblast the embed surface to be in contact with concrete clean to promote good bonding to the repair material.

E. Fill the space between the frame and the existing concrete with Class I nonshrink grout.

F. Where surface of a member is exposed to view and the repair material cannot be adjusted to match the color of the existing material, hold back the repair material 2 inches from the surface. Fill the remaining 2 inches with color-adjusted cement grout.

3.06 NON-FIXED INSTALLATION OF PIPES

A. The following applies to installation through existing concrete of piping to be sealed with adjustable linked seals, resilient connectors, or packing and sealant.

When more appropriate, the City Engineer may require installation of a sleeve instead of the core-drilled hole specified herein.

B. Size core-drilled opening to permit installation of the required seal; locate to minimize cutting of existing reinforcing steel.

C. Where linked or resilient seals are to be installed, coat the interior surface of the opening with epoxy at least 1/8 inch thick for a smooth and even surface promoting a good seal.

D. Where packing and sealant are required, seal exposed reinforcing bars with at least a 1/8-inch thick layer of epoxy extending 1/2 inch beyond the bars on all sides. Prepare the surface of the cut concrete and the pipe as recommended by the sealant manufacturer.

3.07 GENERAL CRACK REPAIR

A. Repair cracks identified by the City Engineer as caused by shrinkage or thermal movement by injection with chemical grout as specified herein.

B. Repair cracks not caused by shrinkage or thermal movement by epoxy injection or as otherwise directed by the City Engineer.

3.08 CHEMICAL GROUT CRACK REPAIR

A. Inject chemical grout into all cracks as directed by the City Engineer in those structures included in the scope of work listed herein in accordance with the chemical grout manufacturer's installation instructions and recommendations.

B. Location of Injection Ports: Locate injection ports as recommended by the chemical grout manufacturer and as needed to insure complete penetration of the joint or crack with the grout. Spacing of injection ports shall not exceed 2 feet.

C. Drilling Ports: Drill holes for injection ports to the depth needed for proper distribution of the chemical grout. Take care to not damage any reinforcing steel.

D. Port preparation: Clean holes for injection ports of all debris and fit with an injection fitting as provided by the manufacturer of the chemical grout, or equal. Install injection fittings in accordance with manufacturer's instructions; allow fittings to remain in place until chemical grout injection work is complete in that area. Install caps or valves at injection ports to prevent back flow of uncured chemical grout after it has been injected.

E. Chemical Grout Injection:

1. Follow instructions and recommendations of the chemical grout manufacturer and its representatives for chemical grout mixing and injection procedures.

2. Seal cracks at the surface where needed to assure complete penetration of injected chemical grout and prevent loss of material.

3. Prior to chemical grout injection, inject water into ports to provide water for the reaction process, flush out foreign matter and verify continuity between adjacent ports. Inject water into each port until it begins to flow from an adjacent or nearby port.

4. If the water injection procedure indicates the potential presence of voids within members or behind members resting against soil, notify the City Engineer immediately.

5. Beginning at the lowest injection port, inject chemical grout until the grout begins to flow from an adjacent or nearby port. Repeat the process until the crack is completely filled. In general, port-to-port travel of the injection process will be from low to high in a continuous operation.

6. If port-to-port continuity does not occur at locations where continuity was verified through water injection, mark location and notify the City Engineer.

7. Avoid sudden application of high pressure during the injection process.

8. After completion of the grouting operation, remove all ports and surface sealing materials leaving an undamaged surface.

3.09 EPOXY CRACK REPAIR

A. Inject epoxy into all cracks in damaged concrete as indicated by the City Engineer in structures included in the scope of work listed herein. Follow installation instructions and recommendations of the epoxy manufacturer.

B. Inject cracks with sufficient pressure to ensure full penetration of epoxy but without causing further damage.

C. Location, drilling, and preparation of ports for injection: As specified for chemical grout herein.

D. Epoxy Injection:

1. Follow instructions of the epoxy manufacturer and its representatives for all mixing and injection procedures.

2. Seal all cracks at the surface where needed to provide for complete penetration of the injected epoxy and to prevent loss of material.

3. Beginning at the lowest injection port, inject the epoxy until it begins to flow from an adjacent or nearby port. Repeat the process until the crack is completely filled.

4. If port-to-port continuity does not occur, mark the location and notify the City Engineer.

5. Avoid sudden application of high pressure during the injection process.

6. After completion of injection operations, remove all ports and surface sealing materials to leave an undamaged surface.

3.10 REPAIR OF DETERIORATED CONCRETE

A. These provisions pertain to concrete damaged by abrasion, chemical attack, or corrosion of reinforcing steel. The only material acceptable for surface repair is repair mortar as specified herein. Where the repaired surface is to be subsequently covered with a PVC liner or other protective material, coordinate finishing details with the liner material manufacturer.

B. Surface Preparation:

1. Remove loose, broken, softened, and acid-contaminated concrete to sound, uncontaminated concrete.

2. Notify the City Engineer when removal of deteriorated concrete is complete. Schedule two weeks for the City Engineer to inspect the surface, perform testing for acid contamination, determine if additional concrete must be removed, and to develop any special repair details that may be needed. Should it be determined that additional concrete must be removed to reach sound, uncontaminated material, schedule another two-week period for further evaluation after completion of the additional removal.

3. Follow repair mortar manufacturer's instructions for additional surface preparation.

C. Repair Mortar Placement:

1. Follow manufacturer's recommendations for mixing and placement of repair mortar. After the initial mixing of the repair mortar, do not add additional water to change the consistency should the mix begin to stiffen.

2. Place repair mortar to the minimum thickness recommended by manufacturer but not less than 1/2 inch. Should there be areas where less than the minimum repair mortar depth of concrete is removed, the Contractor may remove additional concrete to attain the minimum repair mortar thickness or may place repair mortar so as to increase the original thickness of the member. In any case, add repair mortar so that minimum cover over existing reinforcing steel is 2 inches. Do not place repair mortar so as to create locally raised areas. Where there is a transition with wall surfaces that are not in need of repair, do not feather the repair mortar at the transition. Sawcut a score line to not less than the minimum repair mortar depth and chip concrete out to it to form the transition. Take care not to cut or otherwise damage reinforcing steel.

3. Finish repair mortar in an even, uniform plane to restore the member to its original surface. Out-of-plane tolerance: No localized depressions or projections; 0.25-inch maximum gap between repair mortar surface and a 10-foot straight edge in any orientation at any location.

D. Finishing:

1. Apply a smooth magnesium float finish to repair mortar.

2. When completed: No sharp edges. Exterior corners, such as at penetrations: One-inch radius. Interior corners: Square, except 2-inch repair mortar fillet at corners to receive PVC lining.

END OF SECTION

Section 04062

UNIT MASONRY SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Face brick.

B. Concrete masonry units.

C. Reinforcement, anchorage, and accessories.

1.02 MEASUREMENT AND PAYMENT

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."

1.03 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Section 05500 - Metal Fabrications: Placement of loose steel lintels.

1.04 REFERENCES

A. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

B. ASTM A 123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

C. ASTM A 615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

D. ASTM C 62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale).

E. ASTM C 90 - Standard Specification for Loadbearing Concrete Masonry Units.

F. ASTM C 216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale).

G. UL - Underwriters Laboratories.

1.05 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Submit product data for face brick, concrete masonry units, adjustable ties, and fabricated wire reinforcement.

C. Submit four samples of face brick to illustrate color, texture, and extremes of color range.

D. Submit manufacturer's certificate under provisions of Section 01450 - Contractor's Quality Control, that products meet or exceed specified requirements.

E. Submit manufacturer's installation instructions.

1.06 QUALIFICATIONS

A. Installer: Company specializing in performing the work of this Section with minimum 5 years experience.

1.07 MOCK-UP

A. Erect face brick and concrete masonry units to 3 feet x 4 feet panel size, include specified mortar and accessories.

B. When accepted, mock-up will demonstrate minimum standard for the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products under provisions of Section 01610 - Basic Product Requirements.

B. Accept units on site. Inspect for damage.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Maintain mortar materials temperature to between 40 degrees F and 120 degrees F prior to, and during, masonry work.

B. In hot weather conditions, limit the amount of water that may evaporate from the mortar bed.

PART 2 - PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. Hollow Load Bearing Block Units: ASTM C 90, Grade N, Type I - Moisture Controlled; normal weight.

B. Solid Load Bearing Block Units: ASTM C 145, Grade N, Type I - Moisture Controlled; normal weight.

C. Masonry Units: Nominal modular size of 8" x 16" x 12". Provide special units for 90 degree corners, bond beams, lintels, and bull-nose corners.

2.02 BRICK UNITS

A. Face Brick: ASTM C 216, Type FBX, Grade SW; color as selected.

B. Size: Nominal modular size of 2-2/3" x 8" x 4".

2.03 REINFORCEMENT AND ANCHORAGE

A. Multiple Wythe Joint Reinforcement: Ladder type; with moisture drip; hot dip galvanized after fabrication cold-drawn steel conforming to ASTM A 82, 3/16-inch side rods with 9 mm cross ties.

B. Reinforcing Steel: ASTM A 615, 60-ksi yield grade, deformed carbon-steel bars, unprotected finish.

2.04 FLASHINGS

A. Plastic Flashing: Sheet polyvinyl chloride; 40-mil-thick minimum.

B. Copper Flashing: Preformed sheets; 20 oz.

C. Asphalt-impregnated felt is not acceptable.

2.05 ACCESSORIES

A. Joint Filler: Closed cell polyethylene; oversized 50 percent to joint width.

B. Building Paper: 15-pound asphalt saturated felt.

C. Cleaning Solutions: Non-acidic, not harmful to masonry work or adjacent materials.

PART 3 - EXECUTION

3.01 EXAMINATION

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

B. Verify items provided by other Sections of work are properly sized and located.

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

D. Beginning of installation means installer accepts existing conditions, including but not limited to weather conditions.

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors supplied to other Sections.

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

3.03 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Lay concrete masonry units in running bond. Course one unit and one mortar joint to equal 8 inches. Form concave mortar joints.

D. Lay brick units in running bond. Course three brick units and three mortar joints to equal 8 inches. Form concave mortar joints.

3.04 PLACING AND BONDING

A. Lay hollow masonry units with face shell bedding on head and bed joints.

B. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.

C. Remove excess mortar as Work progresses.

D. Interlock intersections and external corners.

E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

F. Perform jobsite cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.05 WEEPS AND VENTS

A. Provide weep holes in veneer at 24 inches on center horizontally above through-wall flashing and at bottom of walls.

3.06 CAVITY WALL

A. Do not permit mortar to drop or accumulate in cavity air space or to plug weep holes.

B. Build inner wythe ahead of outer wythe to receive cavity insulation, and air/vapor barrier adhesive.

3.07 REINFORCEMENT AND ANCHORAGES - CAVITY WALL MASONRY

A. Install horizontal joint reinforcement 16 inches on center.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.

C. Place joint reinforcement continuous in first and second joint below top of walls.

D. Lap joint reinforcement ends minimum 6 inches. Extend minimum 16 inches each side of openings.

E. Place and consolidate grout fill without displacing reinforcing where grouting is shown on drawings.

3.08 MASONRY FLASHINGS

A. Extend flashings through veneer, turn up minimum 8 inches and bed into mortar joint of masonry.

B. Lap end joints minimum 6 inches and seal watertight.

C. Use flashing manufacturer's recommended adhesive and sealer.

3.09 LINTELS

A. Install loose steel lintels over openings.

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

C. Openings Up To 78 Inches: Place two, No. 5 reinforcing bars 1 inch from bottom web.

D. Openings Over 78 Inches: Reinforce openings as detailed.

E. Use single piece reinforcing bars only.

F. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

G. Place and consolidate grout fill without displacing reinforcing.

H. Allow masonry lintels to attain specified strength before removing temporary supports.

I. Maintain minimum 8 inch bearing on each side of opening.

3.10 GROUTED COMPONENTS

A. Reinforce bond beam with two, No. 5 bars, placed 1 inch from bottom web.

B. Reinforce jambs and joints with one No. 5 bar placed in center of masonry core.

C. Lap splices minimum 24 bar diameters.

D. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

E. Place and consolidate grout fill without displacing reinforcing.

F. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

3.11 BUILT-IN WORK

A. As work progresses, build in metal door frames, fabricated metal frames, plates and other items furnished by other Sections.

B. Build in items plumb and level.

C. Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with grout.

D. Do not build in organic materials subject to deterioration.

3.12 TOLERANCES

A. Maximum Variation From Unit to Adjacent Unit: 1/32 inch.

B. Maximum Variation From Plane of Wall: 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.

C. Maximum Variation From Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

D. Maximum Variation From Level Coursing: 1/8 inch in 3 feet; 1/4 inch in 10 feet; and 1/2 inch in 30 feet.

E. Maximum Variation of Joint Thickness: 1/8 inch in 3 feet.

F. Maximum Variation From Cross Sectional Thickness of Walls: 1/4 inch.

3.13 CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit, sleeves, and grounds. Coordinate with other Sections of work to provide correct size, shape, and location.

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

3.14 CLEANING

A. Clean work under provisions of Section 01710 - Cleaning.

B. Remove excess mortar and mortar smears.

C. Replace defective mortar. Match adjacent work.

D. Clean soiled surfaces with cleaning solution.

E. Use non-metallic tools in cleaning operations.

3.15 PROTECTION OF FINISHED WORK

A. Without damaging completed work, provide protective boards at exposed external corners which may be damaged by construction activities.

END OF SECTION

Section 04810

UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes unit masonry assemblies consisting of the following:

1. Concrete masonry units (CMUs).
2. Mortar and grout.
3. Reinforcing steel.
4. Masonry joint reinforcement.
5. Ties and anchors.
6. Miscellaneous masonry accessories.

B. Related Sections include the following:

1. Division 7 Section "Bituminous Dampproofing" for dampproofing applied to cavity face of backup wythes of cavity walls.
2. Division 7 Section "Water Repellents" for water repellents applied to unit masonry assemblies.
3. Division 7 Section "Sheet Metal Flashing and Trim" for exposed sheet metal flashing.
4. Division 7 Section "Joint Sealants" for sealing control and expansion joints in unit masonry.

C. Products furnished, but not installed, under this Section include the following:

1. Anchor sections of adjustable masonry anchors for connecting to structural frame, installed under Division 5 Section "Structural Steel."

D. Products installed, but not furnished, under this Section include the following:

1. Steel lintels and shelf angles for unit masonry, furnished under Division 5 Section "Metal Fabrications."

2. Manufactured reglets in masonry joints for metal flashing, furnished under Division 7 Section "Sheet Metal Flashing and Trim."

E. Allowances: Not Used

1.3 DEFINITIONS

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

1.4 SUBMITTALS

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

B. Shop Drawings: For the following:

1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."

C. Samples for Verification: For each type and color of the following:

1. concrete masonry units.
2. Accessories embedded in masonry.

D. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:

1. Masonry units.

a. Include material test reports substantiating compliance with requirements.

2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Reinforcing bars.
6. Joint reinforcement.
7. Anchors, ties, and metal accessories.

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

1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

F. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

D. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in

delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
2. Where 1 wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

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

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

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

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not uses units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.2 CONCRETE MASONRY UNITS (CMUs)

A. Shapes: Provide shapes indicated and as follows:

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners, unless otherwise indicated.

B. Concrete Masonry Units: ASTM C 90.

1. Weight Classification: Normal weight, unless otherwise indicated.
2. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
3. Not Used

4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

2.3 CONCRETE LINTELS

A. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Division 3 Section "Cast-in-Place Concrete."

2.4 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S.

D. Masonry Cement: ASTM C 91.

E. Mortar Cement: ASTM C 1329.

F. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

G. Aggregate for Grout: ASTM C 404.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

I. Water: Potable.

2.5 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60

B. Masonry Joint Reinforcement, General: ASTM A 951.

1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: W2.8 or 0.188-inch diameter.
4. Wire Size for Cross Rods: W2.8 or 0.188-inch diameter.
5. Not Used
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.

7. Provide in lengths of not less than 1O feet , with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: truss type with single pair of side rods.

D. Masonry Joint Reinforcement for Multiwythe Masonry:

1. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate ties that extend into facing wythe. Ties have two hooks that engage eyes or slots in reinforcement and resist movement perpendicular to wall. Ties extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.

2.6 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with eight subparagraphs below, unless otherwise indicated.

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/A 153M, Class B-2 coating.
2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 316.
3. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 zinc coating.
4. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, hot-dip galvanized after fabrication to comply with ASTM A 153/A 153M.
5. Stainless-Steel Sheet: ASTM A 666, Type 316.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

C. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch diameter, hot-dip galvanized steel.

2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.25-inch diameter, hot-dip galvanized steel wire.
3. Not Used
4. Not Used

D. Partition Top anchors: 0.097-inch thick metal plate with 3/8-inch diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication stainless steel.

2.7 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A 1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142-inch steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.

2.8 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.9 MORTAR AND GROUT MIXES

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

1. Do not use calcium chloride in mortar or grout.

2. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed· to view, regardless of weather conditions, to ensure that mortar color is consistent.

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

C. Mortar for Unit Masonry: Comply with ASTM C 270 Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

D. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. Not Used
2. For reinforced masonry, use Type N.
3. For mortar parge coats, use Type N.
4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
5. For interior non-load-bearing partitions, Type O may be used instead of Type N.

E. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

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

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

G. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:

1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet or 1/2 inch maximum.

2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet or 1/2 inch maximum.
3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 1O feet , 1/4 inch in 20 feet or 1/2 inch maximum.
4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch .
6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.3 LAYING MASONRY WALLS

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

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

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

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

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

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

H. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c., unless otherwise indicated.
3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 7 Section "Fire-Resistive Joint Systems."

3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow concrete masonry units as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool all exposed joints smooth and flush.

D. Not Used

3.5 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:

1. Masonry Joint Reinforcement: Installed in horizontal mortar joints.

a. Align bed joints of both wythes, use tab-type reinforcement.

2. Header Bonding: Provide masonry unit headers extending not less than 3 inches into each wythe. Space headers not over 12 inches clear horizontally and 16 inches clear vertically.

B. Bond wythes of cavity walls together using bonding system indicated on Drawings.

C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

D. Parge cavity face of backup wythe in a single coat approximately 3/8 inch thick. Trowel face of parge coat smooth.

E. Coat cavity face of backup wythe to comply with Division 7 Section "Bituminous Dampproofing."

3.6 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches .

1. Space reinforcement not more than 16 inches (406 mm) o.c.
2. Not Used
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.

a. Reinforcement above is in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL MEMBERS

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

1. Provide an open space not less than 1/2 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:

1. Install preformed control-joint gaskets designed to fit standard sash block.
2. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

C. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 7 Section "Joint Sealants," but not less than 3/8 inch

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.9 LINTELS

A. Install steel lintels where indicated.

B. Provide concrete lintels where shown and where openings of more than 24 inches for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated. See drawings for further lintel information.

3.1O Not Used

3.11 Not Used

3.12 FIELD QUALITY CONTROL

A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.

1. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.

3.13 Not Used

3.14 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated. Joints to be finished smooth. Leave no indentations from face of wall.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.

3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.15 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Division 2 Section "Earthwork."
3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

SECTION 05051

ANCHOR SYSTEMS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install anchor systems.

2. This Section includes all anchor systems required for the Work, but not specified under other Sections.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before anchor systems Work.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices

1. No separate payment will be made for Anchoring Systems under this section. Include payment in Lump Sum with price breakdown included in the Schedule of Values.

2. Refer to Section 01270 - Measurement and Payment, and Section 01292 - Schedule of Values.

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

1.3 REFERENCES

A. Standards referenced in this Section are:

1. ACI 318, Building Code Requirements for Structural Concrete.

2. ACI 350, Code Requirements for Environmental Engineering Concrete Structures.

3. ACI 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete.
4. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
5. ASTM A276, Specification for Stainless Steel Bars and Shapes.
6. ASTM A493, Specification for Stainless Steel Wire and WireRods for Cold Heading and Cold Forging.
7. ASTM A563, Specification for Carbon and Alloy Steel Nuts.
8. ASTM A1011/A1011 M, Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
9. ASTM B633, Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
10. ASTM C307, Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings.
11. ASTM C579, Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
12. ASTM C881/C881M, Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
13. ASTM 0695, Test Method for Compressive Properties of Rigid Plastics.
14. ASTM 0790, Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
15. ASTM E329, Specification for Agencies Engaged in Construction Inspection and/or Testing.
16. ASTM E488, Test Methods for Strength of Anchors in Concrete and Masonry Elements.
17. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
18. ASTM F594, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
19. ASTM F1554, Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.

20. FS A-A-1922A, Shield, Expansion (Caulking Anchors, Single Lead).

21. FS A-A-1923A, Concrete Expansion Anchors.

22. FS A-A-1925A, Shield, Expansion (Nail Anchors).

23. FS A-A-55614, Shield, Expansion (non-drilling expansion anchors).

24. ICC-ES AC01, Acceptance Criteria for Expansion Anchors in Masonry Elements.

25. ICC-ES AC58, Acceptance Criteria for Adhesive Anchors in Masonry Elements.

26. ICC-ES AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.

27. ICC-ES AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

28. ISO 3506-1, Mechanical Properties of Corrosion-Resistant Stainless Steel Fasteners -- Part 1: Bolts, Screws and Studs.

29. ANSI/MSS SP-58, Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Testing Laboratory: Shall comply with ASTM E329 and shall be experienced in tension testing of post-installed anchoring systems.

2. Post-installed Anchor Installer: Shall be experienced and trained by post-installed anchor system manufacturer in proper installation of manufacturer's products. Product installation training by distributors or manufacturer's representatives is unacceptable unless the person furnishing the training is qualified as a trainer by the anchor manufacturer.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Listing of all anchor systems products intended for use in the Work including product type, intended location in the Project, and embedded lengths.

2. Product Data:

a. Manufacturer's specifications, load tables, dimension diagrams, acceptable base material conditions, acceptable drilling methods, and acceptable bored hole conditions.

b. When required by ENGINEER, copies of valid ICC ES reports that presents load-carrying capacities and installation requirements for anchor systems.

3. Samples:

a. Representative Samples of anchor systems proposed for use in the Work. Review will be for type and finish only. Compliance with all other requirements is CONTRACTOR's exclusive responsibility.

B. Informational Submittals: Submit the following:

1. Certificates:

a. For each type of anchor bolt or threaded rod, submit copies of laboratory test reports and other data required to demonstrate compliance with the Contract Documents.

b. Post-installed anchor system manufacturer's certification that installer received training in the proper installation of manufacturer's products required for the Work.

2. Manufacturer's Instructions:

a. Installation instructions for each anchor system product proposed for use, including bore hole cleaning procedures and adhesive injection, cure and gel time tables, and temperature ranges (storage, installation and in-service).

3. Field Quality Control Submittals:

a. Submit results of field quality control testing and inspections performed by testing laboratory.

1.6 DELIVERY, STORAGE AND HANDLING

A. Storage and Protection:

1. Keep materials dry during delivery and storage.

2. Store adhesive materials within manufacturer's recommended storage temperature range.

3. Protect anchor systems from damage at the Site. Protect products from corrosion and deterioration.

PART 2 PRODUCTS

2.1 SYSTEM PERFORMANCE

A. General:

1. At locations where conditions dictate that Work specified in other Sections is to be of corrosion resistant materials, provide associated anchor systems of stainless steel materials, unless other corrosion-resistant anchor system material is specified. Provide anchor systems of stainless steel materials where stainless steel materials are required in the Contract Documents.

2. Stainless Steel Nuts:

   a. For anchor bolts and adhesive anchors, provide ASTM A194/A194M, Grade *BS* (Nitronic 60) stainless steel nuts for stainless steel anchors used for anchoring equipment, gates, and weirs, and other locations, if any, where the attachment will require future removal for operation or maintenance. Provide lock washer or double nuts on each anchorage device provided for equipment, as required by equipment manufacturer.

   b. For other locations, provide for each anchorage device a nut as specified or as required by anchor manufacturer. When ASTM A194/A194M, Grade 8S (Nitronic 60) nuts are not required for anchor bolts and adhesive anchors as specified in this Section, provide anti-seizing compound where stainless steel rods are used with stainless steel nuts of the same type.

8. Design Criteria

1. Size, Length, and Load-carrying Capacity: Comply with the Contract Documents. When size, length or load-carrying capacity of anchor system is not otherwise shown or indicated, provide the following:

   a. Anchor Bolts: Provide size, length, and capacity required to carry design load based on values and requirements of Paragraph 3.2.A of

this Section. For conditions outside limits of critical edge distance and spacing in Paragraph 3.2.A of this Section, minimum anchor bolt embedment as shown or indicated in Paragraph 3.2.A of this Section apply and capacity shall be based on requirements of Laws and Regulations, including applicable building codes.

b. Adhesive Anchors, Expansion Anchors, or Concrete Inserts: Provide size, length, type, and capacity required to carry design load. Anchor capacity shall be based on the procedures required by the building code in effect at the Site. Where Evaluation Service Reports issued by the ICC Evaluation Service are required in this Section, anchor capacities shall be based on design procedure required in the applicable ICC Evaluation Service Report.

1) General: Determine capacity considering reductions due to installation and inspection procedures, embedment length, strength of base fastening materials, spacing, and edge distance, as indicated in the manufacturer's design guidelines. For capacity determination, concrete shall be assumed to be in the cracked condition.

2) Concrete Adhesive Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum embedment depth of the greater of the following: required to develop tensile strength of anchor, or a minimum embedment of 10 anchor diameters; and minimum anchor spacing and edge distance of 12 anchor diameters.

3) Concrete Masonry Adhesive Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum anchor spacing and edge distance as indicated in anchor manufacturer's instructions.

4) Concrete Expansion Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum embedment depth of six anchor diameters, and minimum anchor spacing and edge distance of seven anchor diameters.

5) Concrete Masonry Expansion Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum anchor spacing and edge distance as indicated in anchor manufacturer's instructions.

6) Concrete Undercut Anchors: Unless otherwise shown or indicated in the Contract Documents, or approved by ENGINEER, provide

minimum anchor spacing and edge distance as tabulated in anchor manufacturer's instructions.

2. Design Loads. Comply with the Contract Documents. When design load of supported material, equipment, or system is not otherwise shown or indicated, provide the following:

   a. Equipment Anchors: Use design load recommended by equipment manufacturer. When equipment can be filled with fluid, use loads that incorporate equipment load and load imposed by fluid.

   b. Delegated Design: When anchor systems are used for supporting materials, equipment, or systems delegated to a design professional retained by CONTRACTOR, Subcontractor, or Supplier, provide anchor system suitable for loads indicated in delegated design documents and consistent with the design intent expressed in the Contract Documents.

C. Application:

1. Anchor Bolts:

   a. Where anchor bolt is shown or indicated, use cast-in-place anchor bolt unless another anchor type is approved by ENGINEER.

   b. Provide anchor bolts as shown or indicated, or as required to secure structural element to appropriate anchor surface.

2. Concrete Adhesive Anchors:

   a. Use only where adhesive anchors are specifically shown or indicated for installation in concrete.

   b. Suitable for use where subject to vibration.

   c. Suitable for use in exterior locations or locations subject to freezing.

   d. Suitable for use in submerged, intermittently submerged, or buried locations.

   e. Do not use in overhead applications, unless otherwise shown or approved by ENGINEER.

   f. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.

3. Concrete Wedge Expansion Anchors:

   a. Use where expansion anchors are shown or indicated for installation in concrete.

   b. Do not use where subject to vibration.

   c. Do not use in exterior locations or locations subject to freezing.

   d. Do not use in submerged, intermittently submerged, or buried locations.

   e. Suitable for use in overhead applications.

4. Drop-in Expansion Anchors:

   a. Use drop-in expansion anchors installed in concrete where light-duty anchors are required to support piping or conduit two-inch diameter or smaller.

   b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.

   c. Do not use where subject to vibration.

   d. Do not use at submerged, intermittently submerged, or buried locations.

   e. Do not use in exterior locations or locations subject to freezing.

   f. Suitable for use in overhead applications.

5. Concrete Undercut Anchors:

   a. Use where undercut anchors are shown or indicated for installation in concrete.

   b. Suitable for use where subject to vibration.

   c. Do not use in submerged, intermittently submerged, or buried locations.

   d. Do not use in exterior locations or locations subject to freezing.

   e. Suitable for use in overhead applications.

6. Concrete Inserts:

a. Use only where shown or indicated in the Contract Documents.

b. Allowed for use to support pipe hangers and pipe supports for pipe size and loading recommended by the concrete insert manufacturer.

7. Drive-In Expansion Anchors:

a. Use drive-in expansion anchors installed in concrete, precast concrete, grouted masonry units, or brick, where light-duty anchors are required to support piping or conduit one-inch diameter and smaller.

b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.

c. Do not use in overhead applications.

8. For Use in Precast Concrete Planks:

a. To support piping or conduit six-inch diameter and smaller, use low-profile drop-in anchors, hollow concrete masonry adhesive anchors, or through-bolts.

b. For piping greater than six-inch diameter, or to support safety-related systems, use through-bolts. Each through-bolt shall consist of threaded rod, nuts, washers, and bearing plate.

2.2 MATERIALS

A. Anchor Bolts:

1. Interior Dry Non-corrosive Locations: Provide straight threaded carbon steel rods complying with ASTM F1554, Grade 36, with heavy hex nuts complying with ASTM A563 Grade A, unless otherwise shown or indicated on the Drawings.

2. Exterior, Buried, Submerged Locations, or When Exposed to Wastewater: Provide stainless steel straight threaded rods complying with ASTM F593, AISI Type 316, Condition A, with ASTM F594, AISI Type 316, stainless steel nuts. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required. Other AISI types may be used when approved by ENGINEER.

3. Equipment: Provide anchor bolts complying with material requirements of this Section and equipment manufacturer's requirements relative to size, embedment length, and anchor bolt projection. Anchor bolts shall be straight threaded rods with

washers and nuts as specified in this Section.

4. Anchoring of Structural Elements: Provide anchor bolts of size, material, and strength shown or indicated in the Contract Documents.

B. Concrete Adhesive Anchors:

1. General:

   a. Adhesive anchors shall consist of threaded rods anchored into hardened concrete using an adhesive system.

2. Products and Manufacturers: Provide one of the following:

   a. HIT-RE 500-SD Injection Epoxy Adhesive Anchoring System, by Hilti Fastening Systems, Inc.

   b. SET-XP Epoxy-Tie Adhesive, by Simpson Strong-Tie Company, Inc.

   c. Or equal.

3. Adhesive:

   a. Adhesive system shall use two-component adhesive mix.

   b. Epoxy adhesives shall comply with physical requirements of ASTM C881/C881M, Type IV, Grade 2 and 3, Class A, B, and C, except gel times.

   c. Adhesives shall have a current evaluation report by ICC Evaluation Service for use in both cracked and uncracked concrete with seismic recognition for SDC A through F as tested and assessed in accordance with ICC-ES AC308.

   d. Adhesives shall have minimum bond strength and minimum design bond strength (bond strength multiplied by strength reduction factor) in accordance with Table 05051-A:

TABLE 05051-A:
ADHESIVE BOND STRENGTH [1,2]

Anchor	Uncracked Concrete		Cracked Concrete	
Rod Diameter / Dowel Size	Bond Strength Cosi)	Design Bond Strength (psi)	Bond Strength (psi)	Design Bond Strength (psi)
3/8-inch / #3	2040	1300	1090	700
1/2-inch / #4	1920	1200	920	560
5/8-inch / #5	1830	1150	710	390
3/4-inch / #6	1760	1050	710	460
7/8inch / #7	1670	900	610	340
1-inch / #8	1650	1050	850	460
-/#9	1900	1000	800	400
1.25-inch/ #10	1580	1000	730	400

Table Notes:
1. Bond strengths listed for hammer-drilled, dry hole.
2. Bond strengths listed for maximum short term concrete temperature of 110 degrees F and maximum long term concrete temperature of 75 degrees F.

4. Anchor:

   a. Provide continuously-threaded, AISI Type 316 stainless steel adhesive anchor rod. Threaded rods shall comply with the concrete adhesive anchor manufacturer's specifications as included in the ICC Service Evaluation Report for the anchor submitted. Nuts shall have specified proof load stresses equal to or greater than the minimum tensile strength of the stainless steel threaded rod used. Provide ASTM A194/A194M, Grade SS (Nitronic 60) stainless steel nuts where required.

C. Concrete Wedge Expansion Anchors:

1. General:

   a. Concrete wedge expansion anchors shall consist of stud, wedge, nut, and washer.

2. Products and Manufacturers: Provide one of the following:

   a. Kwik Bolt TZ Wedge Anchor, by Hilti Fastening Systems, Inc.

   b. Or equal.

3. Anchors shall comply with physical requirements of FS A-A-1923A, Type 4. Provide concrete wedge expansion anchors suitable for use in cracked and uncracked concrete in accordance with ACI 318 and ACI 350, Appendix D. Demonstrate suitability of cracked concrete wedge anchors in accordance with ACI 355.2 prequalification tests.

4. Interior Dry Non-corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM 8633.

5. Other Locations: Provide expansion anchors complete with nuts and washers, AISI Type 304 stainless steel anchor body, in accordance with ASTM A276 or ASTM A493.

6. Concrete wedge expansion anchors shall have a current ICC Evaluation Service Report for use in both cracked and uncracked concrete with seismic recognition in seismic design Categories A through F when tested and assessed in accordance with ICC-ES AC193.

D. Drop-in Expansion Anchors:

1. General:

   a. Drop-in expansion anchors shall each consist of an internally threaded, deformation-controlled expansion anchor with pre-assembled
   expander plug.

2. Products and Manufacturers: Provide one of the following:

   a. HDI Drop-In Anchors, by Hilti Fastening Systems, Inc.

   b. Drop-In Anchor, by Simpson Strong-Tie Company, Inc.

   c. Or equal.

3. Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM 8633, complying with physical requirements of FS A-A-55614, Type I. Anchors shall be flush or shell type. Provide low-profile anchors for use in precast concrete planks.

E. Concrete Undercut Anchors:

1. General:

   a. Each concrete undercut anchor shall consist of threaded stud, thick-walled expansion sleeve, expander coupler, and nut and washer. Anchors shall be pre-set type or through-set type, as shown on the Drawings.

2. Products and Manufacturers: Provide one of the following:
   a. HOA Undercut Anchor, by Hilti Fastening Systems, Inc.

b. DUC Ductile Undercut Anchor, by USP Structural Connectors.

c. Or equal

3. Provide concrete undercut expansion anchors in accordance with ACI 318 and ACI 350, Appendix D. Demonstrate suitability of cracked concrete undercut anchors in accordance with ACI 355.2 prequalification tests.

4. Installed anchor shall exhibit form fit between bearing elements and the undercut in the concrete.

5. Interior Dry Non-Corrosive Locations: Provide carbon steel anchors, complete with nuts and washers, zinc plated, in accordance with ASTM 8633.

6. Other Locations: Provide stainless steel anchors, complete with nuts and washers, manufactured of AISI Type 316 stainless steel or materials complying with ISO 3506-1 and having corrosion resistance equivalent to AISI Type 316 stainless steel.

7. Concrete undercut anchors shall have a current ICC Evaluation Service Report for use in both cracked and uncracked concrete for seismic recognition for seismic design Categories A through F when tested and assessed in accordance with ICC-ES AC193.

F. Concrete Inserts:

1. Manufacturers: Provide products of one of the following:

a. Unistrut Corporation.

b. Cooper 8-Line, Inc.

c. Anvil International, Inc.

d. Or equal.

2. Spot Concrete Inserts:

a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall comply with ANSI/MSS SP-58, malleable iron, Type 18. Spot inserts shall allow for lateral adjustment and have means for attachment to forms. Provide nuts compatible with insert and to suit threaded hanger rod sizes.

3. Continuous Concrete Inserts:

   a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall be continuous type and shall be manufactured from minimum 12-gage cold-formed channel sections, complying with ASTM A1011/A1011M, stainless steel, Grade 33, complete with styrofoam inserts, end caps, and means for attaching to forms. Provide channel nuts compatible with insert suitable for threaded hanger rod sizes.

4. Provide inserts with plain finish.

G. Drive-In Expansion Anchors:

1. General:

   a. Drive-In expansion anchors shall each consist of stainless steel drive pin and expanding alloy body.

2. Products and Manufacturers: Provide one of the following:

   a. Metal HIT Anchor, by Hilti Fastening Systems, Inc.

   b. Zinc Nailon Anchor, by Simpson Strong-Tie Company, Inc.

   c. Or equal.

3. Provide Type 304 stainless steel drive pin with zinc alloy body. Anchor shall comply with physical requirements of FS A-A-1925A, Type 1.

H. Unless approved by ENGINEER, do not use power-actuated fasteners or other types of bolts and fasteners not specified in this Section.

I. Anti-Seizing Compound:

1. Products and Manufacturers: Provide one of the following:

   a. Pure Nickel Never-Seez, by Bostik.

   b. Nickel-Graf, by Anti-Seize Technology.

   c. Or equal.

2. Provide pure nickel anti-seizing compound.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine conditions under which materials will be installed and advise ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Anchor Bolts:

1. Provide anchor bolts as shown or indicated in the Contract Documents, or as required to secure structural element to the appropriate anchor surface.

2. Locate and accurately set anchor bolts using templates or other devices as required, prior to placing concrete. Wet setting of anchor bolts is unacceptable.

3. Protect threads and shank from damage during installation and subsequent construction operations.

4. Unless otherwise shown or approved by ENGINEER anchor bolts shall comply with Table 05051-8:

TABLE 05051-B:
SINGLE ANCHOR ALLOWABLE LOADS ON ANCHOR BOLTS [1]

	F1554 Grade 36				F1554			
	F593 Type 316, Condition A				Grade 55			
		Minimum Edge Distance and Spacing[2] (inch)		Tension[3] (lb)	Minimum Embedment (inch)	Minimum Edge Distance and Spacing[2] (inch)		Tension[3] (lb)
1/2	6	9	1,262	2,420	8.5	12.75	1,660	3,190
5/8	7.5	11.25	2,010	3,860	10.5	15.75	2,640	5,080
3/4	9	13.5	2,974	5,720	13	19.5	3,910	7,520
718	10.5	15.75	4,106	7,890	15	22.5	5,400	10,390
1	12	18	5,386	10,360	17	25.5	7,090	13,450
1 1/8	13.5	20.25	6,787	13,052	19	28.5	8,930	16,580
1 1/4	15	22.5	8,617	16,572	21	31.5	11,340	20,040

Table Notes:

1. Table is based on ACI 318 and ACI 350, Appendix D, $f_c = 4000$ psi. Table 05 05 33-B is not applicable to anchor bolts embedded in grouted masonry.

2. Critical edge distance and spacing are indicated in the table. Capacity of anchor bolts for other combination of edge distances and spacing shall be evaluated in accordance with ACI 318 and ACI 350, Appendix D.

3. Values for shear and tension listed are not considered to act concurrently. Interaction of tension and shear will be evaluated by ENGINEER in accordance with ACI 318 and ACI 350, Appendix D.

B. Adhesive Anchors, Undercut Anchors, and Expansion Anchors - General:

1. Prior to drilling, locate existing reinforcing steel in vicinity of proposed holes. If reinforcing conflicts with proposed hole location, obtain ENGINEER's approval of alternate hole locations to avoid drilling through or damaging existing reinforcing bars.

C. Adhesive Anchors:

1. Comply with manufacturer's written installation instructions and the following.

2. Drill holes to adhesive system manufacturer's recommended drill bit diameter to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits that comply with the tolerances of ANSI B212.15. Core-drilled holes are unacceptable.

3. Before setting adhesive anchor, hole shall be made free of dust and debris by method recommended by adhesive anchor system manufacturer. Hole shall be brushed with adhesive system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.

4. Before injecting adhesive, obtain ENGINEER's concurrence that hole is dry and free of oil and other contaminants.

5. Prior to injecting adhesive into the drilled hole, dispense, to a location appropriate for such waste, an initial amount of adhesive from the mixing nozzle, until adhesive is uniform color.

6. Inject adhesive into hole through injection system-mixing nozzle and necessary extension tubes, placed to bottom of hole. Discharge end shall be withdrawn as adhesive is placed but kept immersed to prevent formation of air pockets. Fill hole to depth that ensures that excess material is expelled from hole during anchor placement.

7. Twist anchors during insertion into partially-filled hole to guarantee full wetting of rod surface with adhesive. Insert rod slowly to avoid developing air pockets.

8. Provide adequate curing in accordance to adhesive system manufacturer's requirements prior to continuing with adjoining Work that could place load

on installed adhesive anchors. Do not begin adjoining Work until adhesive anchors are successfully tested or when allowed by ENGINEER.

9. Limitations:

   a. Installation Temperature: Comply with manufacturer's instructions for installation temperature requirements. Provide temporary protection and other measures, such as heated enclosures, necessary to ensure that base material temperature complies with anchor systems manufacturer's requirements during installation and curing of adhesive anchor system.

   b. Oversized Holes: Advise ENGINEER immediately if size of drilled hole is larger than recommended by anchor system manufacturer. Cost of corrective measures, including but not limited to redesign of anchors due to decreased anchor capacities, shall be paid by CONTRACTOR.

   c. Embedment depths shall be based on installation in normal-weight concrete with compressive strength of 2,500 psi when embedded in existing concrete, and 4,000 psi when embedded in new concrete.

D. Expansion Anchors:

1. Comply with expansion anchor manufacturer's written installation instructions and the following:

2. Drill holes using anchor system manufacturer's recommended drill bit diameter and to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits complying with tolerances of ANSI 8212.15. Core drilled holes are unacceptable.

3. Before installing anchor, hole shall be made free of dust and debris by method recommended by anchor system manufacturer. Hole shall be brushed with anchor system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles.

4. Before installing anchor, obtain ENGINEER's concurrence that hole is dry and free of oil and other contaminants.

5. Protect threads from damage during anchor installation. Drive anchors not less than four threads below surface of the attachment. Set anchors to anchor manufacturer's recommended torque using a torque wrench.

E. Concrete Undercut Anchors:

1. Comply with undercut anchor manufacturer's written installation instructions and the following.

2. Protect threads from damage during anchor installation.

3. Drill hole to anchor manufacturer's specified depth and diameter using a drill bit matched to the specific anchor.

4. Before setting the undercut anchor, hole shall be free of dust and debris using method recommended by undercut anchor system manufacturer. Hole shall be blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles.

5. Insert the anchor by hand until anchor reaches bottom of hole.

6. Set anchor in accordance with manufacturer's instructions using anchor manufacturer's specified setting tool.

7. Verify that the setting mark is visible on the threaded rod above the sleeve.

8. Anchor shall be set to manufacturer's recommended torque, using a torque wrench.

F. Concrete Inserts:

1. Comply with concrete insert manufacturer's installation instructions.

2. Inserts shall be flush with slab bottom surface.

3. Protect embedded items from damage during concrete placing. Ensure that embedded items are securely fastened to prevent movement during concrete placing, and ensure that embedded items do fill with concrete during concrete placing.

4. Inserts intended for piping greater than four-inch diameter shall be provided with hooked rods attached to concrete reinforcing.

G. Anti-Seizing Compound:

1. Provide anti-seizing compound in accordance with anti-seizing compound manufacturer's installation instructions, at locations indicated in Paragraph 2.1.B of this Section.

2. Do not use anti-seizing compound at locations where anchor bolt or adhesive anchor will contact potable water or water that will be treated to become potable.

3.3 CLEANING

A. After embedding concrete is placed, remove protection and clean bolts and inserts.

3.4 FIELD QUALITY CONTROL

A. Site Tests:

1. Furnish services of independent testing laboratory to perform field quality tensile testing of post-installed anchors at the Site.

   a. Testing shall comply with ASTM E488.

   b. Test at least ten percent of all types of post-installed anchors. If one or more post-installed anchors fail the test, CONTRACTOR shall pay cost of testing, or at ENGINEER's option CONTRACTOR may arrange for testing paid by CONTRACTOR, for all post-installed anchors of same diameter and type installed on the same day as the failed anchor. If anchors installed on the same day as the failed anchor also fail the test, ENGINEER may require retesting of all anchors of the same diameter and type installed in the Work. CONTRACTOR shall be responsible for retesting costs.

   c. Test post-installed anchors to 50 percent of ultimate tensile capacity of post-installed anchor. ENGINEER will direct which anchors are to be tested.

   d. Apply test loads with hydraulic ram.

   e. Displacement of post-installed anchors shall not exceed D/10, where D is nominal diameter of anchor being tested.

2. Correct defective Work by removing and replacing or correcting, as directed by ENGINEER.

3. CONTRACTOR shall pay for all corrections and subsequent testing required to confirm integrity of post-installed anchors.

4. Testing agency shall submit test results to CONTRACTOR and ENGINEER within 24 hours of completion of test.

8. Manufacturer's Services:

1. Provide at the Site services of qualified adhesive manufacturer's representative during initial installation of adhesive anchor systems to train

CONTRACTOR's personnel in proper installation procedures. Manufacturer's representative shall observe to confirm that installer demonstrates proper installation procedures for adhesive anchors and adhesive material.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL

PART I. - GENERAL

A. RELATED DOCUMENTS

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

B. SUMMARY

1. This Section includes fabrication and erection of structural steel work, as shown on .drawings including schedules, notes, and details showing size and location of members, typical connections, and types of steel required, and as required by these specifications.

   a. Structural steel is that work defined in American Institute of Steel Construction (AISC) "Code of Standard Practice" and as otherwise shown on drawings.
   b. Miscellaneous Metal Fabrications are specified elsewhere in Division 5.
   c. Refer to Division 3 for anchor bolt installation in concrete, Division 4 for anchor bolt installation in masonry.

C. SUBMITTALS

1. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

2. Product data or manufacturer's specifications and installation instructions for following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).

   a. Structural steel (each type), including certified copies of mill reports covering chemical and physical properties.
   b. High-strength bolts (each type), including nuts and washers.

      (1) Include Direct Tension Indicators if used.

   c. Structural steel primer paint.
   d. Shrinkage-resistant grout.

3. Shop drawings prepared under supervision of a licensed Structural Engineer, including complete details and schedules for fabrication and assembly of structural steel members, procedures, and diagrams.

   a. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols and show size, length, and type of each weld.
   b. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as work of other sections.

4. Test reports conducted on shop- and field-bolted and welded connections. Include data on type(s) of tests conducted and test results.

5. Certified copies of each survey conducted by a licensed Land Surveyor, showing elevations and locations of base plates and anchor bolts to receive structural steel and final elevations and locations for major members. Indicate discrepancies between actual installation and contract documents.

D. QUALITY ASSURANCE

1. Codes and Standards: Comply with provisions of following, except as otherwise indicated:

   a. American Institute of Steel Construction (AISC) "Code of Standard Practice for Steel Buildings and Bridges."

      (1) Paragraph 4.2.1 of the above code is hereby modified by deletion of the following sentence:

         (a) "This approval constitutes the owner's acceptance of all responsibility for the design adequacy of any detail configuration of connections developed by the fabricator as a part of his preparation of these shop drawings."

   b. AISC "Specifications for Structural Steel Buildings," including "Commentary."
   c. "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Structural Connections.
   d. American Welding Society (AWS) D1.1 "Structural Welding Code - Steel."
   e. ASTM A 6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use."

2. Qualifications for Welding Work: Qualify welding procedures and welding operators in accordance with AWS "Qualification" requirements.

   a. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.
   b. If recertification of welders is required, retesting will be Contractor's responsibility.

E. DELIVERY, STORAGE, AND HANDLING

1. Deliver materials to site at such intervals to ensure uninterrupted progress of work.

2. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time to not to delay work.

3. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration. If bolts and nuts become dry or rusty, clean and relubricate before use.

a. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

PART II. - PRODUCTS

A. MATERIALS

1. Metal Surfaces, General: For fabrication of work that will be exposed to view, use only materials that are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating, and applying surface finishes.

2. Structural Steel Shapes, Plates, and Bars: ASTM A 36.

3. Cold-Formed Steel Tubing: ASTM A 500, Grade B.

4. Hot-Formed Steel Tubing: ASTM A 501.

5. Steel Pipe: ASTM A 53, Type E or S, Grade B; or ASTM A 501.

   a. Finish: Black, except where indicated to be galvanized.

6. Steel Castings: ASTM A 27, Grade 65-35, medium-strength carbon steel.

7. Headed Stud-Type Shear Connectors: ASTM A 108, Grade 1015 or 1020, cold-finished carbon steel with dimensions complying with AISC Specifications.

8. Anchor Bolts: ASTM A 307, nonheaded type unless otherwise indicated.

9. Unfinished Threaded Fasteners: ASTM A 307, Grade A, regular low-carbon steel bolts and nuts.

   a. Provide hexagonal heads and nuts for all connections.

10. High-Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers, as follows:

    a. Quenched and tempered medium-carbon steel bolts, nuts, and washers, complying with ASTM A 325.

       (1) Where indicated as galvanized, provide units that are zinc coated, either mechanically deposited complying with ASTM B 695, Class 50, or hot-dip galvanized complying with ASTM A 153.

    b. Quenched and tempered alloy steel bolts, nuts, and washers, complying with ASTM A 490.

11. Direct Tension Indicators: ASTM F 959, type as required.
    a. Use on all A325 and A490 bolts on connections that are slip critical.

12. Electrodes for Welding: Comply with AWS Code.

13. Structural Steel Primer Paint: Fabricator's standard rust- inhibiting primer.

14. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean, uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum water required for placement and hydration.

15. Nonmetallic Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining product containing selected silica sands conforming to ASTM C827 with a compressive streinght at 28 days of 8,000 PSI,

    a. Products: Subject to compliance with requirements, provide one of the following:

       1 100 Non-Shrink Grout (Non-Metallic); Conspec, Inc.
       2 Supreme Grout; Cormix, Inc.
       3 Sure Grip Grout; Dayton Superior.
       4 Euco N.S.; Euclid Chemical Co.
       5 Crystex; L & M Construction Chemicals, Inc.
       6 Masterflow 713; Master Builders.
       7 Sealtight 588 Grout; W.R. Meadows.
       8 Propak; Protex Industries, Inc.
       9 Set Non-Shrink; Set Products, Inc.
       10) Five Star Grout; U.S. Grout Corp.

B. FABRICATION

1. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings. Provide camber in structural members where indicated.

   a. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.
   b. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

2. Connections: Weld or bolt shop connections, as indicated.

3. Bolt field connections, except where welded connections or other connections are indicated.

   a. Provide high-strength threaded fasteners for principal bolted connections, except where unfinished bolts are indicated.
   b. Provide unfinished threaded fasteners for only bolted connections of secondary framing members to primary members (including purlins, girts, and other framing members taking only nominal stresses) and for temporary bracing to facilitate erection.

4. High-Strength Bolted Construction: Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts."

5. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.

6. Assemble and weld built-up sections by methods that will produce true alignment of axes without warp.

7. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld shear connectors in field, spaced as shown, to beams and girders in composite construction. Use automatic end welding of headed stud shear connectors in accordance with manufacturer's printed instructions.

8. Steel Wall Framing: Select members that are true and straight for fabrication of steel wall framing. Straighten as required to provide uniform, square, and true members in completed wall framing.

9. Build up welded door frames attached to structural steel framing. Weld exposed joints continuously and grind smooth. Plug-weld steel bar stops to frames, except where shown removable. Secure removable stops to frames with countersunk, cross-recessed head machine screws, uniformly spaced not more than 10 inches o.c., unless otherwise indicated.

10. Holes for Other Work: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on final shop drawings.

11. Provide threaded nuts welded to framing and other specialty items as indicated to receive other work.

12. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.

13. Expansion Joints: Provide expansion joints in steel shelf angles when part of structural steel frame; locate at vertical brick expansion joints as indicated on drawings.

C. SHOP PAINTING

1. General: Shop-paint structural steel, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel that is partially exposed on exposed portions and initial 2 inches of embedded areas only.

   a. Do not paint surfaces to be welded or high-strength bolted with friction-type connections.
   b. Do not paint surfaces scheduled to receive sprayed-on fireproofing.
   c. Apply 2 coats of paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2. Surface Preparation: After inspection and before shipping, clean steelwork to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) as follows:

   a. SP-1 "Solvent Cleaning."
   b. SP-2 "Hand-Tool Cleaning."

c. SP-3 "Power-Tool Cleaning."
d. SP-5 "White Metal Blast Cleaning."
e. SP-6 "Commercial Blast Cleaning."
f. SP-7 "Brush-Off Blast Cleaning."
g. SP-10 "Near-White Blast Cleaning."

3. Painting: Immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions and at a rate to provide dry film thickness of not less than 1.5 mils. Use painting methods that result in full coverage of joints, corners, edges, and exposed surfaces.

4. Painting: Provide a one-coat, shop-applied paint system complying with Steel Structures Painting Council (SSPC) Paint System Guide No. 7.00.

D. SOURCE QUALITY CONTROL

1. General: Materials and fabrication procedures are subject to inspection and tests in mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

   a. Promptly remove and replace materials or fabricated components that do not comply.

2. Design of Members and Connections: Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site whenever possible without causing delay in the work.

   a. Promptly notify Architect whenever design of members and connections for any portion of structure are not clearly indicated.

PART III. - EXECUTION

A. ERECTION

1. Surveys: Employ a licensed land surveyor for accurate erection of structural steel. Check elevations of concrete and masonry bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceeds, and report discrepancies to Architect. Do not proceed with erection until corrections have been made or until compensating adjustments to structural steel work have been agreed upon with Architect.

2. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.

3. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete work.

4. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.

a. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.
b. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
c. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure. Pregrouting of base plates will not be permitted.
d. For proprietary grout materials, comply with manufacturer's instructions.

5. Field Assembly: Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

6. Level and plumb individual members of structure within specified AISC tolerances.

7. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.

8. Splice members only where indicated and accepted on shop drawings.

9. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces.

   a. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
   b. Do not enlarge unfair holes in members by burning or by using drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

10. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members that are not under stress, as acceptable to Architect. Finish gas-cut sections equal to a sheared appearance when permitted.

11. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.

    a. Apply by brush or spray to provide minimum dry film thickness of 1.5 mils.

12. Touch-Up Painting: Cleaning and touch-up painting of field welds, bolted connections, and abraded areas of shop paint on structural steel is included in Division 9 under painting work.

B. QUALITY CONTROL

1. Engage an independent testing and inspection agency to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports.

2. Owner will engage an independent testing and inspection agency to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports.

3. Testing agency shall conduct and interpret tests, state in each report whether test specimens comply with requirements, and specifically state any deviations therefrom.

4. Provide access for testing agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished.

5. Testing agency may inspect structural steel at plant before shipment.

6. Correct deficiencies in structural steel work that inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests, at Contractor's expense, as necessary to reconfirm any noncompliance of original work and to show compliance of corrected work.

7. Shop-Bolted Connections: Inspect or test in accordance with AISC specifications.

   a. Verify that gaps of installed Direct Tension Indicators are less than gaps specified in ASTM F 959, Table 2.

8. Shop Welding: Inspect and test during fabrication of structural steel assemblies, as follows:

   a. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
   b. Perform visual inspection of all welds.
   c. Perform tests of welds as follows. Inspection procedures listed are to be used at Contractor's option.

      Liquid Penetrant Inspection: ASTM E 165.
      Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration not acceptable.
      (3) Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
      (4) Ultrasonic Inspection: ASTM E 164.

9. Field-Bolted Connections: Inspect in accordance with AISC specifications.

   a. For Direct Tension Indicators, comply with requirements of ASTM F 959. Verify that gaps are less than gaps specified in Table 2.

10. Field Welding: Inspect and test during erection of structural steel as follows:

a. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
b. Perform visual inspection of all welds.
c. Perform tests of welds as follows:

Liquid Penetrant Inspection: ASTM E 165.
Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration not acceptable.
(3) Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
(4) Ultrasonic Inspection: ASTM E 164.

END OF SECTION

Section 05400

COLD FORMED METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Load bearing formed steel stud exterior wall framing.

B. Formed steel purlin, framing and bridging.

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.

1.03 RELATED SECTIONS

A. Section 07920, Caulking and Sealants.

1.04 REFERENCES

A. AISI - American Iron and Steel Institute - Cold-Formed Steel Design Manual.

B. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

C. ASTM A653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot Dip Process.

D. ASTM A570 - Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.

E. ASTM A611 - Structural Steel (SS), Sheet, Carbon, Cold-Rolled.

F. AWS D1.1 - Structural Welding Code.

G. AWS D1.3 - Light Steel Welding Code.

H. SSPC (Steel Structures Painting Council) - Steel Structures Painting Manual.

1.05 SYSTEM DESCRIPTION

A. Size components to withstand design loads as follows:

1. Vertical Assembly: 30 psf positive and 28 psf negative.

2. Horizontal Assembly: 30 psf live and dead loads. 75 psf uplift wind force at eave and ridge purlins.

B. Maximum Allowable Deflection: 1/180 span.

C. Design wall and roof systems to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.

D. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

1.06 SUBMITTALS

A. Submit under provisions of Section 01330 – Submittal Procedures, and Section 01340 – Shop Drawings, Product Data, and Samples.

B. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, welds, type and location of fasteners, and accessories or items required of related work.

C. Indicate stud, roof purlin, and roof layout.

D. Describe method for securing studs to tracks and for bolted framing connections.

E. Provide calculations for loadings and stresses of studs and purlins under the Professional Structural Engineer's seal.

F. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, and limitations.

G. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.07 QUALITY ASSURANCE

A. Calculate structural properties of framing members in accordance with AISI and AWS D1.3 requirements.
B. Maintain one copy of each document on site.

1.08 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing the work of this section with minimum three years documented experience approved by manufacturer.

C. Design structural elements under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State of Texas.

1.09 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.10 COORDINATION

A. Coordinate work under provisions of Section 01312 - Coordination and Meetings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Dietrich Industries, Inc.

B. Dale Industries, Inc.

C. Alabama Metal Industries Corp.

D. Substitutions: Under provisions of Section 01630 - Product Substitution Procedures.

2.02 FRAMING MATERIALS

A. Studs: ASTM A653, Grade D sheet steel, formed to channel shape, solid web, knurled faces; 18 gage, size and shape as per project drawings.

B. Purlins: ASTM A653, Grade D sheet steel, formed to zee shape, solid web; 16 gage thick; size and shapes as per project drawings.

C. Track: Formed steel; channel shaped; same width as studs, tight fit; 8 gage thick, solid web.

2.03 ACCESSORIES

A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered.

B. Plates, Gussets, Clips: Formed sheet steel, thickness determined for conditions encountered.

C. Touch-Up Primer for Galvanized Surfaces: SSPC - Paint 20 zinc rich.

2.04 FASTENERS

A. Self-drilling, Self-tapping Screws, Bolts, Nuts and Washers: ASTM A123, hot dip galvanized to 1.25 oz/sq ft.

B. Anchorage Devices: Power actuated, drilled expansion bolts, or screws with sleeves.

C. Welding: In conformance with AWS D1.1 and AWS D1.3.

2.05 FABRICATION

A. Fabricate assemblies of wall sections of sizes and profiles required; with framing members fitted, reinforced, and braced to suit design requirements.

B. Fit and assemble in largest practical sections for delivery to site, ready for installation.

2.06 FINISHES

A. Studs: Galvanize to G90 coating class.

B. Tracks and Headers: Galvanize to G90 coating class.

C. Joists and Purlins: Galvanize to G90 coating class.

D. Bracing, Furring, Bridging: Same finish as framing members.

E. Plates, Gussets, Clips: Same finish as framing members.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify site conditions under provisions of Section 01312 - Coordination and Meetings.

B. Verify that building framing components are ready to receive work.

3.02 ERECTION OF STUDDING

A. Install components in accordance with manufacturer's instructions.

B. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners at maximum 24 inches o.c.

C. Place studs at 16 inches o.c.(maximum); not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using fastener method.

D. Construct corners using minimum three studs. Double stud wall openings, door and window jambs.

E. Erect load bearing studs one-piece full length. Splicing of studs is not permitted.

F. Erect load-bearing studs, brace, and reinforce to develop full strength, to achieve design requirements.

G. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.

H. Install intermediate studs above and below openings to align with wall stud spacing.

I. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.

J. Attach furring channels to studs for attachment of fixtures anchored to walls.

K. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

L. Touch-up field welds and damaged galvanized, primed surfaces with primer.

M. Complete framing ready to receive wall system as per plans.

3.03 ERECTION OF PURLINS

A. Install framing components in accordance with manufacturer's instructions.

B. Make provisions for erection stresses. Provide temporary alignment and bracing.

C. Place purlins at spacing shown on plans. Connect purlins to supports using fastener method.

D. Set purlins parallel and level, with lateral bracing and bridging.

E. Locate joist end bearing directly over load bearing studs or provide load-distributing member to top of stud track.

F. Touch-up field welds and damaged galvanized surfaces with primer.

G. Complete framing ready to receive roof plywood sheathing.

3.04 ERECTION TOLERANCES

A. Maximum Variation from True Position: 1/16 inch.

B. Maximum Variation of any Member from Plane: 1/16 inch.

END OF SECTION

Section 05501

METAL FABRICATIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Bolts, anchors, nuts, sleeves, concrete anchors, scheduled items, and other miscellaneous metal items not specifically included under other sections of these specifications.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices

1. No separate payment will be made for metal fabrications under this section. Include payment as part of the Work in appropriate sections.

2. Refer to Section 01270 – Measurement and Payment and Section 01292 – Schedule of Values.

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

1.03 REFERENCES

A. ASTM A 36 - Standard Specification for Carbon Structural Steel.

B. ASTM A 53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

C. ASTM A 123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

D. ASTM A 153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

E. ASTM A 193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.

F. ASTM A 276 - Standard Specification for Stainless Steel Bars and Shapes.

G. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

H. ASTM A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

I. ASTM A 384 - Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.

J. ASTM A 449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.

K. ASTM A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

L. ASTM A 501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

M. ASTM A 510 - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.

N. ASTM A 563 - Standard Specification for Carbon and Alloy Steel Nuts.

O. ASTM A 992 - Standard Specification for Structural Steel Shapes.

P. ASTM B 663 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

Q. ASTM F 436 - Standard Specification for Hardened Steel Washers.

R. ASTM F 593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

S. ASTM F 594 - Standard Specification for Stainless Steel Nuts.

T. ASTM F 959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.

U. ASTM F 1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

V. ASTM F 1852 - Standard Specification for "Twist-Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat-Treated, 120/105 ksi Minimum Tensile Strength.

W. AWS A2.0 - Standard Welding Symbols.

X. AWS D1.1 - Structural Welding Code – Steel.

Y. ICC Evaluation Service AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements.

Z. ICC Evaluation Service AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements.

AA. ISO 898 - Mechanical Properties of Fasteners Made of Carbon Steel and Alloy Steel.

AB. SSPC - Steel Structures Painting Manual.

1.04 SUBMITTALS

A. Conform to Section 01330 – Submittal Procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

C. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

D. Concrete Anchors: Submit manufacturer's technical literature and certified test reports showing compliance with specified performance characteristics and physical properties of concrete anchors.

E. All steel design shall be consistent with AISC Manual of Steel Construction, latest edition, and International Building Code, latest edition.

1.05 QUALITY ASSURANCE

A. Prepare Shop Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Texas.

B. Welders' Certificates: Submit under provisions of Section 01330 – Submittal Procedures, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

C. Concrete Anchor Installer Training: Conduct a thorough training by the concrete anchor manufacturer or manufacturer's representative for the concrete anchor installer on the project. Training shall consist of a review of

the complete installation process for drilled-in anchors, to include but not limited to:

1. Hole drilling procedure.

2. Hole preparation and cleaning technique.

3. Adhesive injection technique and dispenser training/maintenance.

4. Proof loading/torquing.

1.06 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on Drawings.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Structural Steel Shapes: W-Shapes per ASTM A 992; Channels and Angles per ASTM A 572, Grade 50.

B. Steel Plates and Bars: ASTM A 36.

C. Stainless Steel Sections: ASTM A 276, Type 316 for non-welded items and Type 316L for welded items.

D. Steel Tubing: ASTM A 500 or ASTM A 501, Grade B.

E. Pipe: ASTM A 53, Grade B, Schedule 40.

F. Bolts, Studs, Nuts, and Washers: ASTM A 307, galvanized to ASTM A 153 for galvanized components; ASTM A 449 where "high strength" is indicated on Drawings.

G. Structural Bolts, Nuts, and Washers: Bolts per ASTM A 325, Type 1, galvanized to ASTM A 153 for galvanized components; nuts per ASTM A 563, Grade C Heavy Hex, Grade DH Heavy Hex for galvanized components; Washers per ASTM F 436, Type 1.

H. Direct-Tension Indicators: ASTM F 959, Type 325 compressible-washer type.

I. Tension-Control (Twist-Off) Bolts: ASTM F 1852, Type 1.

J. Stainless Steel Bolts and Nuts: Bolts per ASTM F 593, Type 316; nuts per

ASTM F 594, Type 316; UNC coarse threads.

K. Anchor Bolts: Bolts per ASTM F 1554, Grade 36; nuts per ASTM A 563, Grade A Hex.

L. Carbon Steel Threaded Anchor Rods: ASTM A 36; or ASTM A 193, Grade B7; or ISO 898 Class 5.8.

M. Stainless Steel Threaded Anchor Rods: ASTM F 593, Type 316.

N. Concrete Anchors: Concrete anchors are inserted into holes drilled in hardened concrete. Use one of the following types:

1. Epoxy Adhesive Anchors: For concrete anchors that are submerged, in splash zones, in enclosed spaces over liquids, or anchoring vibrating equipment, use epoxy adhesive anchors. Adhesive anchors may be used at all locations where concrete anchors are required. Epoxy systems shall be Sika/FI System with Sikadur Injection Gel Epoxy, Master Builders Concresive Epoxy Cartridge Dispensing System and Concresive Paste LPL, or equal. Threaded rods shall be ASTM F 593 Type 316 studs. Where adhesive anchors, or connected metal, are exposed to direct sunlight, the anchors shall be certified to maintain at least 90 percent of their rated strength (tested at 73 degrees F) when tested at 160 degrees F.

2. Cartridge Injection Adhesive Anchors: Threaded steel rods or inserts, complete with nuts, washers, polymer or hybrid mortar adhesive injection system, and manufacturer's installation instructions. Type and size as indicated on Drawings.

   a. Interior Use: Unless otherwise indicated on Drawings, provide carbon steel threaded rods conforming to ASTM A 36, ASTM A 193 Type B7, or ISO 898 Class 5.8, with zinc plating in accordance with ASTM B 633, Type III Fe/Zn 5 (SC1), or carbon steel HIT TZ rods conforming to ASTM A 510 with chemical composition of AISI 1038.

   b. Exterior Use: As indicated on Drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F 594 unless otherwise specified. Avoid installing stainless steel anchors in contact with

galvanically dissimilar metals.

c. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the City Engineer, provide Hilti HAS threaded rods or HIT-TZ rods with HIT-HY 150 MAX Adhesive Anchoring System or approved equal considering load resistance, in-service and installation temperature, availability of comprehensive installation instructions, and creep.

3. Capsule Anchors: Threaded steel rods or inserts, complete with nuts, washers, glass or foil capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, and manufacturer's installation instructions. Type and size as indicated on Drawings.

a. Interior Use: Unless otherwise indicated on Drawings, provide chisel-pointed carbon steel rods conforming to ASTM A 36, ASTM A 193 Type B7, or ISO 898 Class 5.8 with zinc plating in accordance with ASTM B 633, Type III Fe/Zn 5 (SC1).

b. Exterior Use: As indicated on Drawings, provide chisel-pointed stainless steel anchors. Stainless steel anchors shall be AISI Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.

c. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the City Engineer, provide Hilti HVA Capsule Adhesive Anchoring System with HVU capsules or approved equal considering load resistance, in-service and installation temperature, availability of comprehensive installation instructions, and creep.

4. Expansion Anchors: Where concrete anchors are indicated and adhesive anchors are not required, wedge-type drilled-in anchors shall be used. Anchors shall be torque-controlled, made with ASTM A 276, Type 316 stainless steel, with impact section to prevent thread damage, complete with required nuts and washers. Provide anchors

with length identification markings conforming to ICC ES AC01 or ICC ES AC193.

a. Interior Use: Unless otherwise indicated on Drawings, provide carbon steel anchors with zinc plating in accordance with ASTM B 633, Type III Fe/Zn 5 (SC1).

b. Exterior Use: As indicated on Drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. Stainless steel nuts shall conform to ASTM F 594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.

c. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the City Engineer, anchors shall be Kwik Bolt TZ or Kwik Bolt 3 by Hilti, Inc. or approved equal considering load resistance and availability of comprehensive installation instructions.

O. Welding Materials: AWS D1.1; type required for materials being welded.

P. Steel members in contact with liquids either continuously or intermittently shall have a minimum thickness of 1/4".

Q. All aluminum shall be type 5052, 6061, 6063, or 214 alloy unless otherwise noted or approved.

R. Shop and Touch-Up Primer: Compatible with systems specified in Section 09900 – Painting or Section 09915 – Protective Coatings.

2.02 FABRICATION

A. Fit and shop assemble in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts;

unobtrusively located; consistent with design of component, except where specifically noted otherwise.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FINISHES

A. Prepare surfaces to be primed in accordance with SSPC SP 2.

B. Do not prime surfaces in direct contact with concrete or where field welding is required.

C. Galvanize, after completion of welded fabrication, in accordance with ASTM A 123, structural steel members. Provide minimum 1.25 oz/sq ft galvanized coating.

PART 3 - EXECUTION

3.01 EXAMINATION

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

B. Beginning of installation means erector accepts existing conditions.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate sections.

C. Coat stainless steel threads with an anti-seizing compound prior to installing nuts.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components indicated on shop drawings.

D. Perform field welding in accordance with AWS D1.1.

E. Obtain the City Engineer's approval prior to site cutting or making adjustments in the field.

F. Cast-In-Place Bolts: Use templates to locate bolts accurately and securely in formwork.

G. After erection, prime welds, abrasions, and surfaces not shop primed except surfaces to be in contact with concrete.

3.04 INSTALLATION OF DRILLED-IN ANCHORS

A. Drilling Holes: Drill holes with rotary impact hammer drills using carbide-tipped bits or with core drills using diamond core bits. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on Drawings, all holes shall be drilled perpendicular to the concrete surface.

1. Cored Holes: Where anchors are to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. HIT HY-150 MAX shall not be installed in core drilled holes unless using HIT-TZ rods.

2. Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the City Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines.

3. Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

B. Perform anchor installation in accordance with anchor manufacturer's written instructions.

C. Epoxy Adhesive Anchors: Use epoxy adhesive anchors only where indicated on Drawings or approved by the City Engineer. Install in accordance with epoxy manufacturer's instructions. Drill hole not more than ¼ inch larger than steel rod diameter into 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 rod is inserted, epoxy grout will completely fill hole around rod. Dip end of steel rod in epoxy and twist rod while inserting into partially-filled hole.

D. Cartridge Injection Adhesive Anchors: Unless indicated otherwise on Drawings, use cartridge injection adhesive anchors for anchoring to existing concrete. Clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Holes do not need to be cleaned for HIT-TZ Rods with HY-150 MAX. Holes may be dry, damp, or wet. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive shall be injected into the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

E. Capsule Anchors: Use capsule anchors only where indicated on Drawings or approved by the City Engineer. Perform drilling and setting operations in accordance with manufacturer instructions. Clean all holes to remove loose material and drilling dust prior to installation of adhesive. Remove water from drilled holes in such a manner as to achieve a surface dry condition. Capsule anchors shall be installed with equipment conforming to manufacturer recommendations. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

F. Expansion Anchors: Use expansion anchors only where indicated on Drawings or approved by the City Engineer. Protect threads from damage during anchor installation. Set anchors to manufacturer's recommended torque, using a torque wrench. Following attainment of 10% of the specified torque, 100% of the specified torque shall be reached within 7 or fewer complete turns of the nut. If the specified torque is not achieved within the required number of turns, the anchor shall be removed and replaced unless otherwise directed by the City Engineer.

G. Observe anchor manufacturer's written recommendations with respect to installation temperatures for cartridge injection adhesive anchors and capsule anchors.

H. Repair of Defective Work: Remove and replace misplaced or malfunctioning anchors. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, nonmetallic grout. Anchors that fail to meet proof load or installation torque requirements shall be

regarded as malfunctioning.

I. Testing: 10 percent of each type and size of drilled-in anchor shall be proof loaded by the independent testing laboratory. Adhesive anchors and capsule anchors shall not be torque tested unless otherwise directed by the City Engineer. If more than 10 percent of the tested anchors fail to achieve the specified torque or proof load within the limits as defined on the Drawings, all anchors of the same diameter and type as the failed anchor shall be tested, unless otherwise instructed by the City Engineer.

1. Torque shall be applied with a calibrated torque wrench.

2. Proof loads shall be applied with a calibrated hydraulic ram. Displacement of adhesive and capsule anchors at proof load shall not exceed D/10, where D is the nominal anchor diameter.

3. Minimum anchor embedments, proof loads, and torques shall be as shown on the Drawings.

3.05 ERECTION TOLERANCES

A. Maximum Variation from Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset from True Alignment: 1/4 inch.

3.06 SCHEDULE

A. The schedule below is a list of principal items only. Refer to Drawings for items not specifically scheduled.

B. Bollards: Steel pipe concrete filled with crowned cap; prime paint finish.

C. Pipe Supports: Steel frame assemblies as detailed.

D. Removable Cover Plate with Lifting Lugs, Stiffeners, and Support Framing: As detailed; stainless steel.

END OF SECTION

Section 05520

METAL RAILING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Metal pipe and tube handrails, guardrails, and fittings.

1.01 MEASUREMENT AND PAYMENT

A. Unit Prices

1. No separate payment will be made for railing under this section. Include payment in Lump Sum with price breakdown included in the Schedule of Values.

2. Refer to Section 01270 – Measurement and Payment and Section 01292 – Schedule of Values.

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

1.03 REFERENCES

A. ASTM A 36 - Standard Specification for Carbon Structural Steel.

B. ASTM A 47 - Standard Specification for Ferritic Malleable Iron Castings.

C. ASTM A 48 - Standard Specification for Gray Iron Castings.

D. ASTM A 53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

E. ASTM A 123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

F. ASTM A 153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

G. ASTM A 312 - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipe.

H. ASTM A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

I. ASTM A 501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

J. ASTM A 554 - Standard Specification for Welded Stainless Steel Mechanical Tubing.

K. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

L. ASTM A 743 - Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.

M. ASTM A 780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

N. ASTM B 26 - Standard Specification for Aluminum-Alloy Sand Castings.

O. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

P. ASTM B 210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.

Q. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

R. ASTM B 241 - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.

S. ASTM B 247 - Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings.

T. ASTM B 429 - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tubes.

U. ASTM B 483 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Tube and Pipe for General Purpose Applications.

V. ASTM B 633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

W. ASTM B 695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.

X. ASTM C 1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

Y. ASTM D 1187 - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.

Z. ASTM E 488 - Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.

AA. ASTM E 894 - Standard Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.

AB. ASTM E 935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.

AC. ASTM E 985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.

AD. AWS A2.0 - Standard Welding Symbols.

AE. AWS D1.1 - Structural Welding Code – Steel.

AF. AWS D1.2 - Structural Welding Code – Aluminum.

AG. AWS D1.6 - Structural Welding Code – Stainless Steel.

AH. AA 30 - Specifications for Aluminum Structures.

AI. AAMA 611 - Voluntary Specifications for Anodized Architectural Aluminum.

AJ. AISC 360 - Specification for Structural Steel Buildings.

AK. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members.

AL. ASCE 8 - Specification for the Design of Cold-Formed Stainless Steel Structural Members.

AM. NAAMM AMP 500 - Metal Finishes Manual.

AN. NAAMM AMP 510 - Metal Stairs Manual.

AO. NAAMM AMP 521 - Pipe Railing Systems Manual.

AP. SSPC - Steel Structures Painting Manual.

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Aluminum: AA 30 "Specification for Aluminum Structures."
2. Stainless Steel: ASCE 8 "Specification for the Design of Cold-Formed Stainless Steel Structural Members."
3. Structural Steel: AISC 360, "Specification for Structural Steel Buildings."
4. Cold-Formed Structural Steel: AISI S100, "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Structural Performance of Railings: Provide railings complying with requirements of ASTM E 985 for structural performance, based on testing performed according to ASTM E 894 and ASTM E 935. Alternately, provide railings designed to be capable of withstanding the following structural loads without exceeding allowable design working stresses of materials for railings, anchors, and connections:

1. Railing Assembly: Capable of withstanding the following loads applied as indicated:

   a. Uniform load of 50 lbf/ft applied to top rail in any direction.
   b. Single concentrated load of 200 lbf applied at any point along the top and in any direction.
   c. Concentrated and uniform loads above need not be assumed to act concurrently, but each shall be applied to produce maximum stress in each of the respective components or any of the supporting components.

2. Intermediate Rails (all those except the top rail), Balusters, Panel Fillers, and Other Infill Area Components: Capable of withstanding the following loads applied as indicated:

   a. Horizontal normal load of 50 lbf applied on an area not to exceed 1 ft square including openings and space between rails.
   b. Above load on infill area need not be assumed to act concurrently with loads applied to top rail.

C. Thermal Movements: Provide railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints,

overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

E. Space support posts 4 feet on center, maximum.

1.05 SUBMITTALS

C. Conform to Section 01330 – Submittal Procedures.

B. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Grout, anchoring cement, and paint products.

C. Shop Drawings: Show fabrication and installation of railings. Include plans, elevations, sections, component details, and attachments to other Work.

1. For installed railings indicated to comply with design loads, include structural analysis data signed and sealed by the qualified licensed professional engineer responsible for their preparation.

D. Product Test Reports: From a qualified testing agency indicating handrails and railings comply with ASTM E 894 and ASTM E 935, based on comprehensive testing of current products.

1.06 QUALITY ASSURANCE

A. Professional Engineer Qualifications: A licensed professional engineer who is legally qualified to practice in the State of Texas and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of railings that are similar to those indicated for this Project in material, design, and extent.

B. Fabricator Qualifications: A firm experienced in producing railings similar to those indicated for this Project and with a record of successful in-

service performance, as well as sufficient production capacity to produce required units.

C. Metal Railing Standards: Prepare metal railings in accordance with ASTM E 985 and NAAMM AMP 521.

D. Source Limitations: Obtain each type of handrail and railing through one source from a single manufacturer.

1.07 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating railings without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

2. Provide allowance for trimming and fitting at site.

1.09 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Kee Safety (formerly Kee Industrial Products), 100 Stradman Street, Buffalo, NY 14206, or equal.
2. The Wagner Companies: R & B Wagner, Inc., 10600 West Brown Deer Road, Milwaukee, WI 53224, or equal.
3. McNichols Company, 16405 Air Center Boulevard #100, Houston, TX 77032, or equal.

2.02 METALS

A. General: Provide metal free from pitting, seam marks, roller marks, stains, discolorations, and other imperfections where exposed to view on finished units.

B. Steel and Iron: Provide steel and iron in the form indicated, complying with the following requirements:

1. Steel Pipe: ASTM A 53, finish, type, and weight class as follows:

a. Galvanized finish, unless otherwise indicated.
b. Black finish for interior installations where indicated.
c. Type F, or Type S, Grade A, standard weight (Schedule 40), unless another grade and weight are required by structural loads.

2. Steel Tubing: Cold-formed steel tubing, ASTM A 500, Grade A, unless another grade is required by structural loads. Hot-formed steel tubing, ASTM A 501, Grade A, unless another grade is required by structural loads.

3. Steel Plates, Shapes, and Bars: ASTM A 36.

4. Malleable Iron Castings: Malleable iron complying with ASTM A 47, Grade 32510.
5. Gray Iron Castings: Gray iron complying with ASTM A 48, Class 30.

C. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of alloy and temper designated below for each aluminum form required:

1. Extruded Bar and Tube: ASTM B 221, alloy 6063-T5/T52.

2. Extruded Structural Pipe and Tube: ASTM B 429, alloy 6063-T6.

3. Drawn Tube and Pipe: ASTM B 483, alloy 6063-T832.

4. Drawn Seamless Tube: ASTM B 210, alloy 6063-T832.

5. Seamless Pipe and Seamless Extruded Tube: ASTM B 241, alloy 6063-T6.

6. Plate and Sheet: ASTM B 209, alloy 6061-T6.

7. Die and Hand Forgings: ASTM B 247, alloy 6061-T6.

8. Castings: ASTM B 26, alloy A 356-T6.

D. Stainless Steel: Grade or type designated below for each form required:

1. Tubing: ASTM A 554, Grade MT 304.

2. Tubing: ASTM A 554, Grade MT 316L.

3. Pipe: ASTM A 312, Grade TP 304.

4. Pipe: ASTM A 312, Grade TP 316L.

5. Castings: ASTM A 743, Grade CF 8 or CF 20.

6. Castings: ASTM A 743, Grade CF 8M or CF 3M.

7. Plate: ASTM A 666, Type 304.

8. Plate: ASTM A 666, Type 316L.

E. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

1. Provide cast brackets with flange tapped for concealed anchorage to threaded hanger bolt.

2. Provide formed or cast brackets with predrilled hole for exposed bolt anchorage.

3. Provide formed steel brackets with predrilled hole for bolted anchorage and with snap-on cover that matches rail finish and conceals bracket base and bolt head.

4. Provide brackets with interlocking pieces that conceal anchorage. Locate screws on bottom of bracket.

2.03 WELDING MATERIALS, FASTENERS, AND ANCHORS

A. Welding Electrodes and Filler Metal: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

1. For steel railings and fittings, use plated fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.
2. For aluminum railings, use fasteners fabricated from Type 304 or Type 316 stainless steel.
3. For stainless steel railings, use fasteners fabricated from Type 304 or Type 316 stainless steel.

C. Fasteners for Interconnecting Railing Components: Use fasteners fabricated from same basic metal as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
2. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.
3. Secure fittings to pipe railings by zinc plated set screws with a case hardened cut point. The minimum outside diameter of the set screws shall be 0.650 inches.

D. Cast-in-Place and Postinstalled Anchors: Anchors of type indicated below, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

1. Cast-in-place anchors.
2. Chemical anchors.
3. Expansion anchors.

2.04 PAINT

A. Finished Painting: Where indicated, interior railing shall be painted with two coats of safety yellow paint over the galvanized surface. Provide safety yellow paint that complies with applicable requirements in Division 9 Section 09900 – Painting and Section 09910 – Protective Coatings.

B. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

C. Shop Primer for Galvanized Steel: Zinc-dust, zinc-oxide primer formulated for priming zinc-coated steel and for compatibility with finish paint systems indicated, and complying with SSPC-Paint 5.

D. Bituminous Paint: Cold-applied ashalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.05 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

B. Interior Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Use for interior applications only that are not exposed to water.

C. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.06 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Form changes in direction of railing members as follows:

1. By bending.
2. By mitering at elbow bends.
3. By inserting prefabricated flush-elbow fittings.
4. By any method indicated above, applicable to change in direction involved.

D. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of railing components.

E. Welded Connections: Fabricate railings for connecting members by welding. Cope components at perpendicular and skew connections to provide close fit, or use fittings designed for this purpose. Weld connections continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

F. Nonwelded Connections: Fabricate railings by connecting members with concealed mechanical fasteners and fittings, unless otherwise indicated. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive where this is manufacturer's standard splicing method.

G. Welded Connections for Aluminum Pipe: Fabricate pipe railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.

I. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

J. For railing posts set in concrete, provide preset sleeves of steel not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, and steel plate forming bottom closure.

K. For removable railing posts, fabricate slip-fit sockets from steel tube whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.

   1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

L. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.

M. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

N. Cut, reinforce, drill, and tap components, as indicated, to receive finish hardware, screws, and similar items.

O. Provide weep holes or another means to drain entrapped water in hollow sections of railing members that are exposed to exterior or to moisture from condensation or other sources.

P. Fabricate joints that will be exposed to weather in a watertight manner.

Q. Close exposed ends of railing members with prefabricated end fittings.

R. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns, unless clearance between end of railing and wall is 1/4 inch or less.

S. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated. Toe boards shall be formed from galvanized steel plate bent into a channel shape so as to provide sufficient horizontal and vertical stiffness to prevent sag and to run straight and true parallel to the rails. Toe boards shall be connected to each railing post with a minimum of two fasteners in horizontal slotted holes. Splices shall be located and detailed to allow for thermal expansion and contraction.

T. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

U. Dimension Requirments: The top rail shall be at least 42 inches above the adjacent finished walking surface. The toe board shall be located 1/4 inch above the walking surface and the rails shall be spaced such that a 12-inch-diameter sphere cannot pass between them. Provide railings with 3 horizontal rails and a 4-inch-high toe board.

2.07 FINISHES, GENERAL

A. Comply with NAAMM AMP 500 for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.08 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.

B. Mechanical Finish: AA-M12 (Mechanical Finish: nonspecular as fabricated).

C. Class II, Clear Anodic Finish: AA-M12-C22-A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

D. Class I, Clear Anodic Finish: AA-M12-C22-A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

E. Class I, Color Anodic Finish: AA-M12-C22-A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

1. Color: As selected by Architect from the full range of industry colors and color densities.

2.09 STAINLESS STEEL FINISHES

A. Remove or blend tool and die marks and stretch lines into finish

B. Grind and polish surfaces to produce uniform, directionally textured polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. 180-Grit Polished Finish: Oil-ground, uniform, textured finish.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.10 STEEL FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:

1. ASTM A 123, for galvanizing steel and iron railings.
2. ASTM A 153, for galvanizing steel and iron hardware, 2.0 ounces/sq ft.

3. ASTM B 695, Class 50, for mechanical galvanizing steel and iron hardware.

C. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

D. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

E. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete.

F. Preparation for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic-phosphate process.

G. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed handrails and railings:

1. Exteriors (SSPC Zone 1B): SSPC-SP 6, "Commercial Blast Cleaning."
2. Interiors (SSPC Zone 1A): SSPC-SP 7, "Brush-off Blast Cleaning."

H. Apply shop primer to prepared surfaces of railing components, unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1," for shop painting. Primer need not be applied to surfaces to be embedded in concrete.

1. Do not apply primer to galvanized surfaces.
2. Stripe paint edges, corners, crevices, bolts, and welds.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

B. Verify that field conditions are acceptable and ready to receive work.

C. Beginning of installation means erector accepts existing conditions.

3.02 PREPARATION

A. Supply items required to be cast into concrete with setting templates, to appropriate sections.

3.03 INSTALLATION, GENERAL

A. Fit exposed connections together accurately to form tight, hairline joints.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required to install railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free from rack, distortion, or defects.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.

3. Align rails so variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, wood, or dissimilar metals with a heavy coat of bituminous paint.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated, but not less than that required by structural loads.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

F. Provide grounding as shown on the Drawings.

3.04 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of handrails and railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.05 ANCHORING POSTS

A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with the following anchoring material, mixed and placed to comply with anchoring material manufacturer's written instructions:
   1. Nonshrink, nonmetallic grout or anchoring cement.

B. Cover anchorage joint with flange of same metal as post, attached to post as follows:

   1. Welded to post after placing anchoring material.

C. Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 1/8-inch build-up, sloped away from post.

D. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

   1. For aluminum pipe railings, attach posts as indicated using fittings designed and engineered for this purpose.
   2. For stainless-steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.
   3. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

E. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.06 ANCHORING RAILING ENDS

A. Anchor railing ends into concrete with round flanges connected to railing ends and anchored into wall construction with postinstalled anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces.

1. Weld flanges to railing ends.

3.07 ATTACHING HANDRAILS TO WALLS

A. Attach handrails to wall with wall brackets. Provide bracket with 1-1/2-inch clearance from inside face of handrail and finished wall surface.

B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. Secure wall brackets to building construction as follows:

1. For concrete anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For wood stud partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.
3. For steel-framed gypsum board assemblies, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.

3.08 CLEANING

A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.09 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at the time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

Section 05521

ALUMINUM HANDRAILS

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. This section includes Aluminum mechanical sub-assembled handrails and fittings.

1.2 MEASUREMENT AND PAYMENT

A. Unless noted in the Bidsheet, no separate payment will be made for work under this section. Include payment for applicable work as noted on the Bidsheet.

B. Refer to Section 01270 – Measurement and Payment.

1.3 REFERENCE

A. Aluminum Association (AA): AA 30-86 – Specifications for Aluminum Structures.

B. American Society of Testing Materials (ASTM): ASTM C595-89 – Standard Specifications for Blended Hydraulic Cements.

1.4 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Submit complete fabrication and installation drawings including materials, parts and accessories.

1.04 WARRANTY

A. Provide warranty under provisions of Specification Section 01170 – Closeout Procedures.

B. The manufacturer shall warrant that the producto is free of defects in material and workmanship under normal use and service, and when properly installed.

C. The manufacturer shall provide written document to the City of Houston that warrants 100 percent of parts and labor for at least 24 months from the date of substantial completion as defined in the Contract Documents. Warranty shall be in printed form and previously published as the manufacturer's standard warranty for the manufactured products.

PART 2 PRODUCTS

2.1 RAILING SYSTEM

A. Railings shall be constructed 1-1/2 inch diameter aluminum pipe schedule 40 with anodized satin finish. Finish to be clear anodized (0.7 mil). All fittings shall be extruded aluminum pre-engineered for railing application.

B. All railing shall be mounted to the side of walkway surfaces using 1/2 inch diameter stainless steel anchors. All hardware used on the railing system shall be stainless steel.

C. All railing surfaces in contact with concrete or dissimilar metals shall receive one coat of zinc chromate.

D. All fittings shall be secured to the post and railing with #17 x 1" 316 stainless steel set screws.

E. Railings shall be provided with two horizontal rails and a 4-inch high toe board.

F. Toe boards shall be 4 inch extruded aluminum "Z" shape. Toe boards shall be connected to each railing post with a minimum of two fasteners in horizontal slotted holes. Splices shall be located and detailed to allow for thermal expansion and contraction.

G. Openings in rail shall be provided for access to gates and valves. Provide double strand 3/16 inch diameter 316 stainless steel chain.

H. Provide expansion joints at maximum 24 ft. centers using splice sleeves.

2.2 MANUFACTURERS

A. Acceptable manufacturers.
   a. Hollaender Manufacturing Company.
   b. Alumaguard.
   c. Enerco Metal Products, Inc.
   d. Rocky Mountain Railings.
   e. Or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation of all equipment and accessories furnished under this section shall be in strict accordance with the manufacturer's recommendations and instructions and in the locations shown on the Drawings.

B. Install components plumb and level, accurately fitted, free from distortion or defects. Provide anchors and sockets required for connecting railings to concrete.

END OF SECTION

Section 06100

ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall and roof sheathing, and preservative treatment.

B. Roof curbs and cants; blocking in wall and roof openings, wood furring and grounds, electrical panel back boards and concealed wood blocking.

1.02 UNIT PRICES

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

1.03 REFERENCES

A. ALSC - American Lumber Standards Committee.

B. APA - American Plywood Association.

C. AWPA (American Wood Protection Association) Standard U1 - Use Category System: User Specification for Treated Wood.

D. NFPA - National Forest Products Association.

E. RIS - Redwood Inspection Service.

F. SPIB - Southern Pine Inspection Bureau.

G. WCLIB - West Coast Lumber Inspection Bureau.

H. WWPA - Western Wood Products Association.

1.04 SUBMITTALS

A. Shop Drawings: Indicate framing system, cambers, bearing details, framed openings, material types, and member sizes.

B. Conform to requirements of Section 01300 - Submittal Procedures.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with the following agencies:

1. Lumber Grading Agency: Certified by ALSC.
2. Plywood Grading Agency: Certified by APA.

PART 2 P R O D U C T S

2.01 LUMBER MATERIALS

A. Lumber Grading Rules: NFPA, RIS, SPIB, WCLIB, and WWPA.

B. Structural Framing: Unless indicated otherwise, structural framing lumber shall be Southern Pine S4S, Grade Number 2, 19 percent maximum moisture content.

C. Non-Structural Light Framing: "Standard" grade, in size shown, 19 percent maximum moisture content.

2.02 SHEATHING MATERIALS

A. Plywood Roof Sheathing: APA Rated Sheathing, Structural I, Exposure Durability 1 (one), unsanded.

B. Plywood Wall Sheathing: APA Rated Sheathing, Structural I, Exposure Durability 1 (one), sanded.

C. Telephone and Electrical Panel Backboards: 3/4 inch, plywood, sanded and painted.

2.03 SHEATHING AND UNDERLAYMENT LOCATIONS

A. Sloped Roof Sheathing: 5/8-inch thick, 48 x 96 inch sized sheets, square edges, preservative treated.

2.04 ACCESSORIES

A. Fasteners: Galvanized steel for exterior, high humidity, and treated wood locations, plain finish elsewhere. All nails used shall be common type only.

B. Structural Framing Connectors: Joist Hangers, Galvanized steel, sized to

suit framing conditions.

C. Anchors: Toggle bolt type for anchorage to hollow masonry. Adhesive anchor or expansion shield type for anchorage to solid grouted masonry or concrete. Bolt or ballistic fastener for anchorages to steel.

D. Building Paper: No. 30 asphalt felt unless noted otherwise.

2.05 WOOD TREATMENT

A. Wood Preservative Pressure Treatment: Comply with AWPA Standard U1 requirements using appropriate Use Category to match installed exposure conditions.

PART 3 E X E C U T I O N

3.01 FRAMING

A. Erect wood framing members in accordance with applicable code. Place members level and plumb. Place horizontal members crown side up.

3.02 SHEATHING

A. Secure wall sheathing with ends staggered, over firm bearing.

B. Use sheathing clips between sheets between roof framing members. Provide solid edge blocking between sheets.

C. Install telephone and electrical panel back boards with plywood sheathing material where required. Size the backboard by 12 inches each side beyond size of electrical panel.

3.03 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment in accordance with manufacturer's instructions.

B. Treat site-sawn cuts. Brush apply one coat of preservative treatment on untreated wood in contract with cementitious materials, roofing and related metal flashings.

C. Allow preservative to cure prior to erecting members.

END OF SECTION

Section 06530

FIBERGLASS GRATING SYSTEMS

PART 1 GENERAL

1.1 DESCRIPTION

A. Furnish molded fiberglass grating in the locations shown in the Drawings.

B. All fiberglass gratings shall be manufactured using the open molding manufacturing process. Pultruded fiberglass gratings and "compression molded" fiberglass gratings are not acceptable.

C. Design panel sizes and dimesnions adequate to support anticipated live loads of 150 lb per square foot plus dead loads. Design panels to fit equipment layouts, providing smaller removable panel sections in location whee access may be required.

1.2 SUBMITTALS

A. Submit information to establish compliance with the specifications in accordance with the procedures set forth in Section 01300. This material shall include a detailed layout of all proposed fiberglass grating and the manufacturer's literature on all system components.

1.3 QUALITY CONTROL

A. All molded fiberglass gratings shall be manufactured in an ISO 9002 Certified manufacturing facility, thus ensuring that every panel is subjected to the following:

1. Full "wet-out" of the glass rovings.
2. Consistent resin-to-glass ratios.
3. Consistent non-skid characteristics.
4. Traceability of resins and glass used in the gratings.
5. Consistent load-carrying capability.
6. Continuing ultraviolet and chemical resistance testing.

7. Elimination of voids.

1.4 MINIMUM STIFFNESS REQUIREMENTS.

A. On a 36" span, a 12" wide strip of the 1Y2" thick grating must not deflect more than 0.18" when subjected to a uniform loading of 100 psf, and the same 12" wide strip of 1Y2" grating must not deflect more than 0.25" when subjected to a concentrated line load of 200 pounds on the same 36" span.

PART2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Delta Composites, L.L.C. (DeltaGrate HS), Houston, Texas

B. Mc Nichols Co ISO 9002 Certified, www.mcnichols.com

C. Other suppliers acceptable to Engineer

2.2 MATERIALS

A. Resin Type

1. All molded fiberglass grating shall be manufactured using the Dow Chemical USA vinyl ester resin known as Derakane MomentumTM 411-350. Orthophthalic polyester resins, isophthalic polyester resins, and henolic resins are not acceptable. The Derakane MomentumT 411-350 resin is designed to meet the corrosion requirements in the toughest of environments and resists chemical attack from both acids and caustics.

2. ASTM E84-98, Standard Method of Test for Surface Burning Characteristics of Building Materials Surface Burning Characteristics of Building Materials, a test to determine the flame spread and the smoke developed density of any material, must have been performed on a sample of the grating panel within the last 3 years. The molded fiberglass grating must possess, at a minimum, an ASTM E84-98 Flame Spread Rating (FSR) of 20 or less.

3. UV inhibitors shall be used in the resin matrix to enhance the gratings resistance to ultraviolet attack.

B. GLASS CONTENT

1. The molded grating shall be manufactured by strategically interweaving high strength, continuous glass rovings within a grating mold to produce an integral laminate with load bars in both the longitudinal and transverse directions. The molded grating panel shall contain a minimum of thirty-eight (38%) percent glass content by weight.

C. SKID RESISTANCE

1. The walking surface of the grating shall be skid resistant, or slip resistant, and this skid resistance shall be achieved by the creation of a concave contour on topside of the bearing bars, more commonly called "memiscus top" grating.

2. Stair tread panels shall be gritted and shall possess a gritted nosing to provide a skid resistnat walking surface.

D. COLOR

1. All molded fiberglass grating shall be orange in color.

2.2 BEARING BAR WIDTH, THICKNESS AND MESH CONFIGURATION

A. All grating panels and stair tread panels shall possess bearing bars that are a minimum of 14." wide at the top of the bearing bar. No molded grating with a bearing bar that measures less than 14." on top will be accepted regardless of published tolerances.

B. All bearing bars shall be 1 Y2" deep.

C. All grating panels shall be manufactured with a mesh configuration of 1 Y2" x 1 1/2"square mesh as measured from centerline to centerline of bearing bars.

D. Stair tread panels shall have a mesh configuration of 1" x 6" rectangular mesh as measured from centerline to centerline of bearing bars.

2.3 ATTACHMENT OF MOLDED FIBERGLASS GRATING

A. The molded fiberglass grating used in all horizontal framing plans shall be secured by the use of the G-Clip manufactured by Grating Fasteners, Inc., Bellechase, Louisiana.

B. Stair treads are to be secured with Type M Clips.

C. Attachment of molded fiberglass grating panels in all horizontal framing plans shall be achieved by the use of one G-Clip for every 5-6 square feet of grating, but no less than four (4) clips per panel for square and rectangular pieces, or three clips for any triangular pieces. All stair treads should be attached with the use of four Type M Clips per stair tread.

D. The longitudinal edges of adjacent fiberglass grating panels are to attached by the use of Type C-Clips. Use of the C-Clip is to reduce the differential deflection of adjacent panels when concentrated loads are applied close to the longitudinal edges of the panes. The C-Clips cause the panels to deflect as "one", thereby reducing the possibility of a tripping hazzard. Use of the C-Clip to tie adjacent panels should be used when the clear span of grating panels exceed 36", and the clip should be installed in the center of the clear span.

E. All grating attachment clips described above shall be manufactured from 316 stainless steel.

PART3 EXECUTION

3.1 SAWING, CUTTING, DRILLING, SEALING, ETC.

A. All cutting, drilling or sanding of fiberglass grating shall be performed according to the manufacturer's instruction and safety precautions.

END OF SECTION

Section 06601

GLASS FIBER AND RESIN FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fiber Reinforced Plastics (FRP); glass fiber reinforced, vinylester resin fabrications.

B. Refer to list of items scheduled at end of Section.

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.

1.03 REFERENCES

A. ASTM A276 B Stainless and Heat-Resisting Steel Bars and Shapes.

B. ASTM D757 B Test Method for Incandescence resistance of Rigid Plastics in Horizontal Position.

C. ASTM E84 B Test Method of Surface Burning Characteristics of Building Materials.

D. ASTM F593 B Stainless Steel Bolts, Hex Cap Screws, and Studs.

E. ASTM F594 B Stainless Steel Nuts

F. OSHA B Occupational Safety and Health Administration; Code of Federal Regulations, Title 29 B Labor.

G. UL B Underwriters Laboratories.

1.04 SYSTEM DESCRIPTION

A. Minimum mechanical properties except as modified under Part 2:

1. Ultimate Tensile Strength: (longitudinal coupon) 30,000 psi

2. Ultimate Tensile Strength: (transverse coupon) 7,000 psi
3. Ultimate Tensile Strength: (full section in bending) 20,000 psi
4. Ultimate Compressive Strength: (longitudinal coupon) 30,000 psi
5. Ultimate Compressive Strength: (transverse coupon) 15,000 psi
6. Ultimate Compressive Strength: (full section in bending) 20,000 psi
7. Ultimate Shear Strength: 5,500 psi
8. Ultimate Bearing Strength: 30,000 psi
9. Modules of Elasticity: (full section in bending) 2,500,000 psi
10. Barcol Hardness: 50

B. Design Live Loads: 100 lbs/sq ft with deflection limited to 1/240 unless otherwise noted.

C. Design items with sufficient strength for handling stresses

D. Ship items in preassembled lengths completely assembled and ready for final field assembly and installation.

E. Clearly identify each piece, part, or unit with a chemical resistant tag, showing manufacturer's certified drawing number, and part number securely fastened to the part with a chemical resistant fastener.

1.05 QUALITY ASSURANCE

A. Fabricator: Company specializing in architectural glass fiber and resin components with 5 years documented experience.

B. Design assemblies under direct supervision of a Professional Structural Engineer experienced in design of this work registered in the State of Texas.

1.06 REGULATORY REQUIREMENTS

A. Fire retardant class I- flame spread of 25 in accordance with ASTM E84.

B. Flammability: ASTM D757, maximum average rate of burning 0.08 in./min.

1.07 SUBMITTALS

A. Submit shop drawings under provisions of Section 01330 - Submittal Procedures.

B. Submit shop drawings indicating design load parameters, dimensions, adjacent construction, materials, thicknesses, fabrication details, required clearances, field jointing, tolerances, colors, finishes, methods of support, integration of components, and anchorages.

C. Submit product data on specified component products.
D. Submit samples as required.

E. Submit fabricator's installation instructions as required.

1.08 OPERATION AND MAINTENANCE DATA

A. Submit cleaning and maintenance data under provisions of Section 01770 - Closeout Procedures.

B. Include instructions for stain removal, surface and gloss restoration.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and protect products under provisions of Section 01610 - Material and Equipment.

B. Protect components from damage by retaining shipping protection in place until installation.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature and humidity conditions favorable to proper curing of resin during and after installation.

PART 2 PRODUCTS

2.01 MATERIALS

A. Glass reinforcement: Three Varieties:

1. A surfacing mat used on all exterior surfaces for maximum chemical resistance.

2. Continuous glass strand rovings internally for longitudinal strength.

3. Continuous strand mats used internally for transverse strength.

B. Roving: Continuous strand reinforcement for continuous impregnation, single end, wound into tubeless packaging, for vinylester resin.

C. Mat: Chopped fine glass fiber strand, sized into mat form, 9.5 oz/sq yd for vinylester resin laminate reinforcement.

D. Resin: Vinylester type, Class I flame spread and flammability ratings in accordance with ASTM E84, chemical resistant, corrosion resistant, high workability characteristics and integral coloring additives.

E. Gel Coat: Provide a resin gel coat with UV inhibitors for all fiberglass items.

F. Polishing Cream: Compatible gel coat polishing cream to restore gloss surface finish.

2.02 STAIRS

A. Stair Treads:

1. Open grate type 1-1/2-inch thick, 5/8-inch solid nosing, and non-skid surface, bearing on stainless steel clip angles bolted to stringers with stainless steel bolts.

2. Ultimate Tensile Strength: 20,000 psi.

3. Ultimate Compressive Strength: 20,000 psi.

4. Maximum deflection from 400 lbs load at midspan (36-inch x 11-1/2-inch tread) 5/16-inch.

B. Design Loads:

1. Design stairs for a moving concentrated load of 1000 lbs. minimum in accordance with OSHA, 29 CFR 1910.24. "Fixed industrial stairs", with a safety factor of 3 applied.

2. Stairs shall sustain 100 psf of vertical projected load.

C. Handrail: Install on both sides of all open stairways having 3 or more risers.

2.03 GRATING

A. Mesh Grating: 1-1/2 inches x 1-1/2 inches.

Mesh type grating to be installed at proposed Chemical Feed/Handling Areas as indicated on the Drawings.

B. Resin shall be vinyl ester with meniscus top and chemical formulations as necessary to provide the corrosion resistance, strength and other physical properties as required.

C. All bearing bars and cross bars of the grating shall be molded into a one-piece construction.

D. Glass content shall be a minimum of 25% and a maximum of 35% by weight as determined by ASTM-D-2584.

E. Grating panels may have no exposed dry glass or voids containing dry glass.

F. Supports for mesh grating shall be adjustable (9" to 2-3/4") grating legs.

G. Provide grating with all accessories including curb angles and clips for anchoring of grating to support angles.

H. Mechanical Properties:

1. Ultimate Tensile Strength: 30,000 psi
2. Ultimate Compressive Strength: 30,000 psi
3. Modules of Elasticity: 2,800,000 psi
4. Weight per Square Foot: 3.75 lbs.
5. Density: .062 070 lbs/ in^3.
6. Open Area: 70 percent

I. Design Loads and Deflection:

1. Maintain a 0.2 inch deflection (maximum) and a 7 to 1 factor of safety due to a 200 pound per square foot uniformly distributed loads.

2.04 HANDRAILS

A. Furnish the handrail system complete including all necessary bolting, epoxy, plastic fasteners, and base plates, as specified and required. It is the specific intent of this requirement to provide a complete system from one source, without further responsibility.

B. Furnish handrail complete with 4-inch toe board, when required, as specified in referenced OSHA document. Provide three horizontal rails with the top rail located 42 inches above the adjacent walking surface. The rails shall be spaced such that a 12-inch diameter sphere cannot pass between them. Omit toe boards at stairways.

C. Design Requirements: OSHA, 29 CFR 1910.21, "Definitions" and OSHA, 29 CFR 1910.23 "Guarding floor and wall openings and holes".

D. Apply a minimum safety factor of 5 to loads referenced in OSHA.

E. Bond all joints, couplings, etc., with epoxy, and pin for additional safety.

F. Posts: Mounted at 6-feet on center maximum spacing.

G. Shop machine corners and splices free of posts and ready for field assembly.

H. Deform toe boards in such a manner as to provide both horizontal and vertical stiffness, without sag, and shall run true with the guardrail. Toe boards shall be connected to each railing post with a minimum of two fasteners in horizontal slotted holes. Splices shall be located and detailed to allow for thermal expansion and contraction.

I. Submit handrail post connection details at steel stair stringers and at concrete walls and slabs. Coordinate such details with the metal fabricator.

2.05 STRUCTURAL MEMBERS

A. Structural members shall be high strength fiberglass pultruded structural shapes whose properties equal or exceed the following:

STD. COUPON PROPERTY SHAPE	ORIENTATION	ROD & UNITS	BAR
Flexural Strength, flatwise 30,000	LW	PSI	100,000
Flexural Modulus, flatwise 1.6	LW	PSI x 10^6	6.0
Flexural Strength, flatwise 10,000	CW	PSI	N.A.
Flexural Modulus, flatwise 0.8	CW	PSI x 10^6	N.A.
Tensile Strength 30,000	LW	PSI	100,000
Tensile Modulus 2.5	LW	PSI x 10^6	6.0
Tensile Strength 7,000	CW	PSI	N.A.
Tensile Modulus 0.8	CW	PSI x 10^6	N.A.
Compressive Strength, edgewise 30,000	LW	PSI	60,000
Compressive Modulus, edgewise 2.5	LW	PSI x 10^6	N.T.
Compressive Strength, edgewise 15,000	CW	PSI	N.A.
Compressive Modulus, edgewise 1.0	CW	PSI x 10^6	N.A.

STD. COUPON PROPERTY SHAPE	ORIENTATION	ROD & UNITS	BAR
Notched Izod Impact Strength 25	LW	FT.-LBS/IN.	40
Notched Izod Impact Strength 4	CW	FT.-LBS./IN.	N.A.
Bearing Stress 30,000	LW	PSI	N.T.
Bearing Stress 30,000	CW	PSI	N.A.
I Shear Strength 5,500	LW	PSI	N.T.
I Shear Strength 5,500	CW	PSI	N.T.
Torque Shear Strength N.T.	LW	PSI	5,500
Barcol Hardness 50	FW	--	50
24 Hour Water Absorption 0.80	--	% Max.	0.25
Arc Resistance 120	LW	Seconds	150
I Dielectric Strength (1/8") 200	FW	VPM	N.T.
II Dielectric Strength 35	LW	KV./IN.	60
Density, Solid Shapes (ASTM 0792) 0.062-0.067	--	LBS./IN.^{3}	0.074
Density, Hollow Shapes (ASTM 0792) 0.060-0.068	--	LBS./IN.^{3}	N.A.
Specific Gravity, Solid Shapes (ASTM 0792) 1.72-1.86	--	--	2.05
Specific Gravity, Hollow Shapes (ASTM 0792) 1.66-1.89	--	--	N.A.
Coefficient of Thermal Expansion N.T.	IN./IN. LW	Degree C.	5.2×10^6
FULL SECTION IN BENDING (Proof Test)			
Modulus of Elasticity 2.5	LW	PSI x 10^6	6.0
Tensile Strength 20,000	LW	PSI	100,000
Compressive Strength 20,000	LW	PSI	N.A.

LEGEND: LW-lengthwise; CW-crosswise; FW-flatwise; I-perpendicular; II-parallel; N.A. - not applicable; N.T.-not tested.

B. Structural shapes shall be fabricated within the following tolerances:

Least specified Leg, Web or Flange Thickness	Angularity
ALL	2 degree from normal

Allowable Deviation From Flat	Flatness
	0.008 inch per inch of width 0.008 inch minimum

All Shapes Specified Length	Cut Lengths
0-8 feet	+1/4 inch
8 - 20 feet	+3/8 inch
20 - 40 feet	+1/2 inch
over 40 feet	+1 inch

2.06 ACCESSORIES

A. Hardware: ASTM A276 stainless steel type 316.

B. Field joints: Bolted connections unless otherwise specified. All fasteners shall be bolts per ASTM F593, Type 316 and nuts per ASTM F594, Type 316; unless indicated otherwise.

2.07 FABRICATION

A. Mold Material: Metal FRP type.

B. Mold Surface: Smooth.

C. Structural FRP Members: Manufactured using a molding process, consisting of a glass fiber reinforced vinylester resin matrix.

D. Finish other surfaces not in contact with the mold to match the molded surfaces in appearance.

E. Finish trim corners and edges.

F. Coat exposed surface and surfaces in contact with moisture or earth with gel coat of colored resin.

G. Cure components prior to shipment and remove materials which contain fiber blemish, pinholes and dry spots or which may be incompatible with adjacent building materials.

H. Seal all cut edges and holes with a compatible resin system.

I. Coat surfaces with a polyurethane coating to prevent ultraviolet surface degradation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work and dimensions are as indicated on shop drawings.

B. Beginning of installation means acceptance of existing surfaces.

3.02 INSTALLATION

A. Install fabrications in accordance with Drawings and fabricator's instructions.

B. Reseal all cut edges with a compatible resin system.

C. Shop prepare all surfaces to be field epoxy bonded.

D. Install all components square and true, without warp, twist, sag, or buckle.

E. Epoxy bond and mechanically fasten all field joints using non-metallic hardware.

3.03 TOLERANCES

A. Maximum Variation from True Position: 1/4 inch.

B. Maximum Offset from True Alignment: 1/8 inch.

3.04 CLEANING

A. Clean components of foreign material.

B. Clean fabrications in accordance with fabricator's instructions.

3.05 PROTECTION

A. Protect finished installation under provisions of Section 01504 - Temporary Facilities and Controls.

3.06 SCHEDULE

A. Stairs: Where indicated, dull grey in color, non-skid surface.
B. Grating: Where indicated, solid safety yellow color throughout, gloss surface finish.

C. Handrail: Where indicated, solid safety yellow color throughout, gloss surface finish.

END OF SECTION

Section 06611

FRP ENCLOSURES

PART 1 GENERAL

1.01 SECTION INCLUDES:

A. Fiber Reinforced Plastics (FRP) buildings and shelters.

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.

1.03 RELATED WORK

A. Section 03310 – Structural Concrete
B. Section 16111 – Conduit, Fittings, and Bodies

1.04 REFERENCES

A. ASTM A276—Stainless and Heat-Resisting Steel Bars and Shapes.

B. ASTM C 518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

C. ASTM D 256 - Standard Test Method for Determining the Pendulum Impact Resistance of Notched Specimens of Plastics.

D. ASTM D 638 - Standard Test Methods for Tensile Properties of Plastics.

E. ASTM D 732 - Standard Test Method for Shear Strength of Plastics by Punch Tool

F. ASTM D757—Test Method for Incandescence resistance of Rigid Plastics in Horizontal Position.

G. ASTM D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

H. ASTM D 792 - Standard Test Method for Specific Gravity (Relative Density) and Density of Plastics by Displacement.

I. ASTM D 1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics.

J. ASTM D 2583 - Standard Test Method for Indentation Hardness of Rigid Plastics By means of a Barcol Impressor.

K. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

L. ASTM F593—Stainless Steel Bolts, Hex Cap Screws, and Studs.

M. ASTM F594—Stainless Steel Nuts.

N. OSHA—Occupational Safety and Health Administration; Code of Federal Regulations, Title 29 - Labor.

O. UL—Underwriters Laboratories.

1.05 SYSTEM DESCRIPTION

A. Laminate Properties

		Value	**Test Method**
1.	Tensile Strength (Bldg)	11,000 psi	ASTM D638
2.	Flexural Strength (Bldg)	18,000 psi	ASTM D790
3.	Shear Strength	12,000	ASTM D732
4.	Barcol Hardness	40	ASTM D2583
5.	Impact	12 ft lbs/inch	ASTM D256
6.	Heat Distortion Point	175	ASTM D384
7.	Density/Specific Gravity	93.6 PCF/1.5	ASTM D792
8.	Burning Characteristics		SEE 1.07 A

B. Core Properties

		Value	**Test Method**
1.	Thermal Conductivity	0.13 BTU IN HR FT^2 °F	ASTM C-518
2.	Density/Specific Gravity	2.0 PCF/.03	ASTM D1622
3.	Burning Characteristic	35 flame spread 240 smoke density	ASTM E-84

C. The procedure used in determining the minimum properties shall be in accordance with ASTM Standards, using the method designated. Test coupons shall be prepared in accordance with ASTM D618 test method.

D. Design items with sufficient strength for handling stresses.

E. Ship items in preassembled lengths completely assembled and ready for final field assembly and installation.

F. Clearly identify each piece, part, or unit with a chemical resistant tag, showing manufacturer's certified drawing number, and part number securely fastened to the part with a chemical resistant fastener.

1.06 QUALITY ASSURANCE

A. Fabricator: Company specializing in glass fiber and resin components with 5 years documented experience.

B. Design assemblies under direct supervision of a Professional Structural Engineer experienced in design of this work registered in the State of Texas.

1.07 REGULATORY REQUIREMENTS

A. Fire retardant class A- flame spread of 25 in accordance with ASTM E84.

B. Flammability: ASTM D757, maximum average rate of burning 0.08 in./min.

1.08 SUBMITTALS

A. Submit shop drawings under provisions of Section 01330—Submittal Procedures.

B. Submit shop drawings indicating design load parameters, dimensions, adjacent construction, materials, thicknesses, fabrication details, required clearances, field jointing, tolerances, colors, finishes, methods of support, integration of components, and anchorages.

C. Submit product data on specified component products.

D. Submit samples as required.

E. Submit fabricator's installation instructions as required.

1.09 OPERATION AND MAINTENANCE DATA

A. Submit cleaning and maintenance data under provisions of Section 01770 – Contract Closeout.

B. Include instructions for stain removal, surface and gloss restoration.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and protect products under provisions of Section 01610— Basic Product Requirements.

B. Protect components from damage by retaining shipping protection in place until installation.

C. The contractor shall deliver, store and handle doors and frames with care to prevent damage and deformation.

D. Doors and Frames shall be identified with the manufacturer's name tag, location, door type, color and weight.

E. Storage shall be on pallets in the original carton at the jobsite.

F. Doors and Frames shall be shipped in wood crates with wood perimeter.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature and humidity conditions favorable to proper curing of resin during and after installation.

1.12 WARRANTY

A. The manufacturer shall guarantee the fiberglass reinforced plastic doors and frames for a period of five (5) years from the date of delivery against failure due to workmanship, materials or corrosion caused by the environment specified by the owner.

PART 2 PRODUCTS

2.01 ONE-PIECE MOLDED SHELTER

A. The one piece molded shelter shall be sized as shown on the Drawings and by standard eave height.

B. Shelters shall withstand 125 miles per hour wind load and 30 pounds per square foot snow load.

C. Fiberglass reinforced plastic shelter shall be of one piece molded construction with composite walls and roof.

1. The exterior surface shall be white gel-coat with a low luster finish which is smooth and free from fiber pattern, roughness or other irregularities.

2. The exterior laminate which chemically bonds with the gel-coat shall be a minimum of 1/8" thick.

3. The laminate consisting of polyester resin and chopped strand fiberglass shall have a minimum glass content of 25%.

4. The center core shall be 1" thick with a minimum insulating value of R-7.

5. The core material shall be rigid closed cell, self extinguishing polyisocyanurate foam with a density of 2.0 pounds per cubic foot.

6. The white interior laminate shall encapsulate the core in place.

7. The molding shall be continuous form in a one piece molded composite shelter with an integral (min.) 3" wide internal mounting flange around the perimeter.

8. The flange shall be pre-drilled (per. Mfg. recommendations) for bolting to a structural concrete pad.

D. Louvers shall be sized and placed as shown on the Drawings.

2.02 FIBERGLASS DOORS

A. Fiberglass reinforced plastic doors shall be 1-3/4" thick by width and height as specified in contract schedules or plans. The doors shall be resin transfer molded (RTM) in matched metal molds to produce industrial quality doors which have a smooth finish. The doors shall be molded in one piece creating a seamless monolithic composite consisting of gel-coat, fiberglass reinforcement, polyester resin, insulating core and internal reinforcements.

B. The exterior surface shall be of gray gel-coat with a smooth low luster finish free from fiber pattern, roughness or other irregularities. The gel-coat shall be .025" thick and shall be resistant to moisture, ultraviolet degradation, and

many acids, alkalies and solvents in both liquid and vapor form. The environment specified shall determine the chemical resistance of the gel-coat required.

C. The exterior laminate which chemically bonds with the gel-coat shall be a minimum of 1/8" thick. The laminate consists of halogenated polyester resin and continuous strand fiberglass reinforcement and shall contain a minimum glass content of 25%. The laminate shall be fire retardant with a Class I rating, and will not support combustion.

D. The core shall be 1-1/2" thick with a minimum insulating value of R-11.5. The core material shall be rigid closed cell, self extinguishing polysocyanurate foam with a density of 2.0 pounds per cubic foot. The core shall be perforated to form resin posts during the molding process which tie the exterior laminates together.

E. The internal reinforcements shall be a combination of structural grain Balsa core, 1/8" thick steel flats and 1/8" thick fiberglass ribs. All reinforcements shall be incorporated into the doors during the resin transfer molding process. Structural Balsa core shall be located on the doors latch side, and used in combination with steel flats where high stress loads are induced by surface applied hardware such as closers and surface bolts. A continuous steel flat shall be located on the door hinge side for optimum mortised or continuous hinge screw retention. Vertical fiberglass rib reinforcements shall be located 6" in from the door sides to structurally rigidize the door and minimize thermal warpage. The vertical reinforcing ribs will leave a slight sink line the full length on both sides of the door, which is acceptable.

F. The doors shall be produced seamless by molding in place all mortises, openings, recesses and pockets.

2.03 FIBERGLASS FRAMES

A. Fiberglass reinforced plastic frames shall be 5-3/4" Jamb with a 2" face, 5/8" stop and 5/8" return. The frames shall be resin transfer molded in matched metal molds to produce a knocked down profile with a smooth finish. The jambs and head profile shall have mitered corners, and molded pockets for corner reinforcement. The head profile shall have molded corner tabs for head to jamb alignment during assembly. All mortises, recesses and openings shall be molded in place during the molding process to produce a totally seamless profile. The frames, jamb and head profiles shall be a monolithic composite consisting of gel-coat, fiberglass reinforced laminate, structural core and internal reinforcement.

B. The exterior surface shall be gray gel-coat with a low luster finish, smooth

and free from fiber pattern, roughness or other irregularities. The gel-coat shall be .025" thick and shall be resistant to moisture, ultraviolet degradation, and many acids, alkalies and solvents in both liquid and vapor form. Chemical resistant gel-coat shall be in accordance to the environmental exposure called out elsewhere in the specification.

C. The exterior laminate which chemically bonds with the gel-coat shall be a minimum of 1/8" thick. The laminate consists of halogenated polyester resin and continuous strand fiberglass reinforcement shall contain a minimum glass content of 25%. The laminate shall be fire retardant with a Class I rating and will not support combustion.

D. The structural core shall be 1/2" thick end grain Balsa wood with a density of 8 pounds per cubic foot. The core porosity allows resin to penetrate the surface during molding, and develops a high strength bond between the core and laminate.

E. Internal reinforcements shall be 1/8" thick steel flats which are totally encapsulated in the fiberglass laminate.

1. The steel reinforcement shall be incorporated into the frame profile during the resin transfer molding process.

2. A continuous steel flat shall be encapsulated in the jamb profile, hinge side only for optimum mortise or continuous hinge screw retention.

3. Head profile reinforcement shall be steel flats located in the face and stop. Corner reinforcements shall be steel angle .094 thick x 1-1/2" wide x 3-1/2" long which slip into molded corner pockets to insure accurate location and prevent corner separation.

2.04 FIBERGLASS LOUVER KITS

A. Louver kit shall be the same color as specified for the doors. Louver kits shall be removable type for vane replacement. Fiberglass vanes shall be inverted "V" type. A fiberglass insect screen shall be provided as specified.

B. The louver kit profile shall be molded in matched metal molds by the resin transfer molding process. The profile shall have mitered corners as fabricated to specified size.

2.05 ACCESSORIES

A. Furnish a supply fan that provides a minimum of 1 complete air exchange

per 3-minutes @ 0.2" static pressure. Provide safety guard, wall collar, and automatic shutter. All surfaces shall be epoxy coated.

B. Provide 5 kilowatt (KW) space heater with integral automatic thermostat to maintain temperature above 70 °F in enclosure.

2.06 ANCHORS

A. For new concrete, butt-mounting enclosure base anchors shall be cast-in-place concrete anchors designed by the FRP Enclosure manufacturer with a minimum size of ½-inch diameter. Set anchors a minimum of 4'-0" on center. As an option, concrete anchors may be post-installed concrete anchors in accordance with Paragraph 2.06B.

B. For existing concrete, butt-mounting enclosure base anchors shall be concrete expansion anchors designed by the FRP Enclosure manufacturer. Provide a minimum of 1/2" diameter anchors spaced at 4'-0" on center.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work and dimensions are as indicated on shop drawings.

B. Beginning of installation means acceptance of existing surfaces.

3.02 INSTALLATION

A. Install fabrications in accordance with Drawings and fabricator's instructions.

B. Reseal all cut edges with a pigmented compatible resin system.

C. Shop prepare all surfaces to be field epoxy bonded.

D. Install all components square and true, without warp, twist, sag, or buckle.

E. Epoxy bond and mechanically fasten all field joints using non-metallic hardware.

F. FRAME INSTALLATION

1. Frames shall be installed plumb, level, square and rigidly secured in the opening.

2. A field applied bottom and center spreader shall be used to maintain opening dimensions.

3. Anchors shall be installed at appropriate positions.

G. DOOR INSTALLATION

1. Doors shall be installed plumb, level and square.

2. Hardware shall be applied and adjusted to achieve quiet and smooth operation.

3. Door shall fit snuggly and close without sticking or binding.

4. Door clearances shall not exceed 1/8" at jambs and heads and 1/4" at meeting stiles for parts of doors.

5. Clearance between door bottom and finished floor or threshold shall not exceed 1/4".

3.03 TOLERANCES

A. Maximum Variation from True Position: 1/4 inch.

B. Maximum Offset from True Alignment: 1/8 inch.

3.04 CLEANING

A. Clean components of foreign material.

B. Clean fabrications in accordance with fabricator's instructions.

3.05 PROTECTION

A. Protect finished installation under provisions of Section 15050 – Basic Mechanical Materials & Method.

B. The fiberglass doors and frames shall be protected from damage during delivery handling and storage. Doors and frames shall be protected (wrapped) after installation and kept free of paint, plaster, cement, scratches etc. by the contractor.

END OF SECTION

Section 07212

BOARD INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Board insulation at cavity wall construction.

1.02 UNIT PRICES

A. No separate payment will be made for Board Insulation under this Section. Include payment in Lump Sum with price breakdown included in the Schedule of Values.

B. Refer to Section 01270 - Measurement and Payment and Section 01292 - Schedule of Values.

1.03 REFERENCES

A. ANSI/ASTM D2842 - Water Absorption of Rigid Cellular Plastics.

B. FS HH-I-1972/GEN - Insulation Board, Thermal, Faced, Polyurethane or Polyisocyanurate.

1.04 PERFORMANCE REQUIREMENTS

A. Materials of this Section shall provide continuity of thermal barrier at building enclosure elements in conjunction with thermal insulating materials in Section 07511 – Built Up Asphalt Roofing.

1.05 SUBMITTALS

A. Submit under provisions of Section 01330 - Submittal Procedures.

B. Product Data: Provide data on product characteristics, performance criteria and limitations.

C. Manufacturer's Installation Instructions: Indicate special environmental conditions required for installation and installation techniques.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 P R O D U C T S

2.01 INSULATION MATERIALS

A. Polyisocyanurate Insulation: FS HH-I-1972 Class 1 or 2 closed cell type, conforming to the following:

1.	Thermal Resistance:	Aged R of 10.8
2.	Thickness:	1-1/2 inch thick
3.	Board Size:	16 inch wide
4.	Water Absorption:	In accordance with ANSI/ASTM D2842 less than 1-1/2 percent by volume maximum
5.	Edges:	Shiplap edges.
6.	Facing:	Factory applied skin of aluminum foil on both faces

2.02 ADHESIVES

A. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify site conditions.

B. Verify that substrate, adjacent materials, and insulation boards are dry and ready to receive insulation and adhesive.

C. Verify substrate surface is flat, free of honeycomb, fins, irregularities, materials or substances that may impede adhesive bond.

3.02 INSTALLATION FOR CAVITY WALLS

A. Install in accordance with manufacturer's recommendations

B. Apply adhesive in three continuous beads per board length to full bed 1/8 inch thick on substrate. Daub adhesive tight to protrusions to ensure continuity of vapor and air barrier.

C. Install boards horizontally between wall reinforcement.

D. Place membrane surface against adhesive and tape seal board joints.

E. Place 6 inch wide polyethylene sheet at perimeter of wall openings from adhesive vapor and air barrier bed to door frame. Tape seal in place to ensure continuity of vapor/air barrier.

END OF SECTION

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

********** ***

RELATED SECTIONS - For use by Specifier. Do not include list in Project Specifications.
Section 04062 - Unit Masonry System

Change asphalt shingle reference above to Section 07610 - Sheet Metal Roofing to match roofing material used.

****

END OF NOTES

Section 07213

BLANKET INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Batt insulation in wall, ceiling, and roof construction.

1.02 UNIT PRICES

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

1.03 REFERENCES

A. ASTM C 665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

1.04 SUBMITTALS

A. Submit under provisions of Section 01300 - Submittal Procedures.

B. Product Data: Provide data on product characteristics, performance criteria.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect product from inclement weather and soiling in accordance with Section 01610 - Basic Product Requirements.

1.06 COORDINATION

A. Coordinate the Work with roofing and soffit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS - INSULATION MATERIALS

A. CertainTeed.

B. Owens Corning Fiberglass.

2.02 MATERIALS

A. Batt Insulation for Wall and Ceilings: ASTM C 665 Type I - without membranes, performed glass fiber batt or roll conforming to the following:

1.	Thermal Resistance	R - 13 Walls; R - 19 Ceilings
2.	Batt or Roll Size	Size to fit construction members.
3.	Facing	Unfaced

B. Batt Insulation for Metal Roofing: ASTM C 665 Type II - with nominal 4 mil white vinyl facing one side, 3" thick, .6 lbs per cubic foot density.

2.03 ACCESSORIES

A. Nails and Staples: Galvanized type sized to suit application.

B. Wire Mesh: Galvanized steel, hexagonal wire mesh.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify site conditions.

B. Verify that substrate, adjacent materials, and insulation are dry and ready to receive insulation.

3.02 INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.

B. Install in exterior ceiling and roofing spaces without gaps or voids.

C. Trim insulation neatly to fit spaces.

D. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation. Leave no gaps or voids.

E. Staple or nail in place at 6-inch maximum on center, or retain in place with

wire mesh secured to framing members.

END OF SECTION

Section 07511

BUILT-UP ASPHALT ROOFING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Built-up asphalt roof membrane.

2. Protected, built-up asphalt roof membrane.

3. Base sheet.

4. Vapor retarder.

5. Roofing insulation.

6. Roof membrane surfacing material.

7. Aggregate ballast.

B. Unit Prices: Refer to Division 1 Section "Unit Prices" for description of Work in this Section that is affected by unit prices.

1.03 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D 1079 for definitions of terms related to roofing work not otherwise defined in this Section.

B. Hot Roofing Asphalt: Roofing asphalt heated to its equiviscous temperature, the temperature at which its viscosity is 125 centipoise for mop-applied roofing asphalt and 75 centipoise for mechanical spreader-applied roofing asphalt within a range of plus or minus 25 deg F measured at the mop cart or mechanical spreader immediately before application.

1.04 PERFORMANCE REQUIREMENTS

A. General: Install a watertight, built-up roofing and base flashing roofing system with compatible components that will not permit the passage of liquid water and will withstand wind loads, thermally induced movement, and exposure to weather without failure.

1.05 SUBMITTALS

A. Product Data: For each type of roofing product specified. Include data substantiating that materials comply with requirements.

B. Shop Drawings: Include plans, sections, details, and attachments to other work, for the following:

1. Base flashings, cants, and membrane terminations.

2. Tapered insulation, including slopes.

3. Crickets, saddles, and tapered edge strips, including slopes.

C. Product Test Reports: Based on evaluation of tests performed by manufacturer and witnessed by a qualified independent testing agency, indicate compliance of components of roofing system with requirements based on comprehensive testing of current product compositions.

D. Research/Evaluation Reports: Evidence of roofing system's compliance with building code in effect for Project from a model code organization acceptable to authorities having jurisdiction.

E. Maintenance Data: For roofing system to include in the maintenance manuals specified in Division 1.

F. Warranty: Sample copy of standard roofing manufacturer's warranty stating obligations, remedies, limitations, and exclusions of warranty.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer to perform Work of this Section who has specialized in installing roofing similar to that required for this Project; who is approved, authorized, or licensed by the roofing system manufacturer to install manufacturer's product; and who is eligible to receive the standard roofing manufacturer's warranty.

B. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method indicated below by UL, FM, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Exterior Fire-Test Exposure: Class A; complying with ASTM E 108, for application and slopes indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store roofing materials in a dry, warm, well-ventilated, weathertight location according to roofing system manufacturer's written instructions. Store rolls of felt and other sheet materials on end on pallets or other raised surfaces. Do not double-stack rolls.

1. Handle and store roofing materials and place equipment in a manner to avoid significant or permanent damage to deck or structural supporting members.

B. Do not leave unused felts and other sheet materials on the roof overnight or when roofing work is not in progress unless protected from weather and moisture and unless maintained at a temperature exceeding 50 deg F.

C. Deliver and store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.

D. Protect roofing insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

1.08 PROJECT CONDITIONS

A. Weather Limitations: Proceed with roofing work only when existing and forecasted weather conditions permit roofing to be installed according to manufacturers' written instructions and warranty requirements.

1.09 WARRANTY

A. General Warranty: The warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Standard Roofing Manufacturer's Warranty: Submit a written warranty, without monetary limitation, signed by roofing system manufacturer agreeing to promptly repair leaks in the roof membrane and base flashings resulting from defects in materials or workmanship for the following warranty period:

1. Warranty Period: 20 years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Built-up Asphalt Roofing:

a. Barrett Co.

b. Celotex Corp. (The).

c. Fields Corp.

d. GAF Building Materials Corp.

e. Certain Teed Commercial Roofing

f. Henry Co.

g. Hickman: W.P. Hickman Systems, Inc.

h. Malarkey Roofing Co.

i. Schuller Roofing Systems.

j. Tamko Roofing Products, Inc.

k. Tremco, Inc.

l. Tri-Ply, Inc.

m. U.S. Intec, Inc.

2. Polyisocyanurate Board Insulation:

a. Apache Products Co.

b. Atlas Roofing Corporation.

c. Celotex Corp. (The).

d. GAF Building Materials Corp.

e. Schuller Roofing Systems.

2.02 BASE-SHEET MATERIALS

A. Base Sheet: Perforated, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides, complying with ASTM D 4601, Type II.

2.03 ROOF MEMBRANE PLIES

A. Ply Felt: Asphalt-impregnated, glass-fiber felt, complying with ASTM D 2178, Type VI.

B. Cap Sheet: Asphalt-impregnated and -coated, glass-fiber cap sheet, with coarse mineral-granule top surfacing and fine mineral surfacing on bottom surface, complying with ASTM D 3909.

2.04 FLASHING MATERIALS

A. Backer Sheet: Asphalt-impregnated, glass-fiber felt, complying with ASTM D 2178, Type VI.

B. Flashing Sheet: Roofing system manufacturer's standard asphalt-impregnated and -coated composite sheet, smooth surfaced, reinforced with a composite polyester/glass-fiber core.

2.05 ASPHALT MATERIALS

A. Asphalt Primer: ASTM D 41.

B. Roofing Asphalt: ASTM D 312, Type III or Type IV, as recommended by built-up roofing membrane manufacturer.

1. Label each container or provide certification with each load of bulk asphalt identifying type of roofing asphalt and indicating softening point, minimum flash point, equiviscous temperature, and finished blowing temperature.

2.06 AUXILIARY MEMBRANE MATERIALS

A. General: Furnish auxiliary materials recommended by roofing system manufacturer for intended use and compatible with built-up roofing.

1. Furnish liquid-type auxiliary materials that meet VOC limits of authorities having jurisdiction.

B. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing system manufacturer for application.

C. Mastic Sealant: Polyisobutylene, plain or modified bitumen, nonhardening, nonmigrating, nonskinning, and nondrying.

D. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions of FM 4470; designed for fastening base sheets and base flashings and for backnailing ply felts to substrate; tested by manufacturer for required pullout strength; and acceptable to roofing system manufacturer.

E. Metal Flashing Sheet: Metal flashing sheet is specified in Division 7 Section "Sheet Metal Flashing and Trim."

F. Wood Nailer Strips: Furnish wood nailer strips complying with requirements of Division 6 Section "Rough Carpentry."

G. Cants: Wood cants are specified in Division 6 Section "Rough Carpentry."

H. Miscellaneous Accessories: Provide miscellaneous accessories recommended by roofing system manufacturer for intended use.

2.07 INSULATION MATERIALS

A. General: Provide preformed, roofing insulation boards that comply with requirements, selected from manufacturer's standard sizes and of thicknesses indicated.

1. Provide preformed, tapered insulation boards where indicated for sloping to drain. Fabricate with the following taper:

a. As indicated on Drawings.

2. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

B. Polyisocyanurate Board Insulation: Rigid, cellular polyisocyanurate thermal insulation with core formed by using HCFCs as blowing agents complying with ASTM C 1289, classified by facer type as follows:

1. Facer Type: Type II, felt or glass-fiber mat on both major surfaces.

2.08 INSULATION ACCESSORIES

A. General: Furnish roofing insulation accessories recommended by insulation manufacturer for intended use and compatible with sheet roofing material.

B. Substrate Joint Tape: 6 or 8 inches wide, coated, glass-fiber joint tape.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions under which roofing will be applied, with Installer present, for compliance with requirements.

B. Verify that roof openings and penetrations are in place and set and braced and that roof drains are properly clamped into position.

C. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at roof penetrations and terminations and match the thicknesses of insulation required.

D. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean substrate of dust, debris, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install built-up roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations of ARMA/NRCA's "Quality Control Guidelines for the Application of Built-Up Roofing."

B. Cant Strips: Install and secure preformed 45-degree cant strips at junctures of built-up roofing membrane system with vertical surfaces or angle changes greater than 45 degrees.

C. Cooperate with inspecting and testing agencies engaged or required to perform services for installing built-up roofing membrane system.

D. Coordinate installing roofing system components so insulation and roofing plies are not exposed to precipitation or left exposed at the end of the workday or when rain is forecast.

1. Provide cutoffs at end of each day's work to cover exposed ply sheets and insulation with a course of coated felt with joints and edges sealed.

2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.

3. Remove and discard temporary seals before beginning work on adjoining roofing.

E. Asphalt Heating: Heat roofing asphalt and apply within plus or minus 25 deg F of equiviscous temperature, unless otherwise required by roofing system manufacturer. Do not raise roofing asphalt temperature above the equiviscous temperature range more than one hour before time of application. Do not exceed roofing asphalt manufacturer's recommended temperature limits during roofing asphalt heating. Do not heat roofing asphalt within 25 deg F of flash point. Discard roofing asphalt maintained at a temperature exceeding 500 deg F for more than 4 hours. Keep kettle lid closed, unless adding roofing asphalt.

1. Substrate-Joint Penetrations: Prevent roofing asphalt from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction. If mopping is applied directly to substrate, tape substrate joints.

3.04 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system manufacturer's written instructions for installing roofing insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated and to Shop Drawings.

D. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 inches or greater, install required thickness in 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush with ring of drain.

F. Install insulation with long joints of insulation in continuous straight lines with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.

1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

G. Attached Insulation: Prime surface of concrete deck with asphalt primer at a rate of 3/4 gal./100 sq. ft., unless a greater weight is required by roofing system manufacturer, and allow primer to dry. Set each layer of insulation in a solid mopping of hot roofing asphalt.

3.05 BASE-SHEET INSTALLATION

A. Prime surface of concrete deck with asphalt primer at a rate of 3/4 gal./100 sq. ft. and allow primer to dry.

B. Install one lapped course of base sheet according to roofing system manufacturer's written instructions, extending sheet over and terminating beyond cants. Attach base sheet as follows:

1. Adhere to substrate in a solid mopping of hot roofing asphalt.

3.06 ROOF MEMBRANE INSTALLATION

A. Install ply felts according to roofing system manufacturer's written instructions, starting at low point of roofing system. Align ply felts without stretching. Shingle side laps of ply felts uniformly to achieve required number of membrane plies throughout. Shingle in direction to shed water. Extend ply felts over and terminate beyond cants.

1. Install 4 ply felts.

2. Application: Embed each ply felt in a solid mopping of hot roofing asphalt applied at rate required by roofing system manufacturer, to form a uniform membrane without ply felts touching each other.

B. Install lapped cap sheet according to roofing system manufacturer's written instructions, starting at low point of roofing system. Offset laps from laps of preceding ply felts and align cap sheet without stretching. Lap in direction to shed water. Extend cap sheet over and terminate beyond cants.

1. Application: Embed cap sheet in a solid mopping of hot roofing asphalt applied at rate required by roofing system manufacturer.

3.07 FLASHING AND STRIPPING INSTALLATION

A. Install base flashing over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions and as follows:

1. Prime substrates with asphalt primer if required by roofing system manufacturer.

2. Backer Sheet Application: Install backer sheet and adhere to substrate in a solid mopping of hot roofing asphalt.

3. Flashing Sheet Application: Adhere flashing sheet to substrate in a solid mopping of hot roofing asphalt. Apply hot roofing asphalt to back of flashing sheet if recommended by roofing system manufacturer.

B. Extend base flashing up walls or parapets a minimum of 8 inches above roof membrane and 4 inches onto field of roof membrane.

C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

1. Seal top termination of base flashing.

D. Install stripping where metal flanges and edgings are set on built-up roofing according to roofing system manufacturer's written instructions.

1. Flashing-Sheet Stripping: Install flashing-sheet stripping in a continuous coating of asphalt roofing cement or in a solid mopping of hot roofing asphalt, and extend onto roof membrane.

3.08 FIELD QUALITY CONTROL

A. Owner will engage an independent testing and inspecting agency to perform field inspections and quality-assurance tests.

1. Testing agency will prepare reports stating whether inspected and tested Work complies with or deviates from requirements.

B. Correct deficiencies in or remove and replace roof membrane that inspections and test reports indicate does not comply with specified requirements.

1. Repair roof membrane that does not comply with specified requirements by re-adhering test specimens back in place and by applying additional plies, equal to the original number of plies specified, over test specimens according to roofing system manufacturer's written instructions.

C. Additional testing, at Contractor's expense, may be performed to determine that corrected Work complies with specified requirements.

D. Test Cuts: Before flood coating and surfacing built-up roofing membrane, test specimens will be removed to evaluate problems observed during quality-assurance inspections of roof membrane as follows:

1. Approximate quantities of components within roof membrane will be determined according to ASTM D 3617.

2. Test specimens will be examined for interply voids according to ASTM D 3617 and to comply with the criteria established in Appendix 3 of ARMA/NRCA'S "Quality Control Guidelines for the Application of Built-up Roofing."

E. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to City Engineer.

1. Notify City Engineer 48 hours in advance of the date and time of inspection.

3.09 PROTECTING AND CLEANING

A. Protect built-up roofing membrane from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to City Engineer.

B. Correct deficiencies in or remove built-up roofing that does not comply with requirements, repair substrates, reinstall roofing, and repair base flashings to a condition free of damage and deterioration at the time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.10 ROOFING INSTALLER'S WARRANTY

A. WHEREAS <NAME> of <ADDRESS>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner:

2. Address:

3. Building Name/Type:

4. Address:

5. Area of Work:

6. Acceptance Date:

7. Warranty Period:

8. Expiration Date:

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

a. Lightning;

b. Peak gust wind speed exceeding 110 mph;

c. Fire;

d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;

e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;

f. Vapor condensation on bottom of roofing; and

g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof has been paid by Owner or by another responsible party so designated.

3. The Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents, resulting from leaks or faults or defects of work.

4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void, unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.

6. The Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.

7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing

Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this <DAY> day of <MONTH>, 19<YEAR>.

1. Authorized Signature:

2. Name:

3. Title:

END OF SECTION

Section 07600

FLASHING AND SHEET METAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal flashing.

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.

1.03 REFERENCES

A. ASTM B 32 - Standard Specification for Solder Metal.

1.04 SUBMITTALS

A. Conform to requirements of Section 01300 - Submittal Procedures.

B. Submit Shop Drawings and manufacturer's product literature and color samples of prefabricated fascia to Owner for approval.

PART 2 PRODUCTS

2.01 MATERIALS

A. Flashing around mechanical equipment and ducts shall be chrome nickel alloy stainless steel balanced to obtain a high degree of corrosion resistance in the presence of lime and cement, annealed dead soft, No. 28 gauge (0.015 inches) thick when concealed, No. 26 gauge (0.108 inches) when exposed, or whatever gauge is indicated on the Plans.

B. Solder shall be 60/40 (percent tin, lead, respectively) conforming to ASTM B 32; include proper flux for materials to be soldered.

C. Aluminum flashing shall be aluminum alloy 3003 with H-12 or H-1 temper conforming to Federal Specification QQ-A-359d and shall be 0.032 inches thick minimum

D. Gutters and downspouts shall be pre-coated galvanized steel with Kynar 500 finish to match roofing panels.

PART 3 EXECUTION

3.01 INSTALLATION

A. Vent pipes shall have 4 lb. lead base flashing sleeve extending out under roofing 6 inches minimum and up to top of vent pipe. Vent pipes shall have 4 lb. lead Cap Flashing lapping over base pipes 1 inch minimum and soldered.

B. Install stainless steel cap flashing for roof ventilators, exhaust fans, and other equipment as detailed on Contract Drawings using approved methods of soldering, jointing, and welding. Fasteners shall be aluminum.

3.02 PAINTING AND PROTECTION

A. Separate contact faces of aluminum, stainless steel, and galvanized sheet metal work which are in contact with dissimilar metals, wood, masonry, concrete, or plaster with one heavy coat of asphaltic paint, or one layer of roofing felt.

B. Finish field paint coats shall conform to Section 09900 - Painting.

3.03 CLEANING

A. After installation is completed, clean aluminum work with mild non-alkali soap and clean water solution. Follow washing with clear rinse. Do not use abrasive cleaners.

END OF SECTION

Section 07920

CAULKING AND SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preparing sealant substrate surfaces.

B. Sealant and backing.

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.

1.03 REFERENCES

A. ASTM C 719 - Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle).

B. ASTM C 834 - Standard Specification for Latex Sealants.

C. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants.

D. ASTM C 1193 – Standard Guide for Use of Joint Sealants.

E. ASTM C 1311 - Standard Specification for Solvent Release Sealants.

F. ASTM D 1056 - Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.

G. FS TT-C-00598 - Caulking Compound, Oil and Resin Base Type.

H. FS TT-S-001657 - Sealing Compound, Single Component, Butyl Rubber Based, Solvent Release Type.

I. FS TT-S-00227 - Sealing Compound: Elastomeric Type, Multi- Component.

J. FS TT-S-00230 - Sealing Compound: Elastomeric Type, Single Component.

K. FS TT-S-001543 - Sealing Compound, Silicone Rubber Base.

L. SWI (Sealing and Waterproofers Institute) - Sealant and Caulking Guide Specification.

1.04 SUBMITTALS

A. Conform to requirements of Section 01300 - Submittal Procedures.

B. Submit product data indicating sealant chemical characteristics, performance criteria, limitations, and color availability. Include manufacturer's certification that sealants, plus the primers, and cleaners required for sealant installation comply with

regulations controlling use of volatile organic compounds.

C. Submit two samples 6 inches in length, in size illustrating colors selected.

D. Submit manufacturer's certificate under provisions of Section 01450 - Contractors Quality Control that products meet or exceed requirements.

1.05 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years documented experience.

B. Applicator: Company specializing in applying the work of this Section with minimum 3 years documented experience and approved by sealant manufacturer.

C. Conform to Sealant and Waterproofers Institute requirements for materials and installation.

1.06 PRECONSTRUCTION TESTING

A. Provide comprehensive certified test data for each type of joint sealant based on tests conducted by a qualified independent testing laboratory on current product formulations within a 12-month period preceding date of Contractor's submittal of test results.

1. Test elastomeric sealants for compliance with requirements specified by reference to ASTM C 920. Include test results for hardness, stain resistance, adhesion and cohesion under cyclic movement (per ASTM C 719), low-temperature flexibility, modules of elasticity at 100 percent strain, effects of heat aging, and effects of accelerated weathering.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Do not install solvent curing sealants in enclosed building spaces.

B. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.08 WARRANTY

A. Provide 5-year warranty under provisions of Section 01700 - Contract Closeout.

B. Include coverage of installed sealants and accessories that fail to achieve airtight and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 SEALANTS

A. Polysulphide Sealant: Single component, chemical curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging self-leveling type; color as selected from the manufactured standard line.

1. Elongation Capability: 20 percent

2. Service Temperature Range: -40 to 180 degrees F

3. Shore A Hardness Range: 20 to 35

B. Polysulphide Sealant: Two component homogeneous mix, chemical curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging type; color as selected from the manufactured standard line.

1. Elongation Capability: 25 percent

2. Service Temperature Range: -40 to 180 degrees F

3. Shore A Hardness Range: 20 to 35

C. Polyurethane Sealant: Single component, chemical curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging, color as selected from the manufactured standard line.

1. Elongation Capability: 25 percent

2. Service Temperature Range: -40 to 180 degrees F

3. Shore A Hardness Range: 20 to 35

D. Polyurethane Sealant: Multi-component, chemical curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging, color as selected from the manufactured standard line.

1. Elongation Capability: 25 percent

2. Service Temperature Range: -40 to 180 degrees F

3. Shore A Hardness Range: 20 to 35

E. Silicone Sealant: For areas not to receive paint, single component, solvent curing, non- sagging, non-staining, fungus resistant, non-bleeding; color as selected from the manufactured standard line.

1. Elongation Capability: 25 percent

2. Service Temperature Range: -75 to +400 degrees F

3. Shore A Hardness Range: 15 to 35

F. Silicone Sealant: For areas not to receive paint, single component, fungus resistant, chemical curing, non-sagging, non-staining, non-bleeding; color as selected from the manufactured standard line.

1. Elongation Capability: 25 percent

2. Service Temperature Range: -75 to +400 degrees F

3. Shore A Hardness Range: 15 to 35

G. Acrylic Sealant: Single component, solvent curing, non-staining, non-bleeding,

non-sagging, capable of continuous water immersion; color as selected from the manufactured standard line, per ASTM C 834.

1. Elongation Capability: 7.5 to 12 percent
2. Service Temperature Range: -13 to 180 degrees F
3. Shore A Hardness Range: 25 to 50

H. Butyl Sealant: Single component, solvent release, non- skinning, non-sagging, black color.

1. Elongation Capability: 7 to 10 percent
2. Service Temperature Range: -13 to 180 degrees F
3. Shore A Hardness Range: 10 to 30

I. Oil Based: Single component, resinous compound, elongation capability of 0 to 2 percent of joint width.

J. Acrylic Emulsion Latex: Single component, non-staining, non-bleeding, non-sagging; color as selected from the manufactured standard line.

1. Elongation Capability: 2 to 5 percent
2. Service Temperature Range: 2 to 160 degrees F
3. Shore A Hardness Range: 15 to 40

2.02 MANUFACTURERS

A. Pecora Corporation.

B. Emseal Joint Systems, Ltd.

C. Sonneborn, ChemRex, Inc.

D. Tremco, Inc.

2.03 ACCESSORIES

A. Primer: Non-staining type, as recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Joint Backing: ASTM D 1056; round, closed cell polyethylene; oversized 30 to 50 percent larger than joint width, and compatible with sealant.

D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and joint openings are ready to receive work and field measurements are as shown on Drawings and recommended by the manufacturer.

B. Beginning of installation means installer accepts existing surfaces and substrates.

3.02 PREPARATION

A. Clean and prime joints in accordance with manufacturer's instructions.

B. Remove loose materials and foreign matter that might impair adhesion of sealant.

C. Verify that joint backing and release tapes are compatible with sealant.

D. Perform preparation in accordance with ASTM C 1193.

E. Protect elements surrounding the work of this Section from damage or disfiguration.

3.03 INSTALLATION

A. Comply with recommendations of ASTM C 1193 - Guide for Use of Joint Sealants. Perform installation in accordance with ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions.

B. Measure joint dimensions and size materials to achieve required width/depth ratios.

C. Install joint backing to achieve a neck dimension no greater than 1/3 the joint width.

D. Install bond breaker where joint backing is not used.

E. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

G. Tool joints as detailed.

3.04 CLEANING AND REPAIRING

A. Clean work under provisions of Section 01710 - Cleaning.

B. Clean adjacent soiled surfaces.

C. Repair or replace defaced or disfigured finishes caused by work of this Section.

3.05 PROTECTION OF FINISHED WORK

A. Protect sealants until cured.

END OF SECTION

Section 08110

STEEL DOOR FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Steel door frames and mounting hardware.

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.

1.03 QUALITY ASSURANCE:

A. Provide door frames complying with Steel Door Institute "Recommended Specifications: Standard Steel Doors and Frames" (SDI-100) and as herein specified.

1.04 MANUFACTURER: Provide door steel frames by one of the following:

A. Amweld Building Products Division.

B. Fenestra.

C. Republic Builders Prod. Corporation.

D. Steelcraft Mfg. Company.

PART 2 PRODUCTS

2.01 MATERIALS

A. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A 653, G60 zinc coating, mill phosphatized.

B. Supports and Anchors: Fabricate of not less than 18 gage galvanized sheet steel.

C. Inserts, Bolts and Fasteners: Manufacturer's standard units, except hot-dip galvanize items to be built into exterior walls, complying with ASTM A 153,

Class C or D as applicable.

D. Shop Applied Paint:

1. Primer: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints.

2. Finish: In accordance with Specification Section 09901-Protective Coatings.

2.02 FABRICATION, GENERAL:

A. Fabricate steel door frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at Project Site.

B. Fabricate frames from either cold-rolled or hot-rolled steel (at fabricator's option).

C. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat Phillips heads for exposed screws and bolts.

D. Finish Hardware Preparation: Prepare door frames to receive mortised and concealed finish hardware in accordance with final Finish Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A 115 series specification for door and frame preparation for hardware.

1. Reinforce door frames to receive surface-applied hardware. Drilling and tapping for surface-applied finish hardware may be done at Project Site.

2. Locate finish hardware as shown on final Shop Drawings or, if not shown, in accordance with "Recommended Locations for Builder's Hardware," published by Door and Hardware Institute.

E. Shop Painting:

1. Clean, treat, and paint exposed surfaces of steel door frame units, including galvanized surfaces.

2. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.

3. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint.

PART 3 EXECUTION

3.01 EXAMINATION:

A. Installer must examine substrate and conditions under which steel door frames are to be installed and must notify Contractor in writing of any condition detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION:

A. General: Install standard steel door frames, and accessories in accordance with final Shop Drawings and manufacturer's data, and as herein specified.

B. Placing Frames.

1. Comply with provisions of SDI-105 "Recommended Erection Instructions For Steel Frames", unless otherwise indicated.

2. Except for frames located at in-place concrete and at drywall installations, place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.

3. At in-place concrete construction, set frames and secure to adjacent construction with machine screws and masonry anchorage devices.

4. In metal stud partitions, install at least 3 wall anchors per jamb at hinge and strike levels. In open steel stud partitions, place studs in wall anchor notches and wire tie. In closed steel stud partitions, attach wall anchors to studs with tapping screws.

3.03 ADJUST AND CLEAN:

A. Comply with Requirements of Sections 01700-Contract Closeout, and 09901-Protective Coatings, of Specifications as applicable.

B. Prime Coat Touch-Up: Immediately after erection, sand smooth any rusted or

damaged areas of prime coat and apply touch-up of compatible air-drying primer.

C. Final Adjustments: Check and readjust operating finish hardware items, leavings steel door frames undamaged and in complete and proper operating condition.

END OF SECTION

Section 08111

STANDARD STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Standard hollow-metal steel doors.
2. Standard hollow-metal steel frames.

B. Related Sections include the following:

1. Division 4 Section "Unit Masonry Assemblies" for building anchors into and grouting standard steel frames in masonry construction.
2. NOT USED.
3. NOT USED.
4. Division 8 Sections for door hardware for standard steel doors.
5. NOT USED

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance rating and finishes for each type of steel door and frame specified.

B. Shop Drawings: In addition to requirements below, provide a schedule of standard steel doors and frames using same reference numbers for details and openings as those on Drawings:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details.
3. Frame details for each frame type, including dimensioned profiles.
4. Details and locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, accessories, joints, and connections.
7. Details of conduit and preparations for electrified door hardware and controls.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Qualification Data: For Installer.

E. Product Test Reports: Based on evaluation of comprehensive fire tests performed by a qualified testing agency, for each type of standard steel door and frame.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

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

C. Source Limitations: Obtain standard steel doors and frames through one source from a single manufacturer.

D. Fire-Rated Door Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.

1. Test Pressure: Test at atmospheric (neutral) pressure according to NFPA 252 or UL 1OB.
2. Test Pressure: Test according to NFPA 252 or UL 1OC. After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40 inches or less above the sill.
3. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply with standard construction

requirements for tested and labeled fire-protection-rated door assemblies except for size.

4. Temperature-Rise Rating: At exit enclosures, provide doors that have a temperature-rise rating of 450 deg F maximum in 30 minutes of fire exposure.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store doors and frames under *cover* at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.

1. If wrappers on doors become wet, *remove* cartons immediately. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating standard steel frames without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate installation of anchorages for standard steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be

embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2- PRODUCTS

2.1 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 zinc-iron-alloy (galvannealed) coating designation.

D. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591/A 591M, Commercial Steel (CS), Class B coating; mill phosphatized.

E. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.

F. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M.

G. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching standard steel door frames of type indicated.

H. Grout: Comply with Division 4 Section "Unit Masonry Assemblies."

I. Grout: Comply with ASTM C 476, with a slump of 4 inches for standard steel door frames built into concrete or masonry, as measured according to ASTM C 143/C 143M.

J. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-developed indexes of 25 and 50 respectively; passing ASTM E 136 for combustion characteristics.

2.2 STANDARD STEEL DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8.

1. Design: Flush panel
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, mineral-board, or vertical steel-stiffener core that produces doors complying with ANSI A250.8.

   a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
   b. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (A-value) of not less 12.3 deg F x h x sq. ft/Btu when tested according to ASTM C 1363.

      1) Locations: Exterior doors and interior doors where indicated.

3. Vertical Edges for Single-Acting DoorsSquare edge unless beveled edge is indicated.

   a. Beveled Edge: 1/8 inch in 2 inches.

4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch radius.
5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch thick end closures or channels of same material as face sheets.
6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:

1. Level 1 and Physical Performance Level C, (Standard Duty), Model (Seamless).

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior door requirements. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:

1. Level 1 and Physical Performance Level C, (Standard Duty), Model (Seamless).

D. Hardware Reinforcement: Fabricate reinforcement plates from same material as door face sheets to comply with the following minimum sizes:

1. Hinges: Minimum 0.123 inch thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
2. Pivots: Minimum 0.167 inch thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
3. Lock Face, Flush Bolts, Closers, and Concealed Holders: Minimum 0.067 inch thick.
4. All Other Surface-Mounted Hardware: Minimum 0.067 inch thick.

E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.3 STANDARD STEEL FRAMES

A. General: Comply with ANSI A250.8 and with details indicated for type and profile.

B. Exterior Frames: Fabricated from metallic-coated steel sheet.

1. Fabricate frames with mitered or coped and welded face corners and seamless face joints.
2. Frames for Level 1 Steel Doors: 0.053-inch thick steel sheet, unless otherwise indicated.

C. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements.

1. Fabricate frames with mitered or coped and welded face corners and seamless face joints, unless otherwise indicated.
2. Frames for Level 1 Steel Doors: 0.053-inch thick steel sheet, unless otherwise indicated.

D. Hardware Reinforcement: Fabricate reinforcement plates from same material as frames to comply with the following minimum sizes:

1. Hinges: Minimum 0.123 inch thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
2. Pivots: Minimum 0.167 inch thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
3. Lock Face, Flush Bolts, Closers, and Concealed Holders: Minimum 0.067 inch thick.
4. All Other Surface-Mounted Hardware: Minimum 0.067 inch thick.

E. Supports and Anchors: Fabricated from electrolytic zinc-coated or metallic-coated steel sheet.

F. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 1O inches long; or wire anchors not less than 0.177 inch thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.

G. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

H. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STOPS AND MOLDINGS

A. Fixed Frame Moldings: Formed integral with standard steel frames, minimum 5/8 inch high, unless otherwise indicated.

2.5 FABRICATION

A. General: Fabricate standard steel doors and frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Standard Steel Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

C. Standard Steel Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners, unless otherwise indicated.
3. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
4. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Two anchors per jamb up to 60 inches in height.
        2) Three anchors per jamb from 60 to 90 inches in height.
        3) Four anchors per jamb from 90 to 120 inches in height.
        4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof more than 120 inches in height.

    b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Three anchors per jamb up to 60 inches in height.
        2) Four anchors per jamb from 60 to 90 inches in height.
        3) Five anchors per jamb from 90 to 96 inches in height.
        4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof more than 96 inches in height.
        5) Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.

5. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

D. Hardware Preparation: Factory prepare standard steel doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."

1. Reinforce doors and frames to receive nontemplated mortised and surface-mounted door hardware.
2. Comply with applicable requirements in ANSI A250.6 and ANSI/DH I A 115 Series specifications for door and frame preparation for hardware. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.

E. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
2. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.6 STEEL FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish standard steel door and frames after assembly.

B. Metallic-Coated Steel Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

C. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

D. Factory-Applied Paint Finish: Manufacturer's standard, complying with ANSI A250.3 for performance and acceptance criteria.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3- EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of standard steel doors and frames.

1. Examine roughing-in for embedded and built-in anchors to verify actual locations of standard steel frame connections before frame installation.
2. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory.

B. Prior to installation and with installation spreaders in place, adjust and securely brace standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Provide doors and frames of sizes, thicknesses, and designs indicated. Install standard steel doors and frames plumb, rigid, properly

aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Standard Steel Frames: Install standard steel frames for doors and other openings, of size and profile indicated. Comply with SDI 105.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. At fire-protection-rated openings, install frames according to NFPA 80.
    b. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    c. Install door silencers in frames before grouting.
    d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    e. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    f. Apply bituminous coating to backs of frames that are filled with mortar, grout, and plaster containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors.

    a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar as specified in Division 4 Section "Unit Masonry Assemblies."
5. Concrete Walls: Solidly fill space between frames and concrete with grout. Install grout in lifts and take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
6. Installation Tolerances: Adjust standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.

c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Standard Steel Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch plus or minus 1/16 inch
b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch
c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including standard steel doors or frames that are warped, bowed, or otherwise unacceptable.

B. Clean grout and other bonding material off standard steel doors and frames immediately after installation.

C. Galvannealed Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

Section 08331

OVERHEAD COILING DOORS

PART I GENERAL

1.1 SECTION INCLUDES

A. Furnishing and installation of overhead coiling doors.

1.2 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 the cost of work performed under this Section in pay items for which this work is a component.

1.3 DEFINITIONS

A. Operation Cycle: One complete cycle of a door begins with the door in the closed position. The door is then moved to the open position and back to the closed position.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide overhead coiling doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:

1. Wind Load: Uniform pressure (velocity pressure) of 40 lbf/sq.-ft., acting inward and outward.

B. Operation-Cycle Requirements: Design overhead coiling door components and operator to operate for not less than 10,000 cycles.

1.5 SUBMITTALS

A. Comply with Section 01330 - Submittal Procedures and Section 01340 - Shop Drawings, Product Data, and Samples and the supplemental requirements below

B. Product Data:For each type and size of overhead coiling door and accessory. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes. Provide roughing-in diagrams, operating instructions, and maintenance

information. Include the following:

1. Setting drawings, templates, and installation instructions for built-in or embedded anchor devices.

2. Summary of forces and loads on walls and jambs.

C. Shop Drawings: For special components and installations not dimensioned or detailed in manufacturer's data sheets.

D. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied finishes.

E. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who is an authorized representative of the overhead coiling door manufacturer for both installation and maintenance of units required for this Project.

B. Source Limitations: Obtain overhead coiling doors through one source from a single manufacturer.

1.7 DELIVERY STORAGE AND HANDLING

A. Comply with the requirements of Section 01610-Basic Product Requirements.

1.8 WARRANTY

A. Provide warranty under provisions of Section 01770 - Closeout Procedures.

B. Door manufacturer shall furnish to the City a warranty written expressly from the manufacturer to the City of Houston, covering workmanship and material under normal use and service. The warranty shall cover 100 percent of parts and labor for at least one (1) full year. The warranty period shall commence after beneficial use has been established by the City. Warranty shall be in printed form and previously published as the manufacturer's standard warranty for similar manufactured units.

PART2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Overhead Door Corporation, or approved equal.

2.2 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Trade Reference: 625 Series Stormtite Insulated Service Doors by Overhead Door Corporation or approved equal.

B. Door Curtain: Fabricate overhead coiling door curtain of interlocking slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of material thickness recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Flat profile type F-265!. The front slat shall be fabricated of 22 gauge galvanized steel. The back slat shall be 24 gauge galvanized steel.

2. Slat cavity shall be filled with CFC-free foamed-in- place, polyurethane insulation.

C. Endlocks: Manufacturer's standard locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.

D. Bottom Bar: Two powder coated galvanized steel angles, thickness 1/8" bolted back to back to reinforce curtain in the guides.

E. Curtain Jamb Guides: Three galvanized structural steel angles with minimum thickness of 3/16". Guides shall be weatherstripped with a vinyl weather seal at each jamb, on the exterior curtain side and interior cmiain side.

F. Finish: Galvanized Steel: Slats and hood shall be galvanized steel in accordance with ASTM A 525 and receive rust-inhibitive, roll coating process, including bonderizing,
0.2 mils thick baked-on prime paint, and 0.6 mils thick baked-on powder coated top coat. Non-galvanized exposed ferrous surfaces shall receive one coat of rust inhibitive primer.

G. Color: Powder coating finish in color as selected by City Representative from manufacturers' standard colors.

2.3 HOODS AND ACCESSORIES

A. Hood: Form to entirely enclose coiled curtain and operating mechanism at opening head and act as weatherseal. Contour to suit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sag.

1. Fabricate steel hoods, for steel doors, of not less than 0.028-inch thick, hot- dip galvanized steel sheet with G90 zinc coating, complying with ASTMA653.

B. Integral Frame, Hood, and Fascia: Provide welded assemblies of the following sheet metal:

1. Fabricate of not less than 0.064-inch-thick, hot-dip galvanized steel sheet with G90 zinc coating, complying with ASTM A 653.

C. Integral Sills: Fabricate sills as integral part of frame assembly of same sheet metal, but not less than 0.078 inch thick.

D. Weatherseals: Provide replaceable, adjustable, continuous, compressible weather- stripping gaskets fitted to bottom and at top of exterior doors, unless otherwise indicated. At door head, use 1/8-inch-thick, replaceable, continuous sheet secured to inside of curtain coil hood.

1. In addition, provide replaceable, adjustable, continuous, flexible, 1/8-inch- thick seals of flexible vinyl, rubber, or neoprene at door jambs for a weathertight installation.

E. Push/Pull Handles: For push-up-operated doors, provide galvanized steel lifting handles on each side of door.

1. Provide pull-down straps or pole hooks for doors more than 84 inches high.

F. Slide Bolt: Fabricate with side locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

G. Chain Lock Keeper: Suitable for padlock.

2.4 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of adjustable-tension steel helical torsion spring, mounted around a steel shaft and contained in a spring barrel connected to door curtain with required barrel rings, designed for standard 20,000 cycle life design. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of hot-fonned, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.

C. Provide spring balance of one or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Provide cast-steel barrel plugs to secure ends of springs to barrel and shaft.

D. Fabricate torsion rod for counterbalance shaft of cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Provide mounting brackets of manufacturer's standard design, either cast- iron or cold-rolled steel plate with bell-mouth guide groove for curtain.

2.5 FINISHES, GENERAL

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 STEEL AND GALVANIZED STEEL FINISHES

A. Powder-Coat-Applied Finish: Apply manufacturer's standard powder-coat-applied finish consisting of primer and topcoat(s) according to coating manufacturer's written instructions for cleaning, pretreatment, application,

thermosetting, and minimum dry film thickness.

1. Color and Gloss: As selected by Contracting Officer's Representative from manufacturer's full range of colors and glosses.

2.7 MANUAL DOOR OPERATORS

A. Push-up Operation (Emergency Mode of Operation): Design counterbalance mechanism so required lift or pull for door operation does not exceed 25 lb.

B. Chain-Hoist Operator (Primary Mode of Operation): Provide manual chain-hoist operator consisting of endless steel hand chain, chain pocket wheel and guard, and gear-reduction unit with a maximum 35-lbf effort for door operation. Provide alloy steel hand chain with chain holder secured to operator guide.

PART3 EXECUTION

3.1 INSTALLATION

A. General: Install door and operating equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports according to Shop Drawings, manufacturer's written instructions, and as specified.

3.2 ADJUSTING

A. Lubricate bearings and sliding parts; adjust doors to operate easily, free from warp, twist, or distortion and fitting weathertight for entire perimeter.

3.3 DEMONSTRATION

A. Startup Services: Engage a factory-authorized service representative to perform startup services and to train Owner's maintenance personnel as specified below:

1. Test and adjust operators and safeties. Replace damaged and malfunctioning operators and equipment.

2. Train Owner's operation and maintenance personnel on operation, troubleshooting, servicing, preventive maintenance, and

procedures for testing and resetting release devices.

3. Review data in the maintenance manuals.

4. Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

Section 08710

DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for doors including thresholds, weatherstripping, and seals.

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 the cost of work performed under this Section in pay items for which this work is a component.

1.03 REFERENCES STANDARDS

A. NFPA 101—Code for Safety to Life from Fire in Buildings and Structures.

B. Door and Hardware Institute.

1.04 SUBMITTALS

A. Conform to requirements of Section 01300 - Submittal Procedures.

B. Shop Drawings: Indicate locations and mounting heights of each type of hardware.

C. Submit manufacturer's parts lists and templates for door and frame preparation.

1.05 PROJECT RECORD DOCUMENTS

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

B. Record actual locations of installed cylinders and their key code.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01730 - Operations and Maintenance Data.

B. Maintenance Data: Include data on operating hardware, lubrication

requirements, and inspection procedures related to preventative maintenance.

1.07 QUALITY ASSURANCE

A. Perform work in accordance with the following requirements:

1. Door and Hardware Institute.

2. NFPA 101, where applicable.

1.08 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Hardware Supplier: Company specializing in supplying commercial institutional door hardware with 3 years documented experience approved by manufacturer.

C. Hardware Supplier Personnel: Employ a qualified person to assist in the work of this section.

1.09 REGULATORY REQUIREMENTS

A. Conform to applicable code for requirements applicable to fire-rated doors and frames, where applicable.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products in accordance with Manufacturer's recommendation.

B. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.

C. Deliver keys to Owner by security shipment direct from hardware supplier.

1.11 COORDINATION

A. Coordinate the work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware.

1.12 MAINTENANCE MATERIALS

A. Provide maintenance materials under provisions of 01700 - Contract Closeout.

B. Provide special wrenches and tools applicable to each different or special hardware component.

C. Provide maintenance tools and accessories supplied by hardware component manufacturer.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers are identified in the hardware schedule at the end of section.

B. Substitutions: Under provisions of Section 01630 - Product Options and Substitutions.

2.02 KEYING

A. Door Locks: Grand master keyed. Include construction keying. Key to existing keying system.

B. Existing Keying System: Best Locking System of Houston, Inc. Best Lock Code No. R-2638.

C. Supply keys in the following quantities:

1. 3 master keys, each master set.

2. 2 construction keys.

3. 3 change keys for each lock.

2.03 FINISHES

A. Finishes: Identified in schedule on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify site conditions.

B. Verify that doors and frames are ready to receive work and dimensions are as indicated on shop drawings.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions.

B. Use templates provided by hardware item manufacturer.

C. Mounting heights for hardware from finished floor to center line of hardware item:

1. Locksets: 40-5/16 inches.

2. Top hinge, top edge from top of door: 5 inches.

3. Center hinge: Centered between other hinges.

4. Bottom hinge, lower edge from floor: 10 inches.

3.03 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.04 ADJUSTING

A. Adjust hardware for smooth operation.

3.05 PROTECTION OF FINISHED WORK

A. Protect finished work under provisions of Section 01500 - Temporary Facilities and Controls.

B. Do not permit adjacent work to damage hardware or finish.

3.06 SCHEDULE

A. The following items define hardware scheduled on the Contract Drawings in the door/hardware schedule.
1. Cylindrical Marine Hardware, Locksets

a. Corbin Russwin, CK4200 Series with stainless steel chassis M26 Option GRC Trim Style, 863-SS Global design. Finish 630 (satin stainless steel).

b. Sargent 9 Line series, OB Design.

c. Schlage, C/locks series, orbit design.

1) Provide 6-pin tumblers, deadlocking latches, box strikes, 2-3/4-inch backset, and construction keying.

2) Finish shall be US-32D satin stainless steel.

2. Exterior door panic device; Yale 7130 - L8XAU556XUS32D, Corbin Russwin ED5600XAS32D.

3. Closers

a. Norton 7500DD series, Yale 4400SS series.

b. Furnish US-32D satin stainless steel finish.

4. Accessories

a. Flush Bolts: Glynn Johnson FB-6, Trimco 3917 x 12", Ives 458B, or equal, with US-32D finish. Provide dustproof strike for floor application.

B. The following items define required hardware that may or may not be scheduled on the Contract Drawings.

1. Interior Hinges

a. Hinges: US-32D satin stainless steel finish.

b. Furnish number of three (3) butt hinges per leaf as follows:

c. Hinge sizes shall be as follows:

1) Door frames 36-inches-wide or less: 4-1/2 x 4-1/2 inches.

2) Door frames more than 36-inches and less than 48-inches wide:
5 x 4-1/2 inches.

2. Exterior Hinges

   a. Hinges: US-32D satin stainless steel finish;

   b. Exterior doors (four ball bearing butt hinges per leaf), 4 1/2 x 4 1/2 inches, Hager BB1199, Lawrence Brothers, Inc. BB5151, Stanely FBB199 with nonremovable pins.

C. Door Stops And Holders

1. Floor-mounted door stops and holders with risers where required, Glynn Johnson F40 (for non-fire-rated doors) series at all exterior doors.

2. Weatherseal all exterior doors: Zero Weather Stripping Co., Inc., Pemco Manufacturing Co., National Guard Products, Inc.

   a. Door bottom surface seal: US-28 finish with extreme temperature neoprene, Zero 52, Pemco 314AN, National 112N.

   b Door frame heads and jambs, stainless steel Zero 19W, Pemco 74ST, National 42CS.

3. Thresholds, US-32D finish for exterior doors except where otherwise noted: Zero 164SS, Pemco 175SS, National Guard 412SS.

D. Hardware Schedule: As shown on Contract Drawings.

END OF SECTION

Section 09260

GYPSUM BOARD

PART 1 G E N E R A L

1.01 WORK INCLUDED

A. Gypsum board.

B. Taped and sanded joint treatment.

1.02 UNIT PRICES

A. Unless indicated in the Unit Price Schedule as a pay item, no separate payment will be made for gypsum board system under this Section. Include payment in Lump Sum with price breakdown included in the Schedule of Values.

1.03 REFERENCES

A. ASTM C 11 - Standard Terminology Relating to Gypsum and Related Building Materials and Systems.

B. ASTM C 475 - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

C. ASTM C 754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.

D. ASTM C 840 - Standard Specification for Application and Finishing of Gypsum Board.

C. ASTM C 1396 - Standard Specification for Gypsum Board.

F. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

1.04 QUALITY ASSURANCE

A. Applicator: Company specializing in gypsum board systems with 3 years documented experience approved by manufacturer.

1.05 REGULATORY REQUIREMENTS

A. Conform to applicable code for fire rated assemblies as required by local codes.

1.06 SUBMITTALS

A. Conform to requirements of Section 01300 - Submittal Procedures.

B. Provide product data on gypsum board, joint compound, and tape.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack gypsum boards flat to prevent sagging.

C. Handle gypsum boards to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.08 PROJECT CONDITIONS

A. Environmental Conditions: Establish and maintain environmental conditions for application and finishing gypsum board to comply with ASTM C 840 and with gypsum board manufacturer's recommendations.

B. Minimum Room Temperatures: For nonadhesive attachment of gypsum board to framing, maintain not less than 40 degrees F. For adhesive attachment and finishing of gypsum board maintain not less than 50 degrees F for 48 hours prior to application and continuously thereafter until drying is complete.

C. Ventilate building spaces to remove water not required for drying joint treatment materials. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS - GYPSUM BOARD SYSTEM

A. United States Gypsum Company.

B. Gold Bond Building Products.

C. Other acceptable manufacturers offering equivalent products, as approved by

Engineer.

D. Substitutions: Under provisions of Section 01630 - Product Options and Substitutions.

2.02 GYPSUM BOARD MATERIALS

A. Regular Gypsum Board: ASTM C 1396, High Strength Ceiling Board, 5/8-inch minimum thickness, maximum available length, edges, tapered.

2.03 ACCESSORIES

A. Joint Materials: ASTM C 475; reinforcing tape, joint compound, adhesive, water, and fasteners.

1. Tape: 2 inches wide self-adhering fiberglass tape.
2. Compound: Drying type pre-mixed vinyl base compound.

PART 3 E X E C U T I O N

3.01 INSPECTION

A. Verify that site conditions are ready to receive work and opening dimensions are as indicated on shop drawings.

B. Beginning of installation means acceptance of existing surfaces and substrate.

3.02 GYPSUM BOARD INSTALLATION

A. Install and finish gypsum board in accordance with ASTM C 840.

B. Erect single layer, standard gypsum, board in most economical direction, with ends and edges occurring over firm bearing.

C. Use fastening method for attaching gypsum board as recommended by board manufacturer.

3.03 JOINT TREATMENT

A. Tape, fill, and sand exposed joints to produce smooth surface ready to receive final finish.

B. Feather coats onto adjoining surfaces so that camber is maximum 1/32 inch.

3.04 TOLERANCES

A. Maximum Variation from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

Section 09900

PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation and field painting application.

B. Shop preparation and shop prime coating when specified in other Sections of these Specifications.

C. A free choice of manufacturer's standard factory mixed or mechanically proportioned intermixed colors. A color schedule will be furnished after manufacturer of material has been selected.

1.02 UNIT PRICES

A. No separate payment will be made for Painting under this Section. Include payment in Lump Sum bid item for the applicable item with price breakdown included in the Schedule of Values.

B. Refer to Section 01270 - Measurement and Payment and Section 01292 - Schedule of Values.

1.03 REFERENCES

A. ASTM D16 - Definitions of Terms Rating to Paint, Varnish, Lacquer, and Related Products.

B. ASTM D2016 - Test Method for Moisture Content of Wood.

C. National Paint and Coatings Association (NPCA) - Guide to U.S. Government Paint Specifications.

D. Painting and Decorating Contractors of America (PDCA) - Painting - Architectural Specifications Manual.

1.04 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this Section.

1.05 SUBMITTALS

A. Submit under provisions of Section 01330 - Submittal Procedures.

B. Product Data: Provide data on all finishing products.

C. Inspection Devices: Furnish inspection devices, in good working conditions for the detection of holidays, and the measurement of coating thickness (wet and dry).

D. Provide mask, gloves and other protective materials, and/or clothing recommended by the paint manufacturer.

E. Provide special, temporary, ventilation required by the paint manufacturer.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 10 years documented experience.

B. Applicator: Company specializing in performing the work of this section with minimum 5 years documented experience approved by manufacturer.

1.07 REGULATORY REQUIREMENTS

A. Conform to applicable locally adopted codes for flame and smoke rating requirements for finishes.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 01610 - Basic Product Requirements.

B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

C. Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

D. Store paint materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F in ventilated area, and as required by manufacturer's instructions.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Do not apply material when surface and ambient temperature are outside the temperature ranges required by the paint product manufacturer.

B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

C. Minimum Application Temperature for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

D. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

1.10 EXTRA MATERIALS

A. Furnish under provisions of Section 01770 - Closeout Procedures.

B. Provide 3 gallons of each color of each coating of material specified for City's maintenance use. Provide in individual gallon quantities.

C. Label each container with manufacturer's name, product number, color number, date and name and number of building rooms where used, equipment or piping coated, etc.

PART 2 P R O D U C T S

2.01 MANUFACTURERS

A. See Schedule in Part 3 for manufacturers, types, surfaces by exposure to be painted, the paint system to use and minimum dry mil thickness.

B. The following manufacturers (with the abbreviated name used in the Painting Schedule) are approved for use. Use the products of only one manufacturer.

1. Devoe & Reynolds Co. (Devoe).

2. Pittsburgh Paints, (PPG).

3. Pratt and Lambert, Inc. (P&L).

4. The Valspar Corporation, (Valspar).

5. The Sherwin Williams Co.,(Sherwin).

C. Products of a manufacturer other than those named may be accepted if proof is submitted, prepared by an independent testing laboratory, that the products, item by item, are the same generic type and equal to those specified in composition, durability, utility, coverage, and appearance for the intended use.

2.02 MATERIALS

A. Coatings: Ready mixed, except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating; good flow and brushing properties; capable of drying or curing free of streaks or sags.

B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

C. Patching Materials: Latex filler.

D. Fastener Head Cover Materials: Latex filler.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify site conditions.

B. Verify that surfaces and substrate conditions are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. Test shop applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:

1. Plaster and Gypsum Wallboard: 12 percent.

2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.

3. Interior Wood: 15 percent, measured in accordance with ASTM D2016.

4. Exterior Wood: 15 percent, measured in accordance with ASTM D2016.

5. Starting work constitutes acceptance (on the Contractor's part) of conditions and substrates and full responsibiliites for the quality and suitable for the finished work.

3.02 PREPARATION

A. Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

B. Correct defects and clean surfaces which affect work of this section. Remove existing coatings that exhibit loose surface defects.

C. Seal with shellac and seal marks which may bleed through surface finishes.

D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

E. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.

F. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder,and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding

metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

G. Interior Wood Items Scheduled to Receive Paint Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.

H. Exterior Wood Scheduled to Receive Paint Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior caulking compound after prime coat has been applied.

3.03 APPLICATION

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

B. Do not apply finishes to surfaces that are not dry.

C. Apply each coat to uniform finish.

D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.

E. Sand surfaces required lightly between coats to achieve required finish.

F. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.

G. Allow applied coat to dry before next coat is applied.

H. Prime concealed surfaces of interior and exterior woodwork with primer paint.

3.04 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01450 - Contractor's Quality Control.

B. Test questionable coated areas.

3.05 CLEANING

A. Clean work under provisions of 01770 - Closeout Procedrures.

B. Collect waste material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.06 DECORATIVE COATINGS SCHEDULE

A. Interior Concrete Masonry Units.

1. Step one: Remove dust, mortar drippings, and other foreign matter.

2. Step two: Apply one of following alkyd system with the block filler indicated in sufficient coats and mill thickness to provide a uniform smooth surface.

a. Devoe:

1) 52901 De-Vo-Ko Bloxfil Latex Block Filler, tinted.

2) One coat 23xx Velour Alkyd Eggshell Enamel, roller stippled, 1.7 mils.

b. PPG:

1) Masonry Block Filler No. 6-7.

2) One coat 50-65 Snolite Alkyd Stippling Eggshell, roller stippled, 1.9 mils.

c. P & L:

1) Primafil 200.

2) One coat Vitra-Shield, roller stripped,2.0 mils.

d. Valspar:

1) 79-W-8 Latex Block Filler, white or tinted if needed.

2) One coat 31 Series Semi-Gloss Enamel, 2.0 mils dry.

e. Sherwin:

1) Heavy Duty Block Filler, B42 W46, not tinted.

2) One coat Pro-Mar Alkyd Eg-Shel Enamel, B33 W100, 2 mils.

B. Drywall

1. Step one: Spackle all scratches, nail holes, dents, and other abrasions. When dry, sand sand surfaces smoothe and vacuum clean.

2. Step two: Apply one of the following alkyd systems.

a. Devoe: 4.8 mils system

1) One coat 50801 Devoe Vinyl Primer, 0.8 mil.

2) Two coats 21xx Velour Alkyd Flat Interior, 2 mils each.

C. Interior Wood Painted

1. Step One. Sand smooth, shellac knots and pitch streaks, fill holes, dents, joints, cracks, and irregularities with linseed oil putty. Sand smooth.

2. Step two: Apply one coat of one of the following primers.

a. Devoe: 51701 Wonder-Tones Acrylic Latex Enamel Undercoat, 1.5 mil.

b. PPG: 6-6 Quick Dry Enamel Undercoat, 1.4 mils.

c. P & L: Interior trim primer, 1 mil.

d. Valspar: Alkyd First Coater 17-W-4, 2 mils dry.

e. Sherwin: Wall and Wood Primer B49 W 2, 2 mils.

3. Step three: Apply two coats of same paint as adjacent walls.

D. Exterior Wood

1. Step one: Sand smooth, shellac knots and pitch streaks, fill holes, dents, joints, cracks, and irregularities with linseed oil putty. Sand smooth.

2. Step two: Apply one of the following alkyd enamel systems.

   a. Devoe: 4.7 mils system

      1) One coat 1102 All Weather Alkyd House Paint Primer, 2.3 mils.

      2) Two coats 70xx Mirrolac Alkyd Urethane Gloss Enamel,1.2 mils each.

   b. PPG: 6 mils system

      1) One coat 6-9 Speedhide Wood Primer-Exterior, 2 mils.

      2) Two coats Speedhide Exterior-Interior Alkyd Gloss Enamel, 2 mils each.

   c. P & L: 4.75 mils system

      1) One coat Permalize Exterior Primer, 2.25 mils.

      2) Two Coats Effecto Enamel, 1.25 mils each.

   d. Valspar: 5 mils system

      1) One coat Alkyd First Coated 17-W-4, 2 mils dry.

      2) Two coats 12 Series Alkyd Enamel, 1.5 mils dry per coat.

   e. Sherwin: 6.2 mils system

      1) One coat A-100 Exterior Wood Primer Y24 W20, 2.2 mils.

      2) Two coats Industrial Enamel B54 Series, 2 mils each.

3.07 SCHEDULE COLORS

A. The City Project Manager will prepare color schedule after award of Contract.

END OF SECTION

Section 10200

LOUVERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section includes the following:

1. Fixed, extruded-aluminum louvers.

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.

1.03 RELATED SECTIONS

A. Related Sections include the following:

1. Division 7 Section 07920-Caulking and Sealants for sealants installed in perimeter joints between louver frames and adjoining construction.
2. Division 9 Section 09900-Painting for field painting louvers.

1.04 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section, unless otherwise defined in this Section or in referenced standards.

1.05 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide exterior metal louvers capable of withstanding the effects of loads and stresses from wind and normal thermal movement without evidencing permanent deformation of louver components including blades, frames, and supports; noise or metal fatigue caused by louver blade rattle or flutter; or permanent damage to fasteners and anchors.

1. Wind Load: Uniform pressure (velocity pressure) of 30 lbf/sq. ft., acting inward or outward.
2. Thermal Movements: Provide louvers that allow for thermal movements resulting from the following maximum change (range) in ambient and

surface temperatures by preventing buckling, opening of joints, overstressing of components, and other detrimental effects:

a. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.06 SUBMITTALS

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

B. Shop Drawings: For louver units and accessories. Include plans; elevations; sections; and details showing profiles, angles, and spacing of louver blades. Show unit dimensions related to wall openings and construction; free area for each size indicated; profiles of frames at jambs, heads, and sills; and anchorage details and locations.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.

D. Product Certificates: Signed by manufacturers of louvers certifying that the products furnished comply with requirements and are licensed to bear the AMCA seal based on tests made according to AMCA 500 and complying with AMCA's Certified Ratings Program.

E. Product Test Reports: Indicate compliance of products with requirements based on comprehensive testing of current products.

F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.07 QUALITY ASSURANCE

A. Source Limitations: Obtain louvers and vents through one source from a single manufacturer where alike in one or more respects regarding type, design, or factory-applied color finish.

B. Welding Standards: As follows:

1. Comply with AWS D1.2, "Structural Welding Code--Aluminum."
2. Comply with AWS D1.3, "Structural Welding Code--Sheet Steel."
3. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

C. SMACNA Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" recommendations for fabrication, construction details, and installation procedures.

D. UL and NEMA Compliance: Provide motors and related components for motor-operated adjustable louvers that are listed and labeled by UL and comply with applicable NEMA standards.

1.08 PROJECT CONDITIONS

A. Field Measurements: Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating louvers without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Airline Products Co.
2. Airolite Co.
3. All-Lite Louver Co.
4. American Warming and Ventilating, Inc.
5. Arrow United Industries.
6. Cesco Products.
7. Construction Specialties, Inc.
8. Dowco Products Group.
9. Greenheck Fan Corporation.
10. Hart & Cooley, Inc.; Reliable Metal Products Division.
11. Industrial Louvers, Inc.
12. NCA Manufacturing, Inc.
13. Riesner Vent Brick Corp.
14. Ruskin Manufacturing; Tomkins Industries, Inc.
15. Sunvent Industries; Sylro Sales Corp.

B. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Louver Schedule on the Drawings.

2.02 MATERIALS

A. Aluminum Extrusions: ASTM B 221, alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209, alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Aluminum Castings: ASTM B 26/B 26M, alloy 319.

D. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.

E. Stainless-Steel Sheet: ASTM A 666, Type 302 or 304.

F. Fasteners: Of same basic metal and alloy as fastened metal or 300 series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.

1. Use types and sizes to suit unit installation conditions.
2. Use Phillips flat-head screws for exposed fasteners, unless otherwise indicated.

G. Anchors and Inserts: Of type, size, and material required for loading and installation indicated. Use nonferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as needed for corrosion resistance. Use toothed steel or expansion bolt devices for drilled-in-place anchors.

H. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12 but containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.03 FABRICATION, GENERAL

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

1. Continuous Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates and without interrupting blade-spacing pattern.

B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

C. Maintain equal louver blade spacing to produce uniform appearance.

D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining materials' tolerances, and perimeter sealant joints.

1. Frame Type: Channel type, unless otherwise indicated.
2. Frame Type: Exterior flange, unless otherwise indicated.
3. Frame Type: Interior flange, unless otherwise indicated.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches o.c., whichever is less. At horizontal joints between louver units, provide horizontal mullions, unless continuous vertical assemblies are indicated.

G. Provide sill extensions and loose sills made of same material as louvers where indicated or required for drainage to exterior and to prevent water penetrating to interior.

H. Join frame members to one another and to fixed louver blades with fillet welds concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

I. Join frame members to one another and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer, concealed from view; unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.04 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Louver Construction: Provide fixed-blade louvers with extruded-aluminum frames and blades.

B. Horizontal Louvers: Either drainable- or nondrainable-blade type complying with the following:

1. Louver Depth: 6 inches, unless otherwise indicated.
2. Frame Thickness: 0.125 inch.
3. Blade Thickness: 0.125 inch.
4. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.08 LOUVER SCREENS

A. General: Provide each exterior louver with louver screens complying with the following requirements:

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Bird screening, unless otherwise indicated.

B. Secure screens to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate screen frames with mitered corners to louver sizes indicated and to comply with the following requirements:

1. Metal: Same kind and form of metal as indicated for louver to which screens are attached.

a. Reinforce extruded-aluminum screen frames at corners with clips.

2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Rewirable frames with a driven spline or insert for securing screen mesh.

D. Louver Screening for Aluminum Louvers: As follows:

1. Bird Screening: Aluminum, 1/2-inch-square mesh, 0.063-inch wire.

2.11 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish louvers after assembly.

2.12 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 606.1 or AAMA 608.1.

1. Color: As selected by Owner's Designated Representative from the full range of industry colors and color densities.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate Setting Drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete construction. Coordinate delivery of such items to Project site.

3.02 INSTALLATION

A. Locate and place louver units level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

G. Install concealed gaskets, flashings, joint fillers, and insulation, as louver installation progresses, where weathertight louver joints are required. Comply with Division 7 Section 07920-Caulking and Sealants for sealants applied during louver installation.

3.03 ADJUSTING, CLEANING, AND PROTECTING

A. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.

B. Periodically clean exposed surfaces of louvers and vents that are not protected by temporary covering to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.

C. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

D. Protect louvers and vents from damage during construction. Use temporary protective coverings where needed and approved by louver manufacturer. Remove protective covering at the time of Substantial Completion.

E. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Clean and touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

Section 10520

FIRE EXTINGUISHERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers and mounting hardware to be provided in each building – one per building.

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.

1.03 REFERENCE

A. Comply with ANSI NFPA 10-1981, Portable Fire Extinguishers.

B. Comply with applicable provisions of the City of Houston Building Code.

C. Fire extinguishers to be U.L. listed.

1.04 SUBMITTALS

A. Comply with Section 01330—Submittal Procedures and the supplemental requirements specified below.

B. Submit manufacturer's product literature, warranties and performance data as applicable, to the Owner for approval.

1.05 DELIVERY, STORAGE AND HANDLING

A. Comply with Section 01610—Basic Product Requirements and the supplemental requirements specified below.

B. Defer delivery of items specified in this section until building is completely finished and ready for final inspection.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Kidde

B. General Fire Equipment, Co.

C. Equal equipment by other manufacturers will be acceptable if approved by the Owner.

2.02 FIRE EXTINGUISHERS

A. Dry Chemical type suitable for Class A, B, and C fires with wall mounting hardware.

B. 4-A 60-B-C U.L. rating.

C. 10 lb charge.

D. Portable, wall mounted.

E. Kiddie Model No. Pro 460 or equal.

F. Provide wall mounting brackets and anchors as specified by manufacturer.

PART 3 EXECUTION

3.01 GENERAL

A. Install fire extinguisher in accordance with the plans and manufacturer's installation instructions.

B. Place manufacturer's literature, warranty forms, etc. in an envelope and leave attached to item after installation.

END OF SECTION

SECTION 11228

MECHANICAL SURFACE AERATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnishing all labor, material, equipment, and incidentals required to install, test and make completely ready for operation, the installation and automation of eight (8) level sensitive, slow-speed mechanical surface aerators in the Aeration Basins as shown on the Drawings and as specified herein.

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.

1.03 RELATED SECTIONS

A. Concrete work is included in Division 3.

B. Field painting is included in Division 9.

C. Process Instrumentation is included in Division 13.

D. Electrical components are included in Division 16.

1.04 QUALITY ASSURANCE.

A. All equipment covered by this Section shall be supplied by the same manufacturer to ensure that all parts work together and function in a coordinated manner.

1.05 SUBMITTALS

A. Shop Drawings:

1. Make, model, weight, and horsepower of each equipment assembly.

2. Manufacturer's catalog information, descriptive literature, specifications, and identification of materials of construction.

3. External utility requirements such as air, water, power, drain, etc., for each component.

4. Functional description of internal and external instrumentation and controls to be supplied including list of parameters monitored, controlled, or alarmed.

5. Control panel elevation drawings showing construction and placement of operator interface devices and other elements.

6. Power and control wiring diagrams, including terminals and numbers.

7. Shop and field painting systems proposed: Include manufacturer's descriptive technical catalog literature and specifications.

8. Written certification that the factory-applied coating system(s) is identical to the requirements specified.

9. Special shipping, storage and protection, and handling instructions.

10. Manufacturer's written/printed installation instructions.

11. Routine maintenance requirements prior to plant startup.

12. Test Data

    a. Results of clean water transfer efficiency tests conducted on similar mechanical surface aerators. The tests shall be on similarly sized equipment and shall demonstrate that the proposed equipment meets the maximum oxygen transfer capacity specified. If such test results are not available or do not demonstrate that the proposed equipment meets the specified oxygen transfer capacity, then perform field oxygen transfer tests on one aerator as specified in this section.

    b. If required, submit copes of the report of the field performance tests conducted on mechanical surface aerators at the site. This report to include test procedure, test data, and calculation of oxygenation capacity. Data shall also substantiate that the aerators can achieve mixing and adequate velocities for the geometry of the tanks as shown on the Drawings.

13. Manufacturer's Calculations

    a. Gear rating calculations

b. Bearing life calculations

c. Calculations supporting all shaft and impeller design criteria (stresses and critical speed)

14. Manufacturer's Certifications

a. Submit manufacturer's certification that Contract Documents have been examined by the manufacturer for proposed electrical, mechanical, and structural systems affecting performance of the equipment.

b. Submit manufacturer's certification that the maximum power requirement, if used, shall not exceed the motor rating under operating conditions.

c. Submit manufacturer's certification that all gear, bearings, shaft and impeller design meet all Specification requirements.

15. Operation and maintenance manual.

a. Operation and maintenance manuals, prepared by the manufacturer, shall be provided for the System in accordance with Section 01782 – Operations and Maintenance Data.

1.06 WARRANTY

A. Provide warranty under provisions of Section 01770 – Closeout Procedures.

B. Manufacturer shall furnish to the City a warranty written expressly from the manufacturer to the City of Houston, covering workmanship and material under normal use and service. The warranty shall cover 100 percent of parts and labor for at least one full year. The warranty period shall commence on the day of start-up acceptance by the City. Warranty shall be in printed form and previously published as the manufacturer's standard warranty for similar manufactured units.

PART 2 PRODUCTS

2.01 MANUFACTURER REQUIREMENTS

A. Acceptable Manufacturers

1. Ovivo,
2. Philadelphia Mixer,
3. WesTech,
4. Lightin,
5. Approved equal.

5. Listing as an approved manufacturer will not relieve the manufacturer from conforming to Contract Specifications.

B. The manufacturer shall have regularly and satisfactorily designed, engineered, manufactured, supplied, and serviced a minimum of five (5) of the installation for same application as described in the specification, which are currently and have been in satisfactory and continuously operating with no substantial operational and maintenance problems in municipal wastewater treatment plants in the United States during the previous five (5) years. Experience records and references shall be provided if requested by the Owner or the Engineer.

C. Potential manufacturers not having the necessary satisfactory experience, as determined by the Owner must provide a five (5) year bond or cash deposit guaranteeing replacement in event of failure within the first five (5) years of operation.

2.02 GENERAL REQUIREMENTS

A. The mechanical surface aerators shall be suitable for satisfactory operation within the normal operation levels shown on the Drawings. Each aerator shall be capable of transferring not less than 3.20 lbs of oxygen per motor output horsepower per hour to clean tap water under standard test conditions of 20 °C and zero dissolved oxygen. Each aerator shall be capable of maintaining a minimum of 90% of the maximum pounds of oxygen input per brake horsepower (with respect to the gearbox output shaft) over the full range of submergence and speed.

B. The proposed mechanical surface aerator will be designed to be compatible with existing stationary anti-vortex baffle. Contractor shall verify dimensions of proposed aerator with existing baffle and modify baffle as necessary to accommodate aerator. Refer to the Drawings for dimensions of existing anti-vortex baffle.

C. The aerators shall be equipped with an automatic dissolved oxygen control system and variable frequency drives to control the speed of operation. The aerators shall be capable of being speed-controlled in automatic or manual mode.

D. Each aerator shall operate without excessive spraying throughout the full range of impeller submergence.

E. The maximum design speed of the aerator, the tip or peripheral speed of the impeller shall not exceed 27 fps. The rotating speed of the impeller shall not exceed 73 rpm for any operating conditions.

F. The aerators in each basin shall have sufficient mixing capacity so as to maintain essentially uniform oxygen concentration through the entire basin and to maintain a mixed liquor suspended solids concentration of at least 6,000 mg/l so that the concentration at any point is within plus or minus 10 percent of the average concentration in the basin. The above shall be obtained within the aerators operating at any point between maximum and minimum submergence.

G. Kilowatt draw shall not fluctuate by more than plus or minus 5 percent at any operating condition between minimum and full submergence at both speeds.

H. Each aerator shall operate at a sound pressure level not in excess of 90 decibels over a frequency range of 37.5 to 9,600 cycles per second when measured at a distance of 5-ft from the unit.

I. All of the equipment specified herein is intended to be standard mechanical surface aeration equipment capable of transferring atmospheric oxygen into the mixed liquor of the activated sludge process. The aerators shall maintain the activated sludge solids in suspension throughout all of the aeration tanks.

J. The aeration basins are divided into eight basins. One aerator shall be installed in each basin as shown on the Drawings.

2.03 AERATORS

A. Each mechanical surface aerator shall be supported on a fixed platform as shown on the Drawings and shall consist of a drive motor, gear reducer, impeller shaft and impeller, variable frequency drive, and all required appurtenances.

B. Units which required the use of submerged bearings shall not be permitted. If required, the gear unit shall be furnished with an extended output shaft supported at the bottom of the housing by an outboard grease

lubricated roller bearing. The outboard roller bearing shall be located within 12-inches of the end of the shaft or the bearing arrangement shall be designed to withstand the out-of-balance overhanging loads from the aerator impeller. Bearing life shall be as later specified herein.

C. Units shall have provisions for the removal of the motor and gear unit without removing the impeller from the aeration basin while tank is full of mixed liquor.

1. Each drive unit shall consist of an electric motor flexibly connected to a gear reduction unit, fully enclosed and designed for outdoor installation.

2. Horizontal or vertical motors shall be connected to the gear reduction unit by a flexible coupling. They shall use a standard NEMA connection with a piloted fit to prevent any need for manual alignment.

3. The motor support shall be of cast-iron or fabricated steel construction and properly machined to ensure proper alignment between motor and reducer for protection of high speed bearings and flexible couplings.

4. All flexible couplings shall be adequately rated to withstand continuously the full load motor horsepower including motor starting torques up to 250 percent of full load motor running torque.

5. Each reduction unit shall have gearing of the spur, helical, or spiral bevel type or a combination thereof. Worm gearing will not be acceptable. The units shall be designed to AGMA Service Classification III.

6. Reduction units shall be of the motor and gear reducer type. The minimum AGMA service factor shall be 2.0 for speed reducers designed and manufactured by the wetted parts manufacturer, and 3.0 for speed reducers not designed and manufactured by the wetted parts manufacturer. Service factor shall be based on full motor nameplate horsepower.

7. Each reduction unit shall be designed to withstand continuously and in either direction all internal loadings developed at the full load motor horsepower, including motor starting torques up to 250 percent of motor running torques and to withstand all external loadings produced by thrust, out-of-balance and vibration resulting from operating conditions.

8. Gears, pinions, and shafting shall be made of wrought and alloy steels.

   a. The gear teeth shall be through-hardened, contour-induction hardened, or carburized. Flame-hardened gears will not be acceptable.

   b. All gears shall be manufactured to AGMA Quality 10 helical or 8 bevel or higher as outline in AGMA Classification Manual 390.03.

9. All bearings incorporated within the gear reduction units and electric motors shall be of the anti-friction type having a rating life expectancy (B-10) as tabulated below based on the latest applicable ANSI and AFBMA Standards when operating continuously at the rated full load motor horsepower and speed.

   a. Electric Motors — B-10 of 100,000 hours

   b. Gear Reducers — B-10 of 250,000 hours

10. A reliable lubrication system, externally accessible, shall be provided for the gears and bearings. Lubrication systems which rely wholly or in part upon an oil circulating pump shall incorporate a proven reliable pressure or flow switch device which will immediately stop the driving motor in the event of insufficient lubrication. Provide this switch with auxiliary contacts for remote monitoring via the SCADA control system. Pressure indicating devices influenced by oil sludge and changes in oil viscosity will not be acceptable. Also, each unit incorporating an oil pump shall have an external oil-pressure gage so that gradual decreases in oil pressure can be observed. External oil cooling will not be permitted. The unit shall be provided with a dipstick or sight glass to observe oil levels. All oil fill and drain lines shall be of sufficient size to permit efficient functioning and shall be located on the gear unit in a position which is easily accessible from the bridge platform. The oil drain piping shall be installed so that a container may be placed under the drain discharge. Internal bearings may be either oil or grease lubricated. The outboard bearing shall be grease lubricated. All grease lubrication pressure lines shall be fed from fittings accessibly located above the platform supporting the mechanism.

11. The housing shall be constructed of hi-tensile strength gray cast-iron with integral dry well construction to eliminate oil leakage at the output shaft and prevent loss of lubrication in the event of seal failure. The housing for vertical installation shall be of two piece

construction with ground matching surfaces for oil retention. Housing components shall be of adequate strength and rigidity to withstand all loads imposed on it from the operation of the equipment. Lifting lugs shall be provided on the housing suitably located to enable safe removal of the combined electrical motor and gear unit from the supporting platform.

12. Each combined electric motor and gear reducer shall be mounted on adjustable mounting screws with nuts and lock bolts to allow leveling and fine vertical adjustment over a range of 6-inches. Screw, nuts and lock bolts shall be of Type 316 Stainless Steel of the size specified by the equipment manufacturer. The equipment manufacturer shall furnish all templates required for setting the anchor bolts.

13. When oil pumps are used, provide a NEMA 4 rated oil pressure switch for each gearbox for low oil pressure shutdown. Unit to be controlled through maintained selector switches.

D. The direction of rotation of the mechanical aerators shall be clockwise.

E. Each aerator impeller shall consist of radial blades or vanes attached to a central element keyed or flange-coupling connected to the drive output shaft.

1. Impeller blades shall be of ¼-inch (minimum thickness) steel plate or cast aluminum – magnesium.

2. All fastenings of impeller blades if required to the impeller hub or drive ring and from the impeller hub to the output shaft of the gear reduction unit, shall be of Type 304 stainless steel or rigid, cast iron.

F. The impeller shaft shall be of suitable diameter as required by the forces imposed by the aerator impeller. The shaft shall be of sufficient size to provide the required rigidity.

G. The equipment shall be designed, constructed and installed in accordance with the best practices and methods. Anchor bolts shall be furnished by the equipment manufacturer. Unless otherwise specified herein, anchor bolts shall be of Type 316 stainless steel.

2.04 MOTOR

A. Motor for the aerator shall be 50 HP or less.

B. Motor shall comply with the requirements of Specification Section 16171 – Low Voltage Motors.

C. The electric motor driver shall be rated for continuous duty in a humid corrosive environment with full mill and chemical duty features. Insulation shall be Class F, limited to Class B temperature rise at 40°C ambient at 1.0 service factor. Motors shall be Inverter Duty, energy efficient type, in full compliance with the "Federal Energy Policy Act of 1992".

D. Motors shall be squirrel cage induction motors for operation on 3-phase, 60 HZ, 460V. Synchronous speed shall be maximum 3600 rpm. All motors shall be designed with applicable IEEE, NEMA, and ANSI standards.

2.07 FIELD PAINTING

A. Prepare prime, finish coat and touch up all components in accordance with Specification Section 09902 – Protective Coatings.

2.08 APPURTENANCES

A. Lifting Lugs. Provide suitably attached for all equipment assemblies and components weighing over 100 pounds.

B. Equipment Identification Plates. Provide 16-gauge Type 304 SS identification plates securely mounted on each separate equipment component and control panel(s) in a readily visible location. Plate shall bear $^{3}/_{8}$-inch high block type with black enamel filled equipment identification number and letters.

2.09 TOOLS AND SPARE PARTS

A. All special tools required for normal operation and maintenance shall be furnished.

B. The following spare parts shall be furnished:

1. One sets of all gaskets and seals per aerator.

2. If used, two low oil pressure switches.

3. Two complete high-speed couplings.

PART 3 EXECUTION

3.01 EQUIPMENT INSTALLATION

A. Install Mechanical Surface Aerators in accordance with manufacturer's instructions and recommendations in the locations shown on the Drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance

with the manufacturer's recommendations. Anchor bolts shall be set in accordance with manufacturer's recommendations and approved shop drawings.

3.02 INSPECTION AND TESTING

A. If required, instruct the manufacturer to conduct the field performance test on one mechanical surface aerator to determine its oxygenation capacity. Refer to Section 1.05.A.12 for conditions under which Engineer may require field tests.

1. The aerator to be tested shall be as selected by the Engineer. Each test shall be performed in one aeration basin at the project construction site.

2. The test shall be performed using clear water having a temperature as near 20 °C as practical and not less than 15 °C. The test shall be to determine the rate of oxygenation and transfer efficiency at full electrical input horsepower and the power and oxygen transfer reduction at ¾ speed for full submergence, minimum submergence and at half submergence.

3. The Engineer shall witness the oxygenation tests; therefore, at least two (2) weeks notification shall be given by the Contractor and manufacturer to the Engineer before the commencement of these tests.

B. Coordinate and cooperate closely with the manufacturer to satisfactorily complete the above performance tests. The oxygenation capacity performance tests shall be as outlined below unless other procedures are approved by the Engineer in writing.

1. The aeration tanks shall be thoroughly cleaned out and then filled with fresh clean water having no surface-active agents.

2. The aerators will be set at the proper operating exposure.

3. Submersible sample pumps shall be installed at three operating depths of 4-ft, 8-ft, and 12-ft, at two selected locations in the basin, on opposite sides of the tank, one at ¼ tank length from center line of tank, and the other at ¾ tank length from center line. Alternately, DO probes can be used in place of the sample pumps.

4. A catalyst, cobalt chloride, or sulfate shall be dissolved in the tank contents, with the aerator running to ensure mixing, to a maximum concentration of 2 mg/l of cobalt ion.

5. After the aerators have reached a steady state condition for 30 minutes, an un-catalized sodium sulfite solution, which removes the dissolved oxygen, shall be released into the basin contents at the impeller. (For a liquid having an initial dissolved oxygen concentration of 10 ppm, approximately 1 lb of dry sodium sulfite will be required per 1,000 gallons of liquid per test.) This will provide an excess to compensate for oxidation during mixing. The test water shall be completely changed when the sodium sulfate concentration reaches a figure of 1,500 ml/l.

6. As the DO rises in the tank, six samples, one for each depth at each location, shall be drawn at 1 to 5 minute intervals. Interval should be selected to get at least six sets of samples between 10 and 80 percent saturation. The DO shall be determined with a properly calibrated DO electrode probe, such as the Weston-Stack or equal. This device shall have an incorporated agitating device.

7. While the aerator is running, electrical measurements shall be made on the input with a recording wattmeter located at the aerator to exclude all line losses. Alternately, a recording wattmeter may be located in a building if line losses have been determined. The recording wattmeter shall also be used to determine excessive power surges due to unstable hydraulic conditions. Power fluctuations shall vary by not more than plus or minus 5 percent.

8. An original and carbon copy of all measurements and data shall be made and each sheet initialed by the representatives of the manufacturer and the Engineer. The carbon copy shall be given to the Engineer.

9. A semi-log plot of the log of the dissolved oxygen deficits against time for each sampling point shall be constructed. Only points between 10 and 80 percent saturation shall be considered. A line of best fit shall be drawn through the plotted points.

10. The slope of the line shall be then calculated.

11. Corrections shall be made for temperature and oxygen saturation of the water at the test site and then the pounds of oxygen dissolved at standard conditions of 20 °C, clean water, and "0" ppm dissolved oxygen concentration shall be computed. The temperature correction coefficient shall be 1.024.

12. The efficiency of the aerators shall be determined by dividing the pounds of oxygen dissolved per hour under standard conditions by the output motor horsepower.

13. All power, water, equipment, sampling pumps, chemicals, probes, equipment setup and appurtenances required for testing shall be furnished by the Contractor.

C. The test runs on all remaining mechanical aerators shall be undertaken with water in the aeration tanks filled up to Elevation 74.00. Provide sufficient tap or other clean water, or treated wastewater for filling the tanks for the above test run. The test runs shall determine acceptable normal running noise, vibration, speed and direction.

D. In the event of improper installation, the Contractor and the manufacturer shall be responsible for supervising the correction of the work and subsequent test runs until the defects are corrected.

E. With the aerator in each basin in operation at maximum design speed and power input, velocity measurements shall be made at various points on the basin bottom, within 2-ft of the basin wall. When operating in clean water, velocity readings of approximately 0.75 ft per second are an indication that the aerators can provide the necessary mixing capacity to maintain the mixed liquor solids in suspension at the concentrations specified below. However, the manufacturer shall conduct sufficient field tests to establish that the mixed liquor solids concentrations are maintained in the concentration specified below when the plant is in operation. When the plant is in operation and the mixed liquor solids are built up to any concentration between 1,000 and 6,000 mg/l, the variation in concentration of the solids shall not be greater than plus or minus 10 percent of the average value in the basin, at any point in the basin with the aerator operating at maximum design speed and power input.

F. If the required oxygenation capacities are not produced, replace the aerators with units of another manufacturer and the above test procedure shall be repeated until satisfactory results are obtained.

3.03 FIELD QUALITY CONTROL

A. Required Manufacturer Services

1. Retain a qualified employee of the manufacturer to perform the following services:

a. Oversee installation of the mechanical surface aerator units specified herein.

b. Inspect the completed installation and note deficiencies.

c. Be present and assist the Contractor during start-up, adjusting, and site testing of completed installations.

d. Conduct field testing as defined in Section 3.02.

e. Instruct Owner personnel in the operation and maintenance of the mechanical surface aerator units.

f. Prepare manufacturer's installation report and submit within 30 days after completion of field testing. Include the following information:

1) Field testing results.

2) Description of installation deficiencies not resolved to the manufacturer's satisfaction.

3) Description of problems-or-potential problems.

4) Names of owner personnel who attended operations and maintenance training sessions.

5) Record copy of materials used for training session including outline summary of course.

6) Certificate stating the aerator equipment has been installed within the manufacturer's recommendations.

B. Functional Test.

1. After Mechanical Surface Aerators and associated equipment have been completely installed and working under the direction of the manufacturer, conduct field tests necessary to demonstrate that operation conforms to these Specifications. Supply water or wastewater, labor, equipment, and incidentals required to complete field tests.

2. Demonstrate with a Final Acceptance Test that these Specifications have been met by the equipment as installed. As a minimum, perform the following tests.

a. That units have been properly installed and are in correct alignment.

b. That units operate without overheating or overloading any parts and without objectionable vibration per manufacturer recommendations.

c. That there are no mechanical defects in any of the parts.

d. That the controls perform satisfactorily.

3. If the Mechanical Surface Aerators' performance does not comply with Specifications, take corrective measures or remove and replace Mechanical Surface Aerators with Mechanical Surface Aerators which satisfy the conditions specified.

C. Start-Up. Beneficial use will not occur until after the start-up activities have been performed and accepted by the City Engineer. Start-up activities include the following:

1. Receipt and acceptance by the City Engineer of draft Operation and Maintenance manuals, including the wiring and ladder diagrams.

2. Installation inspection by City operating, electrical and instrumentation staff followed by any corrective measures required by the Contractor.

3. Satisfactory operation of Mechanical Surface Aerators for 7 consecutive days under the City's control. If malfunctions or other operational problems halt the 7-day test period, the Contractor shall make appropriate corrections and restart the 7-day test period.

4. Provide the services of a factory-trained technician for a period of 4 hours to train the City's operating and maintenance personnel. Training session shall be scheduled and coordinated by the Contractor.

D. Acceptance. After the start-up operation has been successfully completed, the City will accept the Mechanical Surface Aerators when final Operation and Maintenance manuals have been received, reviewed, and accepted by the City. Include ladder logic diagrams and wiring and termination diagrams for both power and instrumentation systems.

END OF SECTION

Section 11237

VORTEX GRIT REMOVAL EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish flat bottom 360° mechanical vortex type grit removal equipment with grit handling equipment from the same manufacturer. The grit removal system shall be capable of removing grit from raw screened waste, washing the grit of organic waste materials, and depositing dewatered grit into a dumpster for final disposal. Each system's grit chamber shall be complete with the following equipment: gear motor, gear head, air bell, propeller drive tube, axial flow propeller, vacuum primed grit removal pump and auxiliary equipment as specified herein. All wetted parts shall be constructed of 316 stainless steel.

2. Included, but not limited to, are the following components for each unit:

   a. Grit separation mechanism:

      1. Gear motor.

      2. Gear head.

      3. Torque tube and impeller.

   b. Grit collection system the following:

      1. Vacuum priming system with pinch valve.

      2. Top mounted grit pump with NPW connection fitting.

      3. Lifting stanchion.

      4. Grit concentrator with classifier.

      5. Screw grit conveyor.

6. Grit collection control panel and local control stations.

7. Anchorage devices.

c. Solenoid valve on the non-potable waterline connection fitting to each grit pump.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the vortex grit removal equipment Work.

C. Related Sections:

1. Division 2, Yard piping

2. Division 3, Concrete.

3. Section 05051, Anchor Systems.

4. Section 09901, Protective Coatings.

5. Painting, except as specified here, is included in Division 9

6. Mechanical piping, valves, pipe hangers and supports are included in the respective sections of Division 15.

7. Process Instrumentation, electrical work and motor specifications, except as specified here, is included in Division 16.

1.02 MEASUREMENT AND PAYMENT

A. No payment will be made for individual grit system components under this section. Include all costs in the lump sum price for grit system improvements.

1.03 REFERENCES

A. Standards referenced in this Section are listed below:

1. American Bearing Manufacturers' Association, (ASMA).

2. American Gear Manufacturers' Association, (AGMA)..

3. American National Standards Institute, (ANSI).

4. American Society for Testing and Materials, (ASTM).

   a. ASTM A 36/A 36M, Specification for Carbon Structural Steel.

   b. ASTM A 48/A 48M, Specification for Gray Iron Castings.

5. American Welding Society, (AWS).

   a. AWS D1.1/D1.1M, Structural Welding Code-Steel.

6. National Electrical Code, (NEC).

7. National Electrical Manufacturers Association, (NEMA).

8. National Fire Protection Association, (NFPA).

   a. NFPA 79, Electrical Standard for Industrial Machinery.

9. National Sanitation Foundation, (NSF).

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

   1. Manufacturer shall have a minimum of five years experience producing substantially similar equipment, and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

   2. The grit collection system Manufacturer shall review and submit certification that the furnished equipment meets the design intent of the project and specified performance parameters outlined herein.

B. Component Supply and Compatibility:

   1. Obtain all equipment included in this Section regardless of the component manufacturer from a single grit collection system Manufacturer.

   2. The grit collection system Manufacturer shall review and approve all Shop Drawings for submittal review for all components furnished under this Section.

   3. All components shall be specifically constructed for the specified

service conditions and shall be integrated into the overall assembly by the grit collection system Manufacturer.

4. Structural components for the grit collection system construction shall be coordinated with the grit equipment Manufacturer prior to construction.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Product Data:

1. Manufacturer's literature, illustrations, specifications and engineering data. Outside utility requirements, such as water, power, air, etc. to be coordinated with the City of Houston, Public Works & Engineering, Wastewater Engineering and/or Operations group.

a. A certified motor data sheet for each type and size of motor. The data sheets shall show winding resistances; torques; guaranteed minimum efficiencies at full, 3/4 and 1/2 load; power factors; slip; full load, locked rotor and running light amperes; temperature rises and results of dielectric tests. All values shall be from tests of previously manufactured electrically duplicate motors. Data sheet shall be marked to indicate motor application, manufacturer, type, frame size, bearings type, lubrication medium, insulation type, and enclosure type.

c. Certification by the Manufacturer that the furnished equipment meets the design intent of the project and performance parameters specified herein.

d. Deviations from Contract Documents. Any substitutions shall comply with the contract requirements for submitting substitutions.

e. Lubricant Specification: Furnish a lubricant specification for the type and grade necessary to meet the requirements of the equipment.

f. Performance test procedures: A performance test procedure is provided herein. If an alternate procedure is selected, Contractor shall submit the alternate plan for approval.

2. Shop Drawings:

a. Drawings showing fabrication methods, assembly, accessories, installation details and wiring diagrams.

b. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.

c. Drawings and information for control panel; local control stations, panel instruments, and field instruments in accordance with Division 13, Applicable Sections on Instrumentation and Controls, and Division 16, Electrical.

B. Informational Submittals: Submit the following:

1. Source Quality Control Submittals:

a. Submit results of routine factory motor tests.

2. Site Quality Control Submittals:

a. Submit a written report giving the results of the required field tests.

b. Submit written report of the results of each visit by a manufacturer's serviceman, including purpose and time of visit, tasks performed and results obtained.

3. Performance test procedures:
   a. Submit proposed performance test procedures.
   b. Certify qualifications of performance testing procedures and representatives performing tests.
   c. Submit qualifications of representative performing tests.

C. Closeout Submittals: Submit the following:

1. Operation and Maintenance Data:

a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.

b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01782, Operations and Maintenance Data.

D. Maintenance Material Submittals: Furnish the following:

1. Spare Parts:

a. Furnish all required spare parts as specified in Part 2 of this specification.

2. Tools:

a. Furnish all required special tools as specified in Part 2 of this specification.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.

B. Storage and Protection:

1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify OWNER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE

A. General:

1. The grit collection system shall operate on the mechanical vortex principle utilizing a flat bottom type design with a 360° influent, effluent flow path. No moving parts subject to wear or stoppage shall be below the water surface. To maximize grit removal efficiency, the grit chamber hydraulics shall incorporate a toroidal flow path enhanced by a slow vortex. Grit chambers incorporating the gravity principle with sloped floor design will not be acceptable.

2. The grit removal device shall be capable of removing 95% of the grit down to 140-mesh in particle size at the peak flow rate of 50 MGD, and no decrease in efficiency will be allowed at flows less than this design rate.

3. The grit collection system shall have less than 2-feet of hydraulic head loss at any shown flow condition.

4. The grit separator mechanism shall be suitable for installation in a concrete chamber sized and arranged as shown. The drive, lubrication and bearings shall be readily accessible from the operating walkway.

5. The grit collection chamber shall have an inlet and outlet separated by 360 degrees of the tank periphery, providing maximum travel of the liquid for effective grit collection. Inlet and outlet must be in the upper portion of the grit chamber to prevent disturbance of the removed grit. To ensure the efficient transport of the grit and simultaneous lifting and discharge of the organic material, the bottom of the upper chamber covering the storage hopper shall be constructed of structural grade 316 stainless steel plate, free from rotation and shall be flat.

6. The grit separation equipment shall have a vertically adjustable mechanical impeller fitted with four blades. Grit scouring intensity shall be adjustable by changing the pitch of the impeller blades or adjustment of the impeller in the vertical plane.

7. The grit separation unit shall be equipped with grit fluidizer vanes bolted to the impeller drive tube within 6-inches of the grit pump suction inlet. The fluidizer vanes shall be grade 316 stainless steel.

8. The grit chamber shall be equipped with an integral flow control baffle for both the inlet and outlet of the main chamber. The baffle shall be designed to direct the inlet flow into the chamber in a manner ensuring proper vortex flow and to prevent short circuiting. The baffle on the outlet shall direct the flow out of the unit and act as a "slice weir" to control the water level in the main chamber and in the inlet channel. No additional downstream flow control device shall be required to keep the velocity between 3.5 fps at peak flow and 1.6 fps at minimum flow. The baffle shall be constructed of Type 316 stainless steel. The installing contractor shall attach the baffle to the concrete structure using 5/8-inch anchor bolts, as shown on the drawings.

9. Flange Connections: Flange connections shall be as shown. The discharge tube connection shall be fitted with Type 316 stainless steel flanges. Outside diameter and drilling pattern shall be ANSI 150 lb. Class. The flange connections shall be located to meet the general configuration and elevations

shown.

B. Design Criteria:

1. The grit chamber shall be capable of handling flows up to the hydraulic peak flow rate shown without loss of grit collection efficiency. Inlet channels to the grit chamber shall be as shown, designed to ensure that the grit does not settle in the inlet channel and to provide for correct operation of the grit chamber.

2. The grit collection device shall be capable of the following grit collection efficiency at the hydraulic peak flow rate:

   a. 95 percent grit capture and removal down to 140 mesh or 105-micron sand equivalent size particle.

3. Design Conditions:

   a. Number of Units Required: 2

   b. Average Flow per Unit: 12 MGD.

   c. Two Hour Peak Flow per Unit: 50 MGD.

2.2 MANUFACTURERS

A. Manufacturers: Provide equipment of one of the following:

1. Smith & Loveless, Inc.

2. Lakeside Equipment.

3. Westech.

2.3 DETAILS OF CONSTRUCTION

A. Mechanical Drive Mechanism:

1. The grit separation mechanism shall consist of a gear motor, gear head, torque tube, and impeller.

2. Gear Motor and Gear Head:

   a. Drive shall be a totally enclosed, helical gear motor, with normal

starting torque and low starting current.

b. Torque tube shall be driven by a large, totally enclosed spur gear and turntable.

c. Helical gear motor shall have a service factor of 2.0 or greater. Gear motor housing shall be manufactured of high grade materials. Pinions and gears shall be high AISI 4140 Alloy, helically machined and hardened for high strength and long wear.

d. A pinion mounted on the output shaft of the helical gear motor shall drive a large spur tooth bull gear enclosed in a heavy cast-iron case. Spur gear shall rotate with a minimum 21 inch diameter turntable bearing for durability and stability. Pinion and bull gear shall have service factor of five or greater at standard operating speeds.

e. Bearings of the drive unit, including the motor, shall have a minimum B-1O bearing life of 100,000 hours, except for the turntable bearing supporting the impeller assembly which shall have a minimum B-1O life of 20 years.

f. Bull gear box shall be specifically designed for this service. It shall have an opening for the drive torque tube to the impeller. Gear box shall be sealed and the bottom opening shall have suitable means to prevent water from entering the gear box. Gear box shall be grease packed or oil lubricated. Provide a means of visually monitoring oil level.

g. Speed reducer shall conform to AGMA rating and specifications for moderate shock, 24-hour continuous full load operation with a service factor of 2.0 or greater.

3. Torque Tube and Impeller:

   a. Torque tube and impeller shall be of steel construction, amply proportioned for all stress and load to which it will be subjected.

   b. Attachment hardware shall be of Type 316 stainless steel.

B. Motors:

1. Gear Drive motors shall be totally enclosed, fan cooled, severe duty, chemical service type, suitable for use in a Class 1, Division 2, Group D area.

2. Motors shall be rated 460 volts suitable for operation on a 480 volt, 3 phase 60 Hz power supply.

3. Motors shall be of proper size to drive the unit continuously without exceeding the nameplate horsepower, but not less than 1.5 horsepower.

4. Motors shall be high efficiency type design with a 1.15 service factor, and shall comply with the latest ANSI, NEMA, ABMA and IEEE Standards as a minimum.

5. Locked rotor current shall be as specified in NEMA standards.

6. Motor thrust bearings shall be adequate to carry continuous thrust loads under all conditions of service, and shall have a minimum B-10 life of 30,000 hours.

7. Motors shall have a stainless steel nameplate which shall provide the following: Type, frame, insulation, class, HP, full load current, RPM, centigrade degree rise, manufacturer's name, serial number, model number, voltage, locked rotor KVA code, bearing numbers and a connection diagram.

8. Motor terminal boxes shall be oversized to provide adequate space for connections and shall be constructed of cast-iron or fabricated steel, neoprene gasketed and bolted. Motor leads shall be permanently marked in agreement with the connection diagram.

C. Grit Collection System:

1. General:

a. Provide a grit collection system for removal of grit from the grit chamber. The system shall consist of a top mounted grit pump, vacuum priming system, pinch valve, grit concentrator, classifier, screw conveyor, and a lifting stanchion for removal of the grit pump.

2. Grit Pumps:

a. Design Conditions:

GRIT PUMPS SCHEDULE

Service	GP-01, 02
Maximum Solids	3inches
Grit Specific Gravity (68°F):	2.65
Quantity of Pumps:	2
Location:	Grit Removal Facility
Design Flow (gpm):	500
Design Discharge Head (ft.):*	62
Flow at Second Design Point, gpm, (Minimum):	500
Head at Second Design Point, ft.* (Minimum):	59
Pump Speed, RPM (Maximum):	1800
Efficiency at Design, (percent):	>85%
Motor, (Hp):	30
Motor: Volts/Phase/Hertz	480/3/60

b. Pump Construction:

1) The grit collection pumps shall be a 6-inch vertical, close-coupled, vacuum primed type pump with curved 5-vane flow inducer completely out of the flow path between the pump inlet and discharge connection, so that the grit pumped is not required to pass through the impeller. All internal clearances shall provide for the passage of a 4-inch spherical solid to preclude clogging of the pump and suction line. The pumps shall be designed to be in-line mounted directly to a flange on top of the suction line. The pumps shall be

vertical for easy removal of the motor and impeller and to facilitate maintenance of the suction line by providing a straight path to any potential blockage.

2) The pump shall be of Ni-Hard construction, with Ni-Hard impeller, and specially designed for the use of mechanical seals and vacuum priming. Self-priming type pumps are not acceptable.

3) In order to minimize seal water caused by lineal movement of the shaft, the shaft bearing nearest the pump impeller shall be locked in place so that end play is limited to the clearance within the bearing. The bottom bearing of the motor shall be locked in placed to handle all thrust loads and the necessary radial load. The upper bearing shall be free to move up and down so that it carries only radial load.

4) The shaft shall be solid stainless steel through the mechanical seal.

5) The impeller shall produce turbine-like flow pattern within the casing, generating flow. To prevent grit from entering the seal area, the impeller if less than full diameter shall be trimmed with the back shroud remaining full diameter so that a minimum clearance from shroud to casing is maintained. Both the end of the shaft and the bore of the impeller shall be tapered to permit easy removal of the impeller from the shaft.

6) The pumps shall be specifically designed for vacuum priming service. The pumps shall have an adaptor providing a large water reservoir above the impeller to provide for positive exclusion of air from the impeller. The seal shall be inside this area to assure lubrication. Grit shall be excluded from this area by a full size impeller shroud.

7) The pump shall be arranged so that the complete rotating element can easily be removed from the casing without disconnecting the electrical wiring or disassembling the motor, impeller, backhead or seal.

8) The pumps shall be sealed against leakage by a single mechanical seal constructed so as to be automatically drained and primed each time the pump is drained and primed.

c. Motors:

1) Motors shall conform to the requirements of Section 16010, Basic Electrical Requirements.

2) Motors shall be totally enclosed, fan cooled, severe duty, chemical service type, suitable for use in a Class 1, Division 2, Group D area.

3) Motors shall be rated 460 volts and suitable for operation on a 480 volt, 3 phase 60 Hz power supply.

4) Motors shall be of proper size to drive the unit continuously without exceeding the nameplate horsepower, but not less than the horsepower required in the Design Requirements.

5) Motors shall have a 1.15 service factor, and shall comply with the latest ANSI, NEMA, ABMA and IEEE Standards as a minimum.

6) Locked rotor current shall be as specified in NEMA standards.

7) Motor thrust bearings shall be adequate to carry continuous thrust loads under all conditions of service, and shall have a minimum B-1O life of 100,000 hours.

8) Motors shall have a stainless steel nameplate which shall provide the following: Type, frame, insulation, class, HP, full load current, RPM, centigrade degree rise, manufacturer's name, serial number, model number, voltage, locked rotor KVA code, bearing numbers and a connection diagram.

9) Motor terminal boxes shall be oversized to provide adequate space for connections and shall be constructed of cast-iron or fabricated steel, neoprene gasketed and bolted. Motor leads shall be permanently marked in agreement with the connection diagram.

3. Vacuum Priming System:

a. General:

1) The vacuum primer shall include a vacuum priming unit to be utilized and sized to prime the grit pumps.

2) All electrical equipment for the vacuum priming unit shall be suitable for use in a Class 1, Division 2, Group D area.

b. Vacuum Priming Control Panel: Provide a NEMA 4X 316 stainless steel control panel in accordance with the requirements of the applicable Sections of Division 16, Electrical, Division 13, Special Construction, and as shown. The panel shall include, but not be limited to the following:

1) A combination magnetic starter for each motor with thermal overload protection and circuit breaker capable of being locked out in the "OPEN" position.

2) Vacuum switches.

c. Controls:

1) Vacuum priming controls shall be complete with vacuum control solenoid valve, prime level sensing probe, heater, and a float operated check valve installed in the system ahead of the vacuum primer to prevent liquid from entering the vacuum pump. The float- operated check valve shall have a transparent body for visual inspection of the liquid level and shall be automatically drained when the vacuum pump shuts off.

2) The priming system shall automatically provide positive lubrication of the mechanical seal each time the grit pump is primed. To prevent excessive stoppage due to grit accumulation, no passageway in the priming system through which grit must pass shall be smaller than the equivalent of a 2-1/2-inch opening.

3) When the master selector switch at the Grit Control Panel is in either "AUTOMATIC" or "TIMER BYPASS" mode, the vacuum priming system solenoid valve is controlled by the grit pumps control logic in the Grit Control Panel.

4) Provide a pneumatically operated discharge pinch valve, with controls located within the Vacuum Priming Control Panel. Controls shall include an oil-less air compressor and a solenoid valve. The operation of the pinch valve shall be tied into the cycle timer and electrode so as to be fully automatic.

d. Manufacturers: Equipment shall be provided by the approved grit removal equipment Manufacturer.

4. Grit Concentrator:

a. A 500 gpm second stage concentrator shall be provided for secondary treatment of organics and secondary grit dewatering. The concentrator shall operate on the constant rate vortex principle. Design shall be such that a small volume of water and the grit will discharge at the bottom for final dewatering and ultimate disposal of the grit.

b. As a minimum, 93 to 94 percent of the water pumped to the concentrator and 95 to 96 percent of the residual organic material shall flow out the top and be returned to the inlet channel of the bar screen facility. The unit shall be capable of intermittent operation with minimal variation in removal efficiency. There shall be less than five percent putrescible material in the recovered grit from the underflow.

c. The concentrator shall be constructed of Ni-hard cast-iron. Inlet and outlet connections shall be provided. The concentrator shall be provided by the manufacturer of the grit chamber and shall be coated on the exterior with a minimum 6-mil dry film thickness of epoxy resin. The operating range shall be compatible with the total grit collection system.

5. Screw Grit Conveyor:

1. The screw conveyor shall be constructed of steel with an inlet hopper to receive the mixture of water and grit. The hopper shall be large enough to allow the grit to settle out of the water. Provide an overflow to return the water to the system. The conveyor shall be of inclined type and free standing with support legs to hold the conveyor at an angle of approximately 22 degrees. The conveyor shall be driven by a motor and speed reducer at the discharge end.

2. The conveyor screw shall be of a helicoid or sectional flight, formed to a uniform pitch and diameter, of one piece construction, mounted on a pipe shaft of sufficient size for the span required, but not less than 2-inch diameter. The screw and pipe shaft shall be made of Type 316 stainless steel.

3. The trough and inlet hopper shall have a minimum thickness of 3/16-inch, and shall be not less than 17 feet long. The inlet hopper sides

shall slope to prevent grit hang-up. Surface area of the hopper shall be not less than 35.5 square feet.

4. Hanger supports for the screw conveyor shaft shall be of the self-aligning, grease lubricated ball bearing type for mounting completely within the trough, provided with grease fitting on top.

5. Provide the trough end with a double ball bearing flanged block to carry the screw shaft, made of heavy gauge steel or an inclined mounted bushing of cast nylon-6 with V ring greased seal. Provide seal glands to prevent seepage of grit into the bearing. Bearings shall be grease lubricated.

6. Couplings, end shaft and drive shaft shall be sized for all expected loadings. Flight couplings shall be of the split type for easy disassembly and replacement of flight sections.

7. The conveyor shall be driven at the drive shaft end through a shaft mounted speed reducer and connected by a V-belt or chain drive to a drive motor or direct drive. Provide a No. 14 gauge Type 316 stainless steel guard.

8. Motors:

   a. Motors shall conform to the requirements of Section 40 05 93, Common Motor Requirements for Process Equipment.

   b. The motors shall be explosion proof, suitable for NEMA Class 1, Division 2, Group D, service.

   c. The motors shall be of adequate size so that there is no overload on the motor above rated nameplate horsepower under normal conditions of service, but not less than one horsepower.

   d. The motors shall be rated 460 volts, 1,800 rpm, suitable for operation on a 480 volt, 60 Hz, 3 phase power supply.

e. The motors shall have a 1.15 service factor and shall comply with the latest ANSI, NEMA, ABMA and IEEE Standards as minimum.

f. The motors shall have a stainless steel nameplate which shall provide the following: Type, frame, insulation, class, HP, full load current, RPM, centigrade degree rise, manufacturer's name, serial number, model number, voltage, locked rotor KVA code, bearing numbers and a connection diagram.

g. The motor terminal boxes shall be of cast-iron or fabricated steel, neoprene gasketed and bolted, and oversized to provide adequate space for connections. The motor leads shall be permanently marked in agreement with the connection diagram.

6. Speed Reducer:

a. The speed reducer shall conform to AGMA rating and specification for moderate shock, 24-hour continuous full load operation with a service factor of 1.50.

b. The speed reducer shall be of the helical or combined helical-worm gear type enclosed in a cast-iron or welded steel casing.

c. The speed reducer moving parts shall be immersed in oil, and bearings shall be anti-friction throughout. The casing shall be provided with inspection covers, oil fill, drain connections and means for inspection of oil flow. Inspection, oil fill, and drain covers shall be chained to the casing to prevent loss.

d. The speed reducer shall be fitted with a bronze bushing and a shear pin device complete with limit switch in a NEMA 7 enclosure. Failure of the shear pin shall actuate the limit switch which shall stop the motor and activate a remote alarm.

2.4 CONTROLS

A. General:

1. Provide automatic and manual control of the grit collection system as shown and specified.

2. Provide control panel, local control stations and devices in accordance with the requirements of Division 13, applicable Sections on Instrumentation and Controls, and as shown.

B. Control Panels:

1. A vendor supplied control panel will provide controls for grit equipment including grit classifier system. A local PLC located in the existing Electrical Building will provide remote control. In addition, a vacuum priming panel will be provided by the manufacturer, to control the vacuum priming system. Local panel shall be provided in accordance with the requirements of Section 13446, Instrumentation and Control and Section 13471, Control Cabinet Enclosures.

2. Local Control Panel shall be NEMA 4X 316 stainless steel suitable for free standing installation as shown in drawings.

3. Local Control Panel shall contain the following devices and provisions.

   a. 480 volt, 3 phase, main disconnect with external operable handle.

   b. Combination magnetic motor starters for grit pump, gear motor drive and grit conveyor. Each starter circuit shall be provided with overload relays and individual over-current protection.

   c. A 120 volt control power transformer suitable sized and protected for all grit panel controls and devices.

   d. Programmable Logic Controllers and accessories.

   e. Selector switches, pushbuttons and status and alarm lights as shown and specified herein.

   f. Control and signaling devices, timers, interlocks and devices for proper control of all system components.

   g. System input requirements as shown.

4. Refer to Section 13446, Instrumentation and Control for a sequence of operation and the I/O list for required points to be communicated with the plant control system. Coordinate with the System Integrator for interfaces with the plant control system.

2.5 TOOLS AND SPARE PARTS

A. Furnish and deliver the following spare parts carefully boxed or packaged and plainly marked for reordering:

1. One set of mechanical seals for each grit pump.

2. One resonance frequency probe dome for each grit pump.

3. One set of bearings and seals for vacuum pump and motor.

4. One set of gaskets for vacuum pump.

5. One set of bearings and seals for screw drive assembly.

6. Two sets of special tools required for normal operation and maintenance.

8. Spare parts shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the OWNER at the conclusion of the Project.

2.6 SURFACE PREPARATION AND SHOP PAINTING

A. Clean, shop prime coat, and shop finish coat ferrous metal surfaces of equipment in accordance with the requirements of Section 09901, Protective Coating.

8. Coat machined, polished and non-ferrous surfaces bearing surfaces and similar unpainted surfaces with corrosion prevention compound which shall be maintained during storage and until equipment begins operation.

C. Surface preparation and painting shall conform to Section 09901, Protective Coating.

D. CONTRACTOR shall certify, in writing, that the shop primer and coating system conforms to the requirements of Section 09 91 00, Painting.

2.7 ANCHORAGE DEVICES

A. Furnish anchor bolts of Type 316 stainless steel, of ample size and strength for the purpose intended, sized by the equipment manufacturer. Anchor bolts shall be wedged, and provided for direct embedment during placement of concrete.

8. Anchorage devices shall conform to the requirements of Section 05057, Anchor Systems.

2.8 SOURCE QUALITY CONTROL

A. Shop Tests:

1. Motor Tests: Perform a routine test on each motor at the manufacturer's factory. The test shall consist of: Running Light Current; Locked Rotor Current; Winding Resistance; High Potential; and Bearing Inspection.

PART 3- EXECUTION

3.1 INSTALLATION

A. Install grit separation equipment in complete accordance with the manufacturer's instructions and recommendations and the approved Shop Drawings.

B. Furnish and install all required oil and grease for initial operation.

3.2 FIELD TESTS

A. After CONTRACTOR and ENGINEER have mutually agreed that the equipment installation is complete and ready for continuous operation, CONTRACTOR and a qualified field service representative of the manufacturer shall conduct a running consecutive seven day test of the equipment and controls in the presence of ENGINEER to demonstrate that the units and their controls will function correctly.

1. Running Tests:

a. Field test each unit together with its controls. Test shall demonstrate to ENGINEER that each part and all parts together function in the manner intended. All necessary testing equipment and manpower shall be provided by CONTRACTOR at their expense.

b. In the event that CONTRACTOR is unable to demonstrate to ENGINEER that the equipment meets the requirements of the above described test, the equipment will be rejected and CONTRACTOR shall adjust and/or modify and retest the equipment as often as necessary to meet the specified requirements.

c. Prior to applying electrical power to any motor driven equipment, the drive motor shall be rotated by an external source to demonstrate free operation of all mechanical parts.

2. Performance Test: CONTRACTOR shall retain the services of a third party grit testing contractor to conduct a grit removal Performance Test to verify the grit removal efficiency of each unit by determining the percentage removal of grit particles of a specific size. Test shall demonstrate compliance with the requirements specified in Paragraph 2.1.B.2.a.

   a. The performance test shall demonstrate 95-percent grit capture and removal down to 140-mesh or 105-micron for sand equivalent size particles.

   b. The test shall duplicate as nearly as possible the expected conditions of operation for the entire grit removal system as well as for each grit chamber with respect to flow and grit characteristics.

   c. Perform testing separately for each unit. More than one unit may be in operation during testing. Unit being tested shall be operated at full rated capacity of the unit for the duration of the test.

   d. Coordinate with the City of Houston Operations to record total plant flow over the course of each sampling period.

   e. For the purpose of this test, grit shall be defined as any inorganic substance having an approximate specific gravity of 2.65 or greater.

   f. The test period shall consist of a six-hour testing period for each grit basin unit. Testing shall be performed as described herein.

   g. Adequate grit samples shall be obtained during each test to obtain workable sample weights. The sample pumps used to obtain the influent and effluent samples shall be sized accordingly. Minimum sample weight from the inlet channel after it is dried and burned shall be 500 grams.

   h. Influent and effluent samples shall be obtained simultaneously. The influent samples shall be taken immediately before the sloped inlet channel, and the effluent samples shall be taken right at the exit of the grit chamber. The point for grabbing the samples shall be at the bottom of the channel and at least two vertical elevations across the entire width of the channel. A minimum of six (6) different points across the width of the bottom of the channels shall be used to collect samples. A minimum of ten (10) sample pairs shall be collected. One (1) sample pair equals one (1) sample taken from the influent and one (1) sample taken from the effluent.

i. Samples shall be collected through orifices or tubes located in the influent and effluent channels and routed to settling basins. The orifices or tubes shall have a minimum diameter of 1-inch. The orifices or tubes shall be monitored to ensure that there is no plugging and that flow is maintained.

j. Grit settling basins shall maintain a surface overflow rate of 3-gpm/sft or less during sample collection.

k. At the completion of the sampling, the supernatant shall be decanted from the top of each settling basin until approximately 1 inch of liquid remains at the bottom. All grit shall be carefully washed from each settling basin to ensure 100 percent capture. Combine influent samples together and combine effluent samples together.

l. Influent and effluent samples shall then be separately passed through a 140-mesh wet sieve screen to trap all particles larger than 140-mesh. The solids retained on the 140-mesh sieve shall be further separated into the following sieve sizes: 20-mesh sieve and sequentially retained on 48-mesh, 65-mesh, 100-mesh, and 140-mesh.

m. The grit analysis and characterization shall include a characterization of the sand equivalent size analysis for each different sieve range based on settling velocity tests.

n. The grit captured on each mesh screen shall be transferred to evaporating dishes, dried, and placed in a muffle furnace to volatilize organics. Each sample shall then be cooled and the residue shall be weighed, including the amount passing through the 140 mesh sieve. This provides a grit quantity for both the influent and the effluent samples for different particle sizes.

o. Calculate the grit removal efficiency for each unit for each sieve mesh size. Calculate the total grit removal efficiency for the combined grit samples collected. Submit all measurements, test reports, and calculations.

p. If the measured grit capture performance is less than 95 percent grit capture for the 140-mesh sieve size the test can be performed up to two more times at the Contractor's own cost.

q. If the grit removal system fails to meet the specified performance grit removal requirements:

i. The Contractor can make adjustments or modifications to the grit removal system and repeat the performance test up to two more times. The grit removal equipment shall be completely retested after modification.

ii. Any repeated performance test shall be inclusive of all equipment and parameters identified in the approved performance test procedures.

iii. Any repeated performance test and associated efforts, including modifications, improvements, structural, or electrical modifications shall be completed at no additional cost to the Owner.

r. If after modifications and retesting the grit removal system fails to meet the specified performance grit removal requirements the Owner will require the Manufacturer to pay a one-time charge as follows:

i. The one-time charge shall be based on the actual performance of the equipment as demonstrated in the performance test results accepted by the Owner.

ii. The charge shall be a one-time payment to the Owner assessed on a percent of equipment purchase price (including Contractor markups) associated with the following Percent Removal performance.

iii. The indicated payback percent charge shall be as follows:

Percent Removal	Percent of Purchase Price
1. =95% to >95%	0%
2. >94% to <95%	1%
3. >93% to <94%	3%
4. >92% to <93%	5%
5. >91% to <92%	7%
6. >90% to <91%	10%
7. >85% to <90%	15%
8. <85%	20%.

3.03 MANUFACTURER'S SERVICES

A. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of 4 visits, minimum 4 hours on-Site for each visit, to the Site. The first visit shall be for assistance in the installation of equipment. Subsequent visits shall be for checking the completed installation, start-up and training of the system. Two separate training sessions

shall be performed to accommodate Operations shift schedules, coordinate with OWNER. Manufacturer's representative shall test operate the system in the presence of the ENGINEER and verify that the equipment conforms to the requirements. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

B. Reports: Submit report by manufacturer of each visit to the site that provides complete information on time, schedule, tasks performed, persons contacted, problems corrected, test results, training, instruction and all other pertinent information.

C All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the OWNER.

END OF SECTION

Section 11288

STAINLESS STEEL SLIDE GATE GATES AND WEIR GATES

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install stainless steel slide gates, weir gates and appurtenances complete and operational.

2. Included are stainless steel slide gates, weir gates anchorage systems, electric actuators and all appurtenances.

3. Extent of the equipment is shown on the Stainless Steel Slide Gate Weir Gate Schedule located at the end of this Section.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the stainless steel slide gates and weir gates Work.

C. Related Sections:

1. Division 3, Concrete.

2. Section 05051, Anchor Systems.

3. Section 09901, Protective Coatings.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices:

1. No separate payment will be made for stainless steel slide gates and weir gates under this Section. Include payment in Lump Sum with price breakdown included in the Schedule of Values.

2. Refer to Section 01270 - Measurement and Payment, and Section 01292 - Schedule of Values.

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

1.3 REFERENCES

A. Standards referenced in this Section are listed below:

1. American Society for Testing and Materials, (ASTM).

a. ASTM A 276, Specification for Stainless Steel Bars and Shapes.

b. ASTM B 584, Specification for Copper Alloy Sand Castings for General Applications

c. AWWA C561-04, Specification for Fabricated Stainless Steel Gates

2. National Electrical Code, (NEC).

3. National Electrical Manufacturers' Association, (NEMA).

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Manufacturer shall have a minimum of five years of experience of producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

2. Stainless steel slide gates and weir gates shall be the product of one manufacturer.

B. Component Supply and Compatibility:

1. Obtain all equipment included in this Section regardless of the component manufacturer from a single stainless steel slide gate and weir gate manufacturer.

2. The stainless steel slide gate and weir gate equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.

3. All components shall be specifically designed for the specified service and shall be integrated into the overall assembly by the stainless steel slide gate and weir gate equipment manufacturer.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Fabrication, assembly and installation diagrams.

b. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.

c. Wiring diagrams for electric motor operators.

2. Product Data:

a. Manufacturer's literature, illustrations, specifications and engineering data.

b. Deviations from the Contract Documents.

c. Lubricant Specification: Furnish a lubricant specification for the type and grade necessary to meet the requirements of the equipment.

B. Informational Submittals: Submit the following:

1. Support Design Information:

a. Submit for record purposes only the weight of each slide gate and weir gate and expected opening and closing thrust loads on the supporting structure.

2. Shop Test Results:

a. Submit results of required shop tests.

3. Field Test Results:

   a. Submit a written report giving the results of the field tests required.

C. Closeout Submittals:

1. Operation and Maintenance Manuals:

   a. Submit complete Installation, Operation and Maintenance Manuals including, test reports, maintenance data and schedules, description of operation and spare parts information.

   b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01782, Operations and Maintenance Data.

1.6 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.

2. Handle all stainless steel slide gates, weir gates and appurtenances properly, in accordance with manufacturer's recommendations. Stainless steel slide gates and weir gates, which are distorted or otherwise damaged, will not be acceptable. Protect all bolt threads and ends from damage.

B. Storage and Protection:

1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

2. Store all mechanical equipment in covered storage off the ground and prevent condensation.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify City, in writing, if any loss or

damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 SERVICE CONDITIONS

A. General:

1. Slide gates and weir gates shall be fabricated of Type 316 stainless steel, rising stem-type and self contained.

2. Design stainless steel slide gates and weir gates to safely withstand conditions listed in Stainless Steel Slide Gate and Weir Gate Schedule, located at the end of the Section.

3. Stainless steel slide gates shall be substantially watertight with leakage less than 0.1 gpm per foot of seating perimeter at design head.

4. Weirs shall be substantially watertight with leakage not to exceed 0.05 gpm of clear water per foot of seal periphery for the design unseating head. In addition, leakage at design unseating head shall not exceed 0.1 gpm of clean water per foot of seal periphery for the design unseating head.

5. Manual operators shall turn right to close, unless otherwise specified. Operators shall indicate the direction of operation.

6. Bolts, studs, cap screws, and adjusting screws shall be of ample section to withstand the force created by operation of the gate under a full head of water.

7. Stainless steel slide gates shall open to not less than 6-inches above the maximum water level in the channel in which they are installed.

2.2 MANUFACTURERS

A. Manufacturers: Provide equipment of one of the following:

1. Rodney Hunt - Fontaine Company.

2. Waterman Industries.

3. Golden Harvest, Inc.

4. Or equal.

2.3 FABRICATION

A. Materials of Construction:

1. Stainless Steel: For frame, slide, rail and yoke, ASTM A 276, Type 316 stainless steel. All metal for stainless steel slide gate and weir gate parts shall have a minimum thickness of 1/4-inch.

2. Bronze Casting: For operating nut, thrust nut and lift nut, ASTM B 584 Alloy 865.

3. All bolts, studs, cap screws and adjusting screws shall be of Type 316 stainless steel.

4. Bolts and nuts shall have hexagon heads.

5. Gasket material and installation shall conform to manufacturer's recommendations.

6. Compression cord for weir gates shall be nitrile rubber, ASTM D 2000.

7. Weir gate fasteners shall be Type 316 stainless steel, ASTM F 593 and F 594.

8. Weir gates pedestal and crank shall be tenzaloy aluminum.

9. Gasket between frame and wall: EPDM rubber, ASTM D 1056.

B. Frames:

1. The frames shall be constructed of structural members or formed plate welded to form a rigid one-piece frame.

2. The frames shall be of the flange back design suitable for mounting on existing concrete wall.

3. The guide slot shall be made of ultra high molecular weight (UHMW) polyethylene.

C. Disc:

1. Fabricate the slide or disc of ASTM A 276, Type 316 stainless steel plate reinforced with structural shapes attached by welding.

2. Provide reinforcing to limit deflection under full head to not more than 1/360 of the span.

3. Weld stem mounting guides to the disc.

4. No seals shall be directly attached to the disc.

D. Disc Guides:

1. Guides shall be of Type 316 stainless steel incorporating a sandwich type construction using plates and structural angles.

2. Guides shall be designed for maximum rigidity as columns to take the thrust developed during the stainless steel slide gate or weir gate operation under maximum head.

3. Guides shall extend beneath the opening a sufficient amount to support the disc in the fully open or closed position.

4. Guides shall be of such length as to retain and support at least two thirds (2/3) of the vertical height of the weir in the fully open position.

E. Stem:

1. Operating stems shall be of Type 316 stainless steel and designed as specified below.

2. Design stem to transmit in compression at least 2-1/2 times the rated output of the operating mechanism with an 80-pound effort on the crank or handwheel. Determine the critical buckling load using the Euler column formula, using C = 2. Where hydraulic cylinder lifts are used, the stem design force shall not be less than 1.25 times the output thrust of the hydraulic cylinder with a pressure equal to the maximum working pressure of the hydraulic fluid supply. Where electric motor driven lifts are used, the stem design force shall not be less than 1.25 times the output thrust of the unit in the stalled motor condition.

3. Stems shall have a slenderness ratio (UR) less than 200.

4. Threaded portion of the stem shall cold roller or have machined cut threads of the Acme type with a surface roughness of 32 micro inches. Join stems of more than one section by stainless steel couplings threaded and keyed, or bored and pinned to the stems. All threaded and keyed couplings of the same size shall be interchangeable. Couplings shall be designed to be of greater strength than the stems.

5. Connect the stem to the disc by means of a bolted connection.

6. Provide rising stems with an adjustable stop collar on the stem above the floorstand lift nut.

F. Yoke (For Self Contained Type Gates):

1. Furnish tops of the extended guides with a yoke for mounting of the lifting device.

2. Construct the yoke of structural shapes of sufficient strength to take the full thrust created by operating the gate under the maximum specified head.

3. Attach the yoke to the framework by bolting or welding to permit removal of the gate slide and stem.

4. The maximum deflection of the yoke shall be 1/360 of the gate's span.

G. Lower Seals:

1. Mount a specially shaped resilient neoprene seal on the bottom of the disc to provide flush-bottom closure for stainless steel slide gates and weir gates. As an alternate, a poured urethane seal shall be mounted in the invert of the frame to form a flush bottom seal.

2. Shape of the seal shall produce a seating surface having a minimum width of 3/4-inch, and the seal will extend beyond the seating surface of the frame.

3. Vertical face of the seal shall be in contact with the seating surface of the guide to provide a proper seal at the corners.

4. J-Bulb seals are not acceptable.

H. Side and Upper Seals:

1. Side and upper seals for slide gates and weir gates shall be fabricated from UHMW polyethylene or UHMW polymer. UHMW bearing strips shall be mechanically retained to lock seat in place.

2. J-Bulb seals are not acceptable.

2.4 APPURTENANCES

A. Stem Guides:

1. Stem guides shall be fabricated from Type 316 stainless steel and shall be equipped with UHMW polyethylene or UHMW polymer.

2. Guides shall be adjustable in two directions and shall be spaced so that stems have a maximum unsupported length of 84-inches.

3. Anchor bolts for stem guides shall be Type 316 stainless steel.

B. Anchor Bolts:

1. Provide Type 316 stainless steel anchor bolts as required for stem guides, floorstands, and all equipment or appurtenances, which must be secured to concrete walls or floors. Anchor bolts shall be of ample size and strength for the purpose intended, and shall be furnished by the manufacturer. Anchor bolts shall be hooked, and provided for direct embedment during placement of concrete.

C. Stem Cover:

1. Furnish all stems with a clear polycarbonate or butyrate plastic pipe stem cover. Covers shall be furnished with a cast aluminum adaptor for mounting covers to floor stands. Stem covers shall be designed and furnished with gasketing and breathers to eliminate water intrusion into operators and condensation within the covers.

2. Stem covers shall be engraved with legible markings showing as a minimum the gate position at 1/4 open, 1/2 open, 3/4 open and full open or vented clear butyrate having a transparent mylar scale calibrated in feet and inches to show gate position.

D. Manual Operators:

1. Manual operation shall be by handwheel or crank operated floorstand or benchstand as shown and specified.

2. Handwheel-operated type shall be without gear reduction and crank-operated type will have either a single or double gear reduction, as required. Each type shall be provided with a threaded cast manganese bronze lift nut to engage the operating stem.

3. Provide anti-friction bearings to properly support both opening and closing thrusts.
4. Stands shall operate the gates under the specified operating head with not greater than a 40-pound pull on the crank or handwheel.

5. All components shall be totally enclosed in a cast-iron weather-proof housing. Provide positive mechanical seals to exclude moisture and dirt and prevent leakage of lubricant out of the unit.

6. Provide lubricating fittings for all gears and bearings.

7. Stands shall include a cast-iron or painted steel pedestal designed to position the input shaft approximately 36-inches above the operating floor. An arrow with the word "OPEN" shall be permanently attached or cast on the floorstand indicating the direction of rotation to open the stainless steel slide gate or weir gate.

8. Removable cranks shall be cast-iron with a revolving brass grip. Removable handwheel shall be fabricated steel designed for rough treatment and minimum weight.

9. For self-contained type stainless steel slide gates and weir gates, the distance between handwheel or crank operator and the operating floor shall be 36-inches minimum and 48-inches maximum.

10. Crank-operated gates shall be provided with nut-operator drives as noted on Stainless Steel Slide Gate and Weir Gate Schedule.

11. Provide mechanical stops adjustable ±five degrees at each end of travel.

E. Electric Actuators:

1. General:

   a. Provide multi-turn electric actuator operable with handwheel even after disengaging and removing electric motor.

   b. Coordinate sizing of each electric actuator with slide gate manufacturer, who shall furnish slide gate and associated electric actuator and appurtenances as a unit.

   c. Conform to AWWA C540 and this Section.

2. Application Criteria:

   a. Ambient Temperature Rating: -20to+158 degrees F.

   b. Ambient Humidity: 100 percent.

   c. Power Supply: 480-volt, three-phase, 60 Hertz.

   d. Control Voltage: 120 VAC, single phase, 60 Hertz.

   e. Torques: As determined by valve manufacturer.

   f. Duty Cycle: Sixty starts per hour, minimum.

3. Electric Motor:

   a. General: Provide motors suitable for "open/close" service, with high torque characteristics and minimum 70 degree C temperature rating.

   b. Motor Construction:

      1) Enclosure: NEMA 4X.

      2) Insulation: Class F.

      3) Service Factor: 25% of highest rated torque

      4) Power Supply: 480 VAC, 3-phase, 6 Hz

5) Provide winding thermostats for overcurrent protection.

6) Efficiency: High-efficiency conforming to NEMA MG 1.

7) Bearings: Anti-friction with minimum B-1O life of 100,000 hours, lifetime pre-lubricated and sealed.

4. Actuator Gearing:

a. Housing: Die-cast aluminum or cast-iron.

b. Close-coupled to electric motor.

c. Input Shaft Gearing: Spur or bevel gear assembly.

d. Output Shaft Gearing: Self-locking worm gears with minimum gear backlash to prevent valve disc chatter or vibration.

e. Gearing shall be of hardened alloy steel or combination of hardened alloy steel and alloy bronze, accurately cut by hobbing machine.

f. Lubrication: Grease or oil bath.

g. Bearings: Ball or roller with minimum B-10 life of 100,000 hours, lifetime pre-lubricated and sealed.

h. Input Shaft: Hardened alloy steel.

i. Provide mechanical stops adjustable to plus-or-minus five degrees at each end of travel.

5. Limit Switches:

a. Provide each actuator with "end of travel" limit switches to allow control of desired end position for each direction of travel.

b. Provide open and close limit switches geared to drive mechanism and in step at all times, whether unit is operated electrically or manually, and whether or not actuator is powered by electric power supply. Friction devices or set-screw arrangements shall not be used to maintain the setting.

c. Limit switch gearing shall be appropriately lubricated.

d. Provide driven mechanism totally enclosed to prevent entrance of foreign matter and loss of lubricant.

e. Provide each limit switch with four auxiliary contacts. Two contacts shall close and two contacts shall open at a desired end position for each direction of travel.

f. Switches shall be rated five amperes at 120 volts.

6. Torque Sensor:

a. Provide adjustable torque switches with each valve actuator. Torque switches shall operate during complete valve cycle without using auxiliary relays, linkages, latches, or other devices.

b. Wire torque switches to de-energize valve actuator motor when excessive torque is developed during each direction of travel.

c. It shall be possible to select the torque switches to control open and close limit positions in each direction of valve travel.

7. Handwheel Operation:

a. Provide actuator with handwheel for manual operation, so connected that operation by motor will not cause handwheel to rotate.

b. Should electric power be returned to motor while handwheel is in use, unit shall prevent transmission of motor torque to handwheel.

c. Handwheel shall require no more than 80-pound effort on rim for seating or unseating load, and no more than 60 pounds on running load.

d. Handwheel shall have an arrow and the word "OPEN" or "CLOSE" indicating required rotation. Handwheel shall operate in clockwise direction to close.

8. Controls:

a. Provide local control panel at each gate as shown on the Drawings.

b Provide non-intrusive control module.

c. Enclosure: NEMA 4X.

d. Starter: Combination reversing magnetic starter with circuit breaker and disconnect switch.

e. Control Power Transformer: Provide transformer to transform rated three-phase, 60 Hertz power to 120 volts, single-phase. Transformer shall be

complete with grounded and fused secondary and dual primary fuses.

f. Refer to Section 13446, Instrumentation and Control for monitoring and control of slide gates and weir gates.

g. Provide "LOCAUOFF/REMOTE" pushbuttons with hold-to-run or momentary contact selection.

h. Provide "LOCAUOFF/REMOTE" indicating lights and zero-to-100 percent position indication in liquid crystal display window.

i. Provide thermal overload and single-phasing protection of motor.

j. Actuator circuit boards shall be rated for high temperature service, minimum 70 degrees C.

k. Provide 120 VAC space heater to maintain internal housing temperature at 20 degrees C.

l. Provide LCD graphic display for displaying of mode of operation, status, position, torque and any alarm condition.

m. Control Interface: Provide dual channel Profibus DP control module to interface actuator into plant SCADA System.

9. Testing:

a. Test each actuator in manufacturer's shop in conformance with AWWA C540.

10. Manufacturers: Provide products of one of the following:

a. EIM, TEC2000.

b. AUMA, AUMATIC.

c. Limitorque, MX Series.

d. Rotork, IQ Series

F. Identification: Identify each stainless steel slide gate and weir gate with a stainless steel nameplate stamped with the approved designation as shown in the Stainless Steel Slide Gate and Weir Gate Schedule, located at the end of this Section. Nameplate shall be permanently fastened to the gate at the factory.

2.5 SURFACE PREPARATION AND PAINTING

A. Clean, prime coat, and finish coat ferrous metal surfaces of equipment in the shop in accordance with the requirements of Section 09901, Protective Coatings.

B. Coat machined, polished and non-ferrous surfaces bearing surfaces and similar unpainted surfaces with corrosion prevention compound, which shall be maintained during storage, and until equipment begins operation.

C. Contractor shall certify, in writing, that the shop primer and coating system conforms to the requirements of Section 09901, Protective Coatings.

2.6 SOURCE QUALITY CONTROL

A. Shop Tests:

1. Test each stainless steel slide gate and weir gate fully assembled in the vertical position for proper seating.

2. Fully open and close gate disc in its guide system to ensure that it operates freely.

3. Operate and test floor stands, bench stands and motor operators to ensure proper assembly and operation.

2.7 STAINLESS STEEL SLIDE GATE AND WEIR GATE SCHEDULE

A. The Stainless Steel Slide Gate and Weir Gate Schedule is located at the end of this Section. Conform to type, size, operation and other data specified, unless otherwise approved by City.

B. Provide all stainless steel slide gates and weir gates as shown and listed in the schedule.

C. Schedule Abbreviation:

1. Type:

a. EF - Embedded Frame.

b. SMF - Surface Mounted Frame.

2. Operator Type:

a. CO - Crank Operated.

b. HW - Handwheel.

c. EA - Electric Actuator.

3. Mounting:

a. EMB - Embedded.

b. SUR - Surface.

D. The seating and unseating design head as stated in the Stainless Steel Slide Gate and Weir Gate Schedule is based on the head measured to the centerline elevation of the gate in its closed position.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install stainless steel slide gate and weir gate equipment in accordance with manufacturer's instructions and recommendations.

B. Brace guides and frames during placement of concrete.

C. Set anchor bolts in accordance with approved Shop Drawings and manufacturer's recommendations.

D. Provide minimum of 1-inch of non-shrink grout below all floorstands.

E. Adjust all parts and components as required to provide correct operation.

3.2 START-UP AND FIELD TESTS

A. After Contractor and City have mutually agreed that the equipment installation

is complete and ready for continuous operation, Contractor and a qualified field service representative of the manufacturer shall conduct a functional field test and a leakage test of each stainless steel slide gate and weir gate in the presence of City to demonstrate that each stainless steel slide gate furnished will function correctly and that maximum permissible leakage is not exceeded.

1. Functional Tests:

   a. Each stainless steel slide gate and weir gate with appurtenances shall be field-tested. Tests shall demonstrate to City that each part and all parts together function in the manner intended. All necessary testing equipment and manpower shall be provided by Contractor at their expense. City will furnish all power, and incidental material and labor required for the tests.

2. Leakage Tests:

   a. Maximum permissible leakage shall be in accordance with the requirements of Paragraph 2.1, above. Excess leakage shall be reduced to meet specified requirements by adjusting the gate, or replacement will be required.

3. In the event that the manufacturer is unable to demonstrate to City that their equipment meets the requirements of the tests, the deficient equipment will be rejected and Contractor shall adjust and/or modify and retest the equipment as often as necessary to meet the specified requirements. No separate payments shall be made for adjustments and/or modifications.

3.3 MANUFACTURER'S SERVICES

A. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of two visits, minimum six hours on-Site for each visit, to the Site. The first visit shall be for assistance in the installation of equipment. Subsequent visits shall be for checking the completed installation, start-up and training of the system. Manufacturer's representative shall test operate the system in the presence of the City and verify that the equipment conforms to the requirements. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

B. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the City.

3.04 PERFORMANCE TESTING

A. Verify equipment performance through 7 consecutive calendar day, 24-hour per day, performance test in accordance with Section 01760 - System and Facility Performance Testing Procedures.

Gate ID	location	Frame Type	Opening Size (H x W)	Mounting	Gate Centerline Elevation	Floor Mounting Elevation	Design Head (Seating/ Unseating)[1]	Operator
SG-01	Influent Grit Basin Channel 1	EF	5.0' x 4.6'	SUR	77.65'	84.09'	4.19'/4.19'	EA
SG-02	Influent Grit Basin Channel 1	EF	5.0' x 4.6'	SUR	77.65'	84.09'	4.19'/4.19'	EA
SG-03	Influent Grit Basin Channel 2	EF	5.0' x 4.6'	SUR	77.65'	84.09'	4.19'/4.19'	EA
SG-04	Influent Grit Basin Channel 2	EF	5.0' x 4.6'	SUR	77.65'	84.09'	4.19'/4.19'	EA

Note 1: Design head measured from centerline elevation of gate.
Note 2: The height shown in the table for weir gate indicates the top of weir plate elevation.
Note 3: Field verify existing gate dimensions.

END OF SECTION

Section 11303

SELF PRIMING CENTRIFUGAL CHOPPER PUMPS

PART 1 GENERAL

1.01 DESCRIPTION

A. This section provides requirements for the supply and installation of self priming chopper pumps and accessories for a scum separation removal system.

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.

1.03 RELATED WORK

A. Field painting, except as herein specified, is included in Division 9 – Finishes.

B. Process instrumentation and electrical work, except as specified herein, is included under Divisions 13 and 16.

C. Mechanical piping and appurtenances, valves, pipe hangers and supports are included under Division 15.

1.04 QUALITY ASSURANCE

A. All materials used shall be new and of high grade and of properties best suited to the Work required.

B. Manufacturer's Qualifications:

1. Equipment provided under this Section shall be a standard product in regular production by manufacturers whose products have proven reliable in similar service for at least five (5) years.

2. Insofar as possible, all equipment of the same specific type shall be the product of one (1) manufacturer.

1.05 ACCEPTABLE MANUFACTURERS

A. Acceptable Manufacturers

1. Vaughan
2. Borger
3. PCM
4. Approved Equal

1.06 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01330—Submittal Procedures and 15050—Basic Mechanical Materials and Methods. Submittals shall include but not be limited to, the following:

1. Submit shop drawings of the pumps, valves, and pressure indicators. Drawings to include mounting pads, brackets, and fixtures. Include drawings of proposed system and reference standards of all materials used.

2. Certified Pump Performance Curves shall include power, head, flow, efficiency and NPSH.

3. Manufacturer's catalog information, descriptive literature, specifications, etc. for pumps, motors, and accessories.

4. Manufacturer's certified installation drawings containing all critical dimensions, piping connection sizes, weights, etc. required for installation of the equipment.

C. Include written test procedures and results of all tests performed at the factory.

D. Submit pumping curves of Total Dynamic Head (TDH), and capacity over the entire operational range for each type of pump. Include installation instructions and diagrams of electronic control devices.

E. Complete bill of materials for all equipment components including Manufacturer's Equipment Warranty.

1.07 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01782—Operating and Maintenance Data. Prepare Operation &

Maintenance (O&M) Manuals specifically for this installation, including but not limited to all required section drawings, equipment parts lists, name of protective coatings, recommended spare parts, descriptions, etc, that are required to instruct operating and maintenance personnel unfamiliar with this equipment. Include all approved Shop Drawings in the Operation and Maintenance Manuals.

B. Preliminary Operation & Maintenance (O&M) Manual. Provide two (2) copies Preliminary O&M Manual in 3-ring view binders including approved shop drawings and data.

C. Final O&M Manual Submittal. Provide six (6) copies of Final O&M Manuals bounded in D-ring binders shall be submitted for final acceptance of the installed system. The Final O&M Manuals shall include As-Built Drawings with field modifications and/or corrections, and manufacturer's certifications including installation inspection, testing, and startup completion reports. All the Final O&M Manual files shall include electronic copies of the O&M manuals in navigable, portable document files (PDF) on a computer disc (CD) attached to each Final O&M Manual submittal.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment to site under provisions of Section 01610—Basic Product Requirements.

B. Store and protect products under provisions of Section 01610—Basic Product Requirements.

C. Store equipment off the ground in original shipping crates in enclosed shelter.

1.09 WARRANTY

A. Provide warranty under provisions of Section 01610—Basic Product Requirements.

PART 2 PRODUCTS

2.01 DETAILS OF CONSTRUCTION

A. Housing: Shall include ANSI Class 125 flanged inlet and discharge flanges, an oversized cleanout and mounting feet. The housing shall be ductile cast iron with all water passages to be smooth, and free of blowholes and imperfections for good flow characteristics.

B. Casing and Back Pull-Out Plate: The pump casing shall be of volute design, spiraling outward to the ANSI Class 125 flanged centerline discharge. Back pull-out design shall incorporate jacking bolts for accurate adjustment of impeller-to-cutter bar clearance, and shall allow removal of pump components without requiring disconnection of casing from inlet or discharge piping. Casing & backplate shall be ductile cast iron with all water passages to be smooth, and free of blowholes and imperfections for good flow characteristics. A pressure tap shall be included on or near the discharge flange. Backplate shall include a replaceable Rockwell C 60 steel cutter adjustable for 0.005-0.015" clearance to cut against the rotating impeller pumpout vanes for removing fiber and debris. Casing shall be a separate parts component of the housing.

C. Impeller: Shall be semi-open type with pump out vanes to reduce seal area pressure. Chopping/maceration of materials shall be accomplished by the action of the cupped and sharpened leading edges of the impeller blades moving across the cutter bar at the intake openings, with a maximum set clearance between the impeller and cutter bar of 0.015-0.025" cold. Impeller shall be cast alloy steel heat treated to minimum Rockwell C 60 and dynamically balanced. The impeller shall be threaded to the shaft and shall have no axial adjustments and no set screws.

D. Cutter Nose: Designed to cut stringy materials and prevent binding using two opposing cutter edges that cut against the inside of the cutter bar fingers. The cutter nose shall be cast steel heat treated to minimum Rockwell C 60.

E. Cutter Bar: Shall be recessed into the pump bowl, and shall extend diametrically across entire pump suction opening. Cutter bar shall be alloy steel and heat treated to minimum 60 Rockwell C Hardness.

F. Upper Cutter: Shall be threaded into the backplate behind the impeller, designed to cut against the pump-out vanes and the impeller hub, reducing and removing stringy materials from the mechanical seal area. Upper cutter shall be cast steel and heat treated to minimum 60 Rockwell C Hardness.

G. Pump Shafting: Shall be heat treated alloy steel.

H. Bearings: Shall be oil bath lubricated with ISO Gr. 100 hydraulic oil and site glass indication. Shaft thrust in both directions shall be taken up by a double-row angular contact ball bearing. A single-row radial bearing shall also be provided. B10 bearing life shall be minimum 100,000 hours.

I. Back Pull-Out Bearing Housing: Shall be ductile cast iron, and machined

with piloted bearing fits for concentricity of all components. Back pull-out design shall incorporate jacking bolts for accurate adjustment of impeller-to-cutter bar clearance, and shall allow removal of pump components without requiring disconnection of housing from inlet or discharge piping. Double lip seals riding on a stainless steel shaft sleeve shall provide sealing at both ends of the bearing housing.

J. Mechanical Seal: Mechanical seal shall be cartridge type with silicon carbide (or tungsten carbide) faces. Seal shall be positively driven by set screws. This cartridge seal shall be a preassembled, and pre-tested so that no seal settings or adjustments are required from the installer. Any springs used to push the seal faces together must be shielded from the fluid to be pumped. The cartridge shall also include a 17-4PH, heat-treated seal sleeve and a CF8M stainless steel seal gland.

K. Shaft Coupling: Bearing housing and motor stool design is to provide accurate, self-aligning mounting for a C-flanged electric motor. Pump and motor coupling shall be elastomeric type.

L. Optional Belt Drive: Adjustable brackets shall be used to support a side-mounted motor. Sheaves and belts shall be properly sized for horsepower ratings, and all guards are to be supplied with the belt drive system.

M. Stainless Steel Nameplates: Shall be attached to the pump and drive motor giving the manufacturer's model and serial number, rated capacity, head, speed and all pertinent data.

N. Motor Requirements: Drive motor shall be 10 HP, 1750 RPM, 460 volts, 3 phase, 60 hertz, high efficiency, chemical duty, C-flange mounted. The motor shall be sized for non-overloading conditions.

O. Surface Preparation: Degreased and coated with 1-3 MDFT of acrylic urethane (except motor).

P. OPTIONAL ADDER Surface Preparation: SSPC-SP5 commercial sandblast (except motor), primed with 5-8 MDFT epoxy primer and finish coated with 2-4 MDFT acrylic (except Motor).

Q. Scum Mixing Assembly

1. One scum mixing assembly, complete with a 3-way diverter valve and automatic electric valve actuator, shall be supplied for each pump by the pump manufacturer in order to maintain unit responsibility. The diverter valve and automatic electric valve actuator shall allow for 100% discharge flow and 100% recirculation flow. The mixing assembly shall

be mounted in the scumpit as shown in the drawings. The deckplate of the mixing assembly is to be located at the top of the scum pit. The 3-way diverter valve and automatic valve actuator shall be mounted on the pump discharge flange.

2. Nozzle System: Each mixing assembly shall include one nozzle below the deck plate as shown in the drawings. The nozzle shall be adjustable a minimum of 270 degrees horizontally and 70 degrees vertically. The nozzle adjustment shall be made with control handles located above the deck plate for ease of access.

3. Deck Plate: The deck plate shall be fabricated from ¼" thick 1018 steel. The inlet flange shall be 4", 150# ANSI rated and be located above the deck plate.

R. Air Release Valve
1. Wastewater Air Release Valves shall be automatic float operated valves designed to release accumulated air from a piping system while the system is in operation and under pressure.

S. Replacement Controls
1. Furnish one (1) replacement NEMA 4X 316 stainless steel control panel. Panel to include pump manufacturer recommended functions. The panel shall include a pump alternator so both pumps will not run at the same time. A Siemens hydroranger ultrasonic level controller or approved equal shall be supplied and mounted in the panel.

2.02 ACCESSORIES

A. Spare Parts - Furnish one complete set of manufacturer's recommended spare parts for each type of pump and any special tools required for disassembly. Spare parts are to be vacuum sealed and labeled as to pump size and series. Include at least the following: seals, gaskets and diaphragms, cutter bar, impeller, cutter nut, upper cutter and diverter valve drive shaft gasket.

2.03 PERFORMANCE REQUIREMENTS

A. The self-priming chopper pump shall be a centrifugal pump specifically designed to pump waste solids at heavy consistencies without plugging or dewatering of the solids.

B. Materials shall be chopped/macerated and conditioned by the pump as an integral part of the pumping action.

C. The pump must have demonstrated the ability to chop through and pump high concentrations of solids such as plastics, heavy rags, grease and hair balls, wood, paper products and stringy materials without plugging, both in tests and field applications.

D. Suction Diameter 6 inches

E. Discharge Diameter 4 inches

F. Individual Pump Capacity (gpm) and TDH (ft) 300gpm@37ft; 380gpm@30 ft. (Pumps do not operate in tandem).

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with the Contract Documents and the manufacturer's written instructions.

B. No modifications to equipment shall be made without the written consent of the manufacturer and approval of Engineer.

C. Field verify all dimensions and elevations. Notify Engineer of specific differences.

D. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for testing and startup.

E. Install pump stands flat and level using stainless steel quick bolts. Attach pumps according to manufacturer's instruction using bolts, nuts, and washers of 316 stainless steel. Anchor rods (bolts) shall be Type 316 SS HILTI-style adhesive anchors. When tightening anchor bolts, use only that force necessary to securely attach pump stand. Do no crack the mounting feet. Use lock washers to prevent the nuts from vibrating loose. When piping has been assembled, tested, and cleaned, attach to pump.

3.02 TESTING

A. All testing shall be done in the presence of the Engineer and the equipment manufacturer or their approved representative.

B. Follow manufacturer's start-up instructions. Perform pumping test using clean water and under the guidance of the manufacturer's technical representative.

C. Preliminary Field Tests shall be made after installation of the pumps. Functional Testing shall demonstrate the following:

1. That the units have been properly installed and are in proper alignment.

2. That the units operate without overheating or overloading of any parts and without objectionable vibration.

3. That there are no mechanical defects in any of the parts.

4. That the pumps can deliver the specified pressure and quantity at the rated speed.

3.03 START-UP AND ACCEPTANCE

A. Beneficial use will not occur until after the start-up activities have been performed and accepted by the City Engineer. Start-up activities include the following:

1. Receipt and acceptance by the City Engineer of draft Operation and Maintenance manuals, including the wiring and ladder diagrams.

2. Installation inspection by City operating, electrical and instrumentation staff followed by any corrective measures required by the Contractor.

3. Satisfactory operation of Self Priming Chopper Pumps for 7 consecutive days under the City's control. If malfunctions or other operational problems halt the 7-day test period, the Contractor shall make appropriate corrections and restart the 7-day test period.

4. Provide the services of a factory-trained technician for a period of 8 hours to train the City's operating and maintenance personnel. Training session shall be scheduled and coordinated by the

Contractor. Furnish the representative for the additional time to correct or supervise correction of any defects of malfunctions.

B. Acceptance. After the start-up operation has been successfully completed, the City will accept the Self Priming Chopper Pumps when final Operation and Maintenance manuals have been received, reviewed, and accepted by the City. Include ladder logic diagrams and wiring and termination diagrams for both power and instrumentation systems.

END OF SECTION

Section 11334

STATIC SCREEN

PART 1 GENERAL

1.01 DESCRIPTION

A. Furnish all labor, materials, equipment, and incidentals required and install, and test, complete and ready for operation, heavy duty static screens as shown on the Drawings and as specified herein.

B. The unit(s) shall be furnished and installed with all necessary accessory equipment and auxiliaries, whether specifically mentioned in this Section or not, as required for an installation incorporating the highest standards for the type of service including field testing and instructing the regular operating personnel in the care, operation, and maintenance of all equipment.

C. Contractor shall verify the existing Scum Removal Facility operational data to coordinate installation of the proposed Static Screens to ensure integrated operation of the static screen with the existing and proposed scum removal equipment.

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.

1.03 RELATED WORK

A. Field painting, except as herein specified, is included in Division 9 – Finishes.

B. Mechanical piping and appurtenances, valves, pipe hangers and supports are included under Division 15.

1.04 QUALITY ASSURANCE

A. All materials used shall be new and of high grade and of properties best suited to the Work required.

B. Manufacturer's Qualifications:

1. Equipment provided under this Section shall be a standard product in regular production by manufacturers whose products have proven reliable in similar service for at least five (5) years. Experience records and references shall be submitted in accordance with Section 01330 – Submittal Procedures. The Owner and Engineer reserve the right to reject any manufacturer based on an unsatisfactory experience record or the inability to meet specifications.

2. Insofar as possible, all equipment, including, but not limited to the screens and the solid drop chute shall be the product of one (1) manufacturer.

1.05 ACCEPTABLE MANUFACTURERS

A. Acceptable Manufacturers

1. Hycor (Parkson)
2. IPEC
3. JDV
4. Approved Equal

1.06 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01330—Submittal Procedures and 15050—Basic Mechanical Materials and Methods. Submittals shall include but not be limited to, the following:

1. Submit shop drawings of the pumps, valves, and pressure indicators. Drawings to include mounting pads, brackets, and fixtures. Include drawings of proposed system and reference standards of all materials used.

2. Manufacturer's certified installation drawings containing all critical dimensions, piping connection sizes, weights, etc. required for installation of the equipment.

E. Manufacturer's Equipment Warranty.

1.07 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section

01782—Operating and Maintenance Data.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment to site under provisions of Section 01610—Basic Product Requirements.

B. Ship in as few parts as possible, requiring minimum onsite assembly.

B. Store and protect products under provisions of Section 01610—Basic Product Requirements.

C. Store equipment off the ground in original shipping crates in enclosed shelter.

1.09 WARRANTY

A. Provide warranty under provisions of Section 01610—Basic Product Requirements.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Each screen shall be designed and installed in conformance with the following data and as shown on the Drawings:

1	Number of units:	2
2	Inlet Pipe Diameter, in:	10"
3	Effluent Pipe Diameter, in:	12"
4	Screen Panel Width, in:	72"
5	Screen slot openings, in	0.06"
6	Design flow per Screen, GPM:	300
7	Maximum flow per screen, GPM:	380

B. The equipment specified herein is intended for use in scum solids removal system, specifically designed to separate scum, solid and semi-solid debris and floating matter from wastewater processes. Each static

screen shall remove debris from wastewater using:

1. A sloped screen panel allowing easy removal of the debris from the static screen and discharge solids to a screenings drop chute with apron.

C. The Static Screen unit will be supported and anchored on the top of the structural platform to receive waste inlet and discharge filtrate flow into the Plant Drain system. Coordinate the screenings drop chute and discharge apron with the structural platform and the receiving waste dumpster to assure proper and safe operation, easy access to all equipment items for routine maintenance, and that the screenings and associated moisture are deposited completely within the receiving waste dumpster.

2.02 MATERIALS AND EQUIPMENT

A. The screen cabinet will be fabricated from 10 gauge type 304L stainless steel. Coordinate mounting and fastening of the unit to the structural beams or channels of the platform. Routine service must be possible with the screen on the platform.

1. The cabinet will have a 10.75 inch diameter plain-end influent connection secured to the back panel at the cabinet influent distribution chamber by means of a full-strength weld.

2. Additionally, the cabinet will have a 12.75 inch diameter plain-end effluent connection secured to the back panel at the cabinet discharge by means of a full-strength weld.

3. Both the influent and effluent connections will be constructed of 10 gauge type 304 stainless steel. The cabinet side walls will extend past the cabinet bottom, each ending in a flange provided with mounting holes. The screen cabinet will be fitted with two (2) observation ports, one in each cabinet side wall, and each observation port having a non-metallic grommet secured around its circumference.

4. The screen cabinet will be equipped with an internal influent distribution chamber. The chamber will receive the incoming flow and evenly distribute it to the weir.

5. At the top of the influent distribution chamber, the incoming flow will spill over the weir. The weir will have a 3.00-inch-radius crown , an 11-inch-minimum screen approach apron, and will be the full width of

the screen cabinet.

6. To properly direct the incoming flow to the screen panel, a hinged flow distribution baffle extending the full length of the weir will be furnished. The flow distribution baffle will be constructed of 16 gauge type 304 stainless steel, and be accurately positioned and located so that the contoured baffle lip is parallel with the weir screen approach apron.

B. The screen panel will be constructed of type 304 stainless steel, and will consist of a screen element, panel pivot, and drip lip.

1. Static screen panel will be mounted to each side of the inside of the frame to direct and carry the screening solids out of the screen panel and drop into the solids drop chute. The screen element will be a single concave curved panel with a radius of 80.38 inches at the screen surface, and extending over an arc of approximately 38.5 degrees, positioned in the screen cabinet to properly process the flow. The screen panels shall be 72 inches wide and approximately 54.25 inches long as measured along the radius.

2. Transverse screen segments will be formed to have a triangular cross section (wedgewire) and to have 360 degree attachment loops on 3.94-inch centers securing each segment to longitudinal .313-inch-diameter support rods. The transverse screen segments will be formed to contain a double arc between each longitudinal support rod, each arc being 1.25-inch radius and 61 degrees. Each arc will be separated by a .625-inch tangent; the screen panel will be oriented so that the arcs lie in the direction of the flow. No rivets, bolts, or other mechanical fastening will be used to attach the transverse screen segments to the longitudinal support rods.

3. The use of plastic, UHMW, or FRP for the screen panel is not acceptable.

4. The wedgewire screen panel will be pivot mounted to allow it to be rotated about the horizontal axis, facilitating inspection of the tapered side of the wedgewire screen.

5. A 12 gauge type 304 stainless steel contoured drip lip will be furnished along the bottom edge of the screen panel to control excess water from running off the screen panel. The drip lip will be contoured so as to direct free water into the screen cabinet for discharge.

C. A 24-inch long solids discharge chute of 12 gauge stainless steel construction will be attached to the scum screen.

D. The scum screen will be equipped with type 304 stainless steel doors and covers. The doors will cover the screen panel, allowing clearance for solids to slide off the screen. The covers will be located atop the scum screen, thereby enclosing the weir/headbox area. The front and sides of each door frame will be covered. The back of each door will be left open. The doors will be attached to the scum screen using type 316 stainless steel threaded fasteners and type 316 continuous hinges. When closed, the doors will be held shut by gravity resting against a reinforcing framework; when open, each door may be held open by sliding prop rods located on the cabinet sides. The covers will be held in place by use of type 316 stainless steel threaded fasteners. Neoprene gasketing will be applied to the scum screen to act as a seal.

2.03 ACCESSORIES

A. Spare Parts - Furnish one complete set of manufacturer's recommended spare parts for each scum screen and any special tools required for disassembly.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with the Contract Documents and the manufacturer's written instructions.

B. Services of the manufacturer's factory trained representative, who is specifically knowledgeable in the type of equipment specified herein, shall be provided during the equipment installation period. The manufacturer's representative shall assist the installation Contractor in determining the location of anchor bolts, setting and leveling the equipment, and coordinating mechanical connections to all the equipment specified herein. Upon completion of the physical installation of the units, the manufacturer shall submit in writing to the Owner's representative a letter stating that the units have been properly installed and are acceptable for operation. Further, said representative shall be available to instruct Owner's personnel in the proper operation and maintenance of the equipment. The manufacturer's representative shall have prior operation, maintenance and instructing experience acceptable to the Engineer. The Engineer reserves the right to require the manufacturer's representative to re-perform operating and maintenance instruction if the services are

found inadequate.

C. A manufacturer's representative for the equipment specified herein shall be present at the jobsite or at the classroom designated by the Owner for the minimum time periods listed for the specified services, travel time excluded:

1. One 8-hour-day for installation assistance, inspection, and certification of installation of the static screen systems.

2. 4-hour for training of the static screen systems.

Startup services and training of Owner's personnel shall be scheduled with the Owner.

D. During the period between six months to one year from the completion of the initial operation and maintenance instruction, a factory-trained representative of the screen manufacturer shall return to the job site for follow-up inspection and system adjustment and optimization.

E. No modifications to equipment shall be made without the written consent of the manufacturer and approval of Engineer.

F. Field verify all dimensions and elevations. Notify Engineer of specific differences.

G. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for testing and startup.

3.02 TESTING

A. All testing shall be done in the presence of the Engineer and the equipment manufacturer or their approved representative.

B. Follow manufacturer's start-up instructions. Perform test using clean water and under the guidance of the manufacturer's technical representative.

C. Preliminary Field Tests shall be made after installation of the scum screens. Functional Testing shall demonstrate the following:

1. That there are no mechanical defects in any of the parts.

3.03 START-UP AND ACCEPTANCE

A. Beneficial use will not occur until after the start-up activities have been performed and accepted by the City Engineer. Start-up activities include the following:

1. Receipt and acceptance by the City Engineer of draft Operation and Maintenance manuals.

2. Installation inspection by City operating, electrical and instrumentation staff followed by any corrective measures required by the Contractor.

3. Satisfactory operation of static scum screen for 7 consecutive days under the City's control. The test shall consist of running the equipment under normal operating conditions for seven consecutive days in full automatic without failure to qualify as acceptable. If there is a failure, the problem must be identified, corrected, and approved by the City Wastewater inspector before the test can be rescheduled. "Failure" is considered any problem that requires correction by maintenance personnel. If malfunctions or other operational problems halt the 7-day test period, the Contractor shall make appropriate corrections and restart the 7-day test period.

4. Provide the services of a factory-trained technician for a period of 8 hours to train the City's operating and maintenance personnel. Training session shall be scheduled and coordinated by the Contractor. Furnish the representative for the additional time to correct or supervise correction of any defects of malfunctions.

B. After the start-up operation has been successfully completed, the City will accept the static scum screens when final Operation and Maintenance manuals have been received, reviewed, and accepted by the City.

END OF SECTION

Section 11370

BRIDGE CRANES AND APPURTENANCES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide and test bridge cranes, hoists, motors, gear reducers, controls and appurtenances as indicated and specified.

1. Rail and supporting beams included in building structure, refer to structural drawings.

2. Hoist capacities and operating data are indicated in the Bridge Crane Schedule.

1.02 REFERENCES:

A. American Bearing Manufacturers Association (ABMA):

1. 9: Load Ratings and Fatigue Life for Ball Bearings.

2. 11: Load Ratings and Fatigue Life for Roller Bearings.

B. American Society of Mechanical Engineers (ASME):

1. B30.16: Overhead Hoists (Underhung) Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings.

2. B30.17: Overhead and Gantry Cranes (Top Running, Single Grinder, Underhung Hoist).

C. American Welding Society (AWS):

1. D1.1: Structural Welding Code Aluminum.

D. National Electric Code (NEC).

E. National Electrical Manufacturers Association (NEMA):

1. MG1: Motors and Generators.

F. Occupational Safety and Hazard Association (OSHA):

1. 29 CFR 1910.179: Overhead and Gantry Cranes.

G. Crane Manufacturers Association of America (CMAA):

1. 70-2004: Specification for Top Running Bridge 7 Gantry Type Multiple Girder Electric Overhead Traveling Cranes.

2. 74-2004: Specification for Top Running & Under Running single Girder Electric Traveling Cranes Utilizing Under Running trolley Hoist.

1.03 SUBMITTALS:

A. Comply with the general requirements of Section 01340—Shop Drawings, Product Data, and Samples and the supplemental requirements below.

1. Data regarding bridge crane characteristics and performance:

2. Certified setting plans, with tolerances, for anchor bolts.

3. Manufacturer's literature as needed to supplement certified data.

4. Operating and maintenance instructions and parts lists. Comply with the requirements of Section 01782 – Operations and Maintenance Data

5. List of recommended spare parts other than those specified.

6. Shop and field inspection reports.

7. Motor shop test results.

8. Recommendations for short and long-term storage.

9. Shop and field testing procedures, equipment to be used.

10. Special tools.

11. Manufacturer's product data, specifications and color charts for shop painting.

12. Provide scaled drawing height and weight of equipment serviced by the hoisting equipment including hook height and travel dimensions.

13. Material Certification:

a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and designed for the service conditions specified and

indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.

b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated.

1.04 QUALITY ASSURANCE:

A. Overhead bridge cranes to be in conformance with CMAA Specification No. 74 and as specified and indicated.

B. Permanently mark the capacity of the hoist and trolley on each hoist and crane, in easy to read letters and in a prominent position.

C. Provide only safety type hooks.

D. Provide hoists so that hook can reach the floor at the lowest level of the lift.

E. Cranes shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

F. Welding: In accordance with American Welding Society Code D1.1.

G. Provide shop tests as specified.

H. Crane manufacturer shall provide beams, hoists, motors, gear reducers, switches, and controls regardless of manufacturer as a complete integrated package to ensure coordination, compatibility and operation of the systems.

I. Crane manufacturer shall have a minimum of five (5) operating installations with cranes of the size specified and in the same service as specified operating for not less than five (5) years.

1.05 DELIVERY, STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610.

1.06 WARRANTY

A. Provide warranty under provisions of Section 01770 – Closeout Procedures.

B. Crane manufacturer shall furnish to the City a warranty written expressly from the manufacturer to the City of Houston, covering workmanship and material under normal use and service. The warranty shall cover 100 percent of parts and labor for at least one full year. The warranty period shall commence on the day of start-up acceptance by the City. Warranty shall be in printed form and previously published as the manufacturer's standard warranty for similar manufactured units.

PART 2- PRODUCTS

2.01 SYSTEM DESCRIPTION:

A. Bridge Crane Schedule:

Type of Crane	Top running, single girder, freestanding columns
Duty Cycle Rating	Class C
Bridge Operating Speed	Single speed,100 fpm
Span	14 ft
Runway Length	36 ft
Hook Height	15 ft (min.)
Overhead Clearance	4 in (min.)
Control System	Pendant and radio control transmitter
Type of Hoist	Electric Wire Rope
Hoist capacity	3.0 Tons
Hoist Motor Horsepower	2 hp
Power Source	460V, 3PH, 60 Hz
Trolley Electrification	Festoon tagline system
Trolley Motor Horsepower	0.5 hp
Trolley Speed	65 - 75 fpm

2.02 CRANE MANUFACTURERS:

A. Acceptable Manufacturers

1. Konecranes.

2. Mass Crane & Hoist.

3. Dearborn Overhead Crane.

4. Approved Equal

B. Listing as an approved manufacturer will not relieve the manufacturer from conforming to Contract Specifications.

2.03 BRIDGE:

A. Top running or under running type crane bridge as indicated in the Bridge Crane Schedule.

1. Provide top running cranes designed to resist all vertical, lateral and torsional forces combined as specified in CMAA-70 and 74.

2. Provide under running cranes in accordance with CMAA-74.

B. Provide girders connected with end trucks.

C. Provide connections in both vertical and horizontal planes to keep entire bridge structure square and aligned under conditions specified and indicated and during shipping and installation.

D. Bridge and truck: Welded steel construction. Provide rigid structure and trucks attached to bridge girders with turned bolts.

E. Provide bridge with holes drilled and reamed for matched fit before final assembly and welding.

F. End trucks: minimum wheel base 1/8 of crane span.

1. Provide bridge trucks with ball or roller bearings and medium or high carbon steel or high strength alloy steel fixed or rotating type steel axles.

2. Provide trucks to prevent drop in excess of one inch in the event of wheel or axle failure.

3. Provide entire truck machine as a factory assembled unit to provide perfect alignment.

G. Truck Wheels: double flanged rolled bridge type forged or cast steel with hardened treads.

1. Wheels to carry maximum wheel load under normal operating conditions. Diameter not less than that shown for maximum load in CMMA-74.

H. Provide driving mechanism such that travel will be steady and free from vibration or racking in any part of structure while traveling under maximum load at all speeds. Prevent any tendency for crane structure to get out of line while traveling along runway under any operating condition.

2.04 ELECTRIC HOISTS:

A. Electric Hoists: Spur-gear driven antifriction bearings throughout. Provide a load side holding hoist motor brake and a separate electrically operated non-load brake. Design brake with capability of supporting the full load at any point when the motor is stopped. Holding brake shall be externally adjustable, electrically operated friction disk brake that shall apply automatically when the power is off. The brake shall hold 150 percent of the rated load and 125 percent of the rated load at any operating speed. Design shafts of motor, drum, and drum pinion to run in grease-lubricated ball or roller bearings. Design the and gear train and bearings to be oil-bath lubricated.

B. Arrange hoist for parallel lug mounting from a 4-wheel geared trolley.

C. Provide hoist with right angle mounting with H-wheel trolley, motorized as specified and indicated.

D. Hoist: Standard type.

E. Hoist: Low headroom type meeting the requirements of ASME B30.16.

F. Design drum with machine-cut grooves and guarded flanges and with capacity to take entire run of cable in one layer with no overlapping.

G. Provide hoist with an upper and lower geared limit switch with automatic reset control circuit to prevent overtravel. Settings to be field adjustable in accordance with OSHA 29 CFR 1910.179.

H. Supply sufficient hoisting cable with hoists for two-part single reeving and to accommodate not only the maximum lift but two additional wraps on drum. Make cable flexible high-strength plowsteel cable with a load safety factor of at least 5 to 1.

I. Make load block of rugged construction containing a ball-bearing sheave and a high-grade forged-steel swivel hook with antifriction bearings.

J. Provide control equipment in an enclosed compartment which forms an integral part of hoist and include a transformer for a 120-volt control circuit.

2.05 TROLLEYS:

A. Provide trolley operating wheels with chain guides, and make chains for each of sufficient length to hang 3 feet above operating floor.

B. Motor-Driven Trolleys: Four-wheel type consisting of a fully enclosed electric motor equipped with a magnetic brake, a geared transmission completely enclosed in an oiltight housing and suspended on flanged driving wheels with power to two wheels. Use ball or roller bearings throughout.

C. Make trolleys designed for operation on beam or rail as indicated on drawings. Trolleys to be provided by the hoist manufacturer.

2.06 SAFETY STOPS:

A. Provide safety stops on all open ends of track (or where indicated) to prevent trolley from running off ends or damaging building. Provide stops with capability of withstanding impact imposed by motion of fully loaded hoist and trolley.

2.07 TRACK:

A. Monorail Track: Standard beam of sizes as indicated on drawings.

B. Shop fabricate all curves for either track or switches to radius indicated.

C. Erect track level throughout, with section ends machined fitted and spliced with web-type or other designed couplings to provide flush level connections. Maximum gap between adjacent ends not exceeding 1/16-inch.

2.08 CABLE REELS:

A. Feed cable reel for electric current supply for all electric hoists with trolleys, except as otherwise indicated, through a single flexible, multi-conductor powercable from a self-winding spring-operated reel located near mid-point of trolley travel or where indicated on drawings.

1. The reel shall have a swivel base.

2. The reel shall have a roller outlet.

B. Furnish junction box to connect cable reel to power supply circuit with hoist.

2.09 ELECTRICAL CONTROLS:

A. Supply complete integral electrical control system with the electric hoisting equipment (by hoist manufacturer) consisting of starters, circuit breakers, overload relays, limit switches, control transformer for a 120-volt control circuit, control relays, and controlling devices.

B. Furnish magnetic controls for motors. Design controls to permit "inching" in both forward and reverse directions under full load, automatically regulated acceleration, and rapid brake response.

C. Provide each hoist with limit switches of automatic-reset control circuit type to prevent overtravel in both raising and lowering directions.

D. Compliance: Make all electrical equipment including motors, controls, resistors, brakes plus all conduit, wiring, panels, and enclosures with applicable requirements for materials, workmanship, construction, and installation of latest NEMA and National Electrical Code Standards.

2.10 MOTORS:

A. Provide in accordance with Section 16171 and as specified herein.

B. Motors for Hoists and Trolley: Totally enclosed, reversible, induction motors especially adapted to hoist service.

1. Enclosure: NEMA 12.

2. Insulation: Minimum Class "F" with Class "B" temperature rise, 40 degrees C ambient unless otherwise indicated or specified.

3. Service Factor: 1.15.

4. Provide capacity to start and operate hoists at maximum speed rated capacity indicated without exceeding nameplate ratings for current and power and without operating in the service factor.

5. Provide ball or roller bearings, in accordance with ABMA Standard 9 and Standard 11; minimum L-10 life of 100,000 hours.

6. Premium efficient motors, nominal and minimum motor efficiencies per NEMA MG1.

7. Rating: 460V, 3 ph, 60 Hertz.

2.11 PUSHBUTTON CONTROL:

A. Provide pendent pushbutton control station with sufficient pushbuttons to control all operations of hoists and trolley. Clearly mark each pushbutton to indicate its function. Make cable long enough to reach within 4 feet of operating floor or platform level with a supporting chain. If necessary, attach an arm to hoist so that pendent cable and pushbutton controls will hang vertically and be readily accessible from operating positions.

B. Controls for Wound-Rotor Motors: Hoist five-step, full magnetic type. Bridge and trolley shall be variable frequency control type. Design all other controls to be designed for single-speed motors.

C. Use five-step, full magnetic type controls for hoisting and closing-line motors for grit chamber. Use single-speed motor controls for trolley drive and chlorination room hoist.

D. For control of pump building hoist, use a five-step pushbutton station operating magnetic controls to provide automatically regulated acceleration and rapid brake response.

E. Provide hoist with an upper limit switch of automatic reset control circuit type to prevent overtravel.

2.12 CONDUCTORS AND COLLECTORS:

A. Manufacturers:

1. Insul-8-Bar Protected Conductors made by Insul-8-Corp.

2. Safety-T-Bar Conductor Systems made by Howell Corp.

3. Duct-O-Bar Conductor System made by Duct-O-Wire Co.Approved EqualUse equipment and accessories approved by Underwriter's Laboratories (UL).

B. For conductor for electric current supply provide safety type in which conductor is shielded by a molded-plastic cover that surrounds conductor except for a slotted opening shaped to contour of collector head. Provide separate conductor for each phase. (Dual conductors in a single insulating shield are not acceptable.) Make conductor of plated steel or copper designed for carrying maximum anticipated current. Make molded-plastic shield of high dielectric strength, rigid yet sufficiently flexible to permit bending to radius of curves or switches, and resistant to corrosion and deterioration from sunlight or weather. Space insulated supports not over 5 feet on straight track.

C. Provide collectors of sliding shoe type with an adjustable spring-load arm capable of horizontal or vertical movement to automatically adapt to irregularities of conductor. Set shoe in a molded-plastic head that will prevent external contact with shoe when it is running on conductor. There shall be no exposed bare current-carrying surfaces or wires in collector or arm where shoe is in contact with conductor.

2.13 SHOP PAINTING:

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with Section 09902 – Protective Coatings.

B. Surface preparation, mixing and application and safety requirements shall be in accordance with the paint manufacturer's printed instructions and as specified.

C. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

D. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

PART 3- EXECUTION

3.01 INSTALLATION:

A. Install items in accordance with manufacturer's printed instructions and as indicated and specified.

B. Check horizontal and vertical alignment of track and rails.

C. Erect rack level throughout, with section ends machined fitted and spliced with web-type couplings to provide flush level connections. Maximum gap between adjacent ends not exceeding 1/16-inch.

D. Do not use cast fittings.

3.02 FIELD TESTING:

A. Required Manufacturer Services

1. Retain a qualified employee of the manufacturer to perform the following services:

a. Oversee installation of the crane specified herein.

b. Inspect the completed installation and note deficiencies.

c. Be present and assist the Contractor during start-up, adjusting, and site testing of completed installations.

d. Furnish test forms and procedures for field testing.

e. Instruct Owner personnel in the operation and maintenance of the blower units. Provide the services of a factory-trained technician for a period of 4 hours to train the City's operating and maintenance personnel. Training session shall be scheduled and coordinated by the Contractor.

f. Prepare manufacturer's installation report and submit within 30 days after completion of field testing. Include the following information:

(1) Field testing results.

(2) Description of installation deficiencies not resolved to the manufacturer's satisfaction.

(3) Description of problems-or-potential problems.

(4) Names of owner personnel who attended operations and maintenance training sessions.

(5) Record copy of materials used for training session including outline summary of course.

(6) Certificate stating the crane has been installed within the manufacturer's recommendations.

B. Provide as specified herein. Perform all tests with instrumentation controls and motor controls. Perform testing in accordance with OSHA 29 CFR 1910.179 and as specified herein.

C. After installation of hoist equipment, and after inspection, operation, testing and adjustment have been completed by manufacturer's field service technician, conduct test for each hoist in presence of the Contractor to determine its ability to operate at rated speeds and capacity under conditions specified and indicated. During tests, observe and record, capacity and motor inputs. Promptly correct or replace all equipment not conforming to the requirements of this section revealed by or noted during tests, at no additional cost to the Owner, and repeat tests until specified results are obtained. Contractor to provide all labor, weights and materials for conducting tests.

1. Provide a 60 minute test for each hoist.

2. Running test shall consist of moving hoist and trolley through two complete cycles. The first cycle will be with no load. For the second cycle, the unit will be loaded with 100 percent of the specified load rating.

3. Test and simulate all limit switches, locking and safety devices.

D. Make all adjustments to place equipment in specified working order at time of above tests.

E. After three (3) unsuccessful testing attempts, remove and replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated.

3.03 FIELD TOUCH-UP PAINTING:

A. After installation and testing, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

END OF SECTION

SECTION 11373

CENTRIFUGAL AERATION BLOWERS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Blower with motor and base

B. Control panel at blower

C. Intake filter/silencer

D. Expansion joints at blowers nozzles

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.

1.03 RELATED WORK

A. Section 05500—Metal Fabrications

B. Section 09902—Protective Coatings

C. Division 13—Special Construction

D. Division 15—Mechanical

E. Division 16—Electrical

1.04 SYSTEM DESCRIPTION

A. Blower complete with its motor, base, control panel, and other accessories shall be furnished as an integrated system designed and assembled by the blower manufacturer. This requirement shall not be abrogated even though motor and control panel requirements are specified in other sections.

B. The control panel furnished with the blower will be located at the blower as shown on the Plans and shall have the following general functions:

1. Permit local manual control of blower.

2. Provide subsystems which will protect the blower from damage.

3. Provide interfacing of plant process monitoring and control systems to the blowers.

C. The foregoing control panel functions are specified in greater detail in Part 2 of this Section.

1.05 QUALITY ASSURANCE

A. Factory test the blower to insure that it will meet specified performance requirements and that vibration measured at the bearing housings does not exceed 1.5 mils. Test to be manufacturer's mechanical test.

B. Have manufacturer prepare a certified test report briefly describing the tests performed and documenting the results. The certified test report shall be provided to the Engineer for review and approval.

1.06 SUBMITTALS

A. Shop Drawings and Product Data

1. Comply with the general requirements of Section 01340—Shop Drawings, Product Data, and Samples and the supplemental requirements below.

2. Submit the following items for approval:

a. Manufacturer's standard drawings showing dimensions of the blower unit including motor and base. Mark out inapplicable information and certify for construction.

b. Manufacturer's standard publications and data sheets illustrating blower construction and describing materials of construction.

c. Blower's performance data as specified below.

d. Motor data as specified in Section 16171—Low Voltage Motors.

e. Blower control panel data as specified in Section 13325—Control Panels and Panel Mounted Equipment.

f. Total weight of the blower unit including blower, motor, and base. Weight of the blower alone and motor alone.

3. Include following information with the blower performance data:

a. Curves showing inlet air volume versus discharge pressure at specified maximum and minimum inlet air temperature and specified ambient air pressure.

b. Curves showing brake horsepower versus inlet air volume at specified maximum and minimum inlet air temperature and specified ambient air pressure.

c. Design operating points and surge limits on foregoing curves.

d. Blower speed.

e. Inlet temperatures and pressures on which curves are based.

B. Factory Test Reports.

1. Submit within 30 days of test completion and before shipment of the blower.

2. Dynamic Balance: Dynamically balance complete rotating assembly as a unit. Submit certificate for each blower, signed by company officer certifying dynamic balance.

3. Test blower to ensure mechanical integrity. Give blower a single point certified performance test at design requirements in accordance with ASTM Power test Code PTC-10.

C. Operation and Maintenance Data.

1. Comply with the requirements of Section 01782—Operations and Maintenance Data.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with the requirements of Section 01610—Basic Product Requirements.

B. Do not ship blowers until Owner has approved factory test reports.

1.08 WARRANTY

A. Provide warranty under provisions of Section 01770 – Closeout Procedures.

B. Blower manufacturer shall furnish to the City a warranty written expressly from the manufacturer to the City of Houston, covering workmanship and material under normal use and service. The warranty shall cover 100 percent of parts and labor for at least one full year. The warranty period shall commence on the day of start-up acceptance by the City. Warranty shall be in printed form and previously published as the manufacturer's standard warranty for similar manufactured units.

PART 2 PRODUCTS

2.01 MANUFACTURER REQUIREMENTS

A. Acceptable Manufacturers

1. Gardner Denver,

2. HSi/Atlas Copco, Inc.

3. Continental.

4. Approved equal.

B. Comply with the requirements of Section 01630—Product Substitution Procedures if substituting blowers made by firms other than those named above.

C. Listing as an approved manufacturer will not relieve the manufacturer from conforming to Contract Specifications.

2.02 BLOWERS

A. General

1. Type: Multi Stage

2. Number of Units: 3

B. Performance Requirements

1. The unit shall be capable of delivery 2,750 SCFM under the following conditions:

   a. Discharge Pressure: 7.0 PSIG
   b. Ambient Air Temperature: 100 degree F
   c. Inlet Temperature: 100 degree F
   d. Inlet Relative Humidity: 70%
   e. Design Blower Inlet Pressure: 14.7 PSIA (ambient)

2. Blower ratings shall be based on data previously established by testing conducted in accordance with the ASME Power Test Code for Centrifugal Compressors.

3. When volumetric capacity of the blower is reduced by at least 55% at specified inlet conditions, the blower shall

   a. Develop a discharge pressure of at least 1.0 PSI above the design discharge pressure.

   b. Not be in surge.

C. Design and Construction Requirements

1. Blower Sections & Heads: Impeller housings shall consist of ASTM A48 cast iron intermediate sections held securely between cast iron inlet and outlet heads with steel tie rods. The modular housing components shall be sealed by precision-machined rabbet joints and bonded with a sealant that can withstand the operating temperature of the blower. Either a tapped drain hole with a stainless steel pipe plug in the bottom of each section or an internal drain with a tapped drain hole on the discharge section shall be provided Inlet and discharge connections are flanged and drilled to mate with ASA 125 lbs. flanges.

2. Impellers: Impellers shall be cast aluminum construction. Each impeller will be dynamically balanced to insure mechanical operation of not more than .235 IPS (peak to peak) vibration amplitude when measured on the bearing housing in the vertical and horizontal direction for direct driven packages. Vibration readings will be taken with the blower at operating speed. Tip speed of the impellers will not exceed 387 ft./sec.

3. Diffusers: Diffuser sections shall be provided between impellers. These sections shall receive air from one impeller and guide it into the next impeller. Diffuser vanes shall be an integral part of the intermediate section casting. Guide vanes shall be an integral part of the return channel in the intermediate casting.

4. Baffle Rings: The blower shall have one-piece ASTM A240 Grade 304 stainless steel baffle rings connected to the castings directly or by mounting rings.

5. Shaft: The blower shaft shall be of sufficient diameter and rigidity/strength to operate at least 20% below the first lateral critical speed and shall be fabricated from high strength carbon steel. Shaft shall be AISI 4140.

6. Bearing Housings: Bearings shall be mounted in ASTM A48 class 30 cast iron outboard bearing housings designed to isolate the bearing from the blower temperature. Each bearing housing shall have a bronze labyrinth, viton lip, or cast iron type insert in the area inboard of the bearing. This insert shall serve as a back-up bearing and protect the bearing from external contamination.

7. Seals: No contact shall be allowed between the rotating element and the housing, except at the shaft bearings or when special contact seals are provided. Non-contact labyrinth seals shall be provided to minimize air/gas leakage.

8. Bearings: The blower shaft will be supported between two deep groove anti-friction ball bearings without filling slots. The bearings shall be able to be lubricated, inspected or replaced without disconnecting any piping or disassembling the blower. The blower shall be grease lubricated. Bearings will be sized for a minimum L_{10} life of 200,000 hours, at the speeds and loads imposed by this application, in accord with AFBMA Standards for Ball and Roller bearings, Section 9.

9. Base: Each motor-blower unit will be mounted on an ASTM A36 hot rolled structural steel fabricated base. Suitable resilient foundation mounting pads will be furnished for installation beneath the base.

10. Flexible Drive Coupling: The blower shall be connected to the driver with a suitable non-lubricated flexible coupling, with a minimum service factor of 1.35 (Elastomer Type). The installing contractor shall check, and if necessary, adjust the alignment of the coupling(s) in accordance with the manufacturer's instructions. Each coupling shall be covered with a suitable coupling guard. During factory layout, a factory laser alignment shall be conducted prior to shipment to facilitate alignment in the field

11. Maximum Allowable Noise

    a. The compressor and motor assembly shall have maximum free field noise level of 90 dBA at 5 feet.

2.03 MOTORS AND POWER TRANSMISSION

A. Motors shall be 150-HP or less, no exceptions.

B. Comply with Section 16171—Low Voltage Motors and the supplemental requirements below.

C. Provide horizontally mounted, induction, totally enclosed, fan-cooled, premium-efficiency motors for operation on 3 phase, 60 HZ, 460V. Synchronous speed shall be maximum 3600 rpm. All motors shall be designed with applicable IEEE, NEMA, and ANSI standards.

D. Type of Power Transmission: Direct coupling.

E. Coupling Guard

    1. Built per OSHA recommended guidelines

    2. Fabricated metal or High Impact Polyethylene Plastic

    3. Bolted to metal base on which blowers and motors are mounted.

F. Blower motors shall be vibration tested in accordance with the following method of test:

Testing shall demonstrate that the vibration with the motor bolted to a steel floor, stator at design temperature, motor shaft extension with half-key, and lubrication at normal operating temperature shall not exceed 0.10 inches/second at rotational frequency and at all multiples through 120 Hz and one half of rotational frequency or 0.15 inches/second unfiltered.

Vibration shall be as measured in any plane on bearing caps of both ends. Stator temperature for vibration tests may be accomplished by restricting cooling air flow or by other industry standard methods; however, the motor manufacturer shall evaluate all effects of the method of testing, and vibration readings shall be taken while air flow is not restricted. During the testing, the motor shall be complete and shall have nothing removed for convenience except the power lead conduit box.

All motor components and accessories shall be in place for motor shop testing. All test variables shall conform to actual field values and shall be maintained throughout all tests. Any lubrication leaks, excessive noise, and overheating shall be corrected prior to shipment. In case of failure of any unit to meet test requirements and specified performance, the motor manufacturer shall make such alterations as are necessary and the tests shall be repeated without additional cost to the Owner until the equipment is satisfactory.

2.04 CONTROL SYSTEM

A. General

1. Provide manufacturer's factory fabricated control system specified below for each blower.

2. Comply with the requirements of Section 13325—Control Panels and Panel- Mounted Equipment in designing local control panels for the blower.

3. General: Provide pressure and temperature indicating instruments calibrated by manufacturer. Provide air and oil cocks and tubing. Provide instruments and switches rated for 120V AC.

4. Panel-Mounted Instruments: Provide control and indicating instruments as follows:

Mark	Nameplate Description	Range	Duty
1	Discharge Air Pressure	0-10 psig	Indication
2	Air Flow Meter Rated	0-120% of cfm	Indication rated flow in cfm
3	Inlet Filter Pressure Loss	30 inches of water column	Indication
4	Blower Motor Control Switch		Local Control

5. Provide local indication and independently isolated 4-20 mA analog output suitable for remote SCADA monitoring for the following:

   a. Motor Temperature
   b. Compressor Inboard Bearing Temperature
   c. Compressor Outboard Bearing Temperature
   d. Oil Temperature

B. Functional Requirements of Typical Blower Control System

1. The following setpoints shall be pre-programmed and field adjustable: Impending Surge, Surge, Impending Overload, and Overload.

2. The panel shall included an ON/OFF switch, and Indicating lights for "Power ON", "WARN", "FAULT", and a "RUN" light.

3. Provide auxiliary relay contacts for remote SCADA monitoring of "Run Status" and "Fault" alarm.

C. Blower Protection Control System: Provide vibration sensor and surge protection system for unit protection.

1. Vibration sensor to de-energize motor and to energize amber alarm light. Sensor controls to include seal-in relay and reset pushbutton so that motor can be energized and alarm light de-energized only on manual reset. Alarm light and switches to be mounted on control panel front.

2. Provide a surge protection device to prevent the blower from operating in surge condition. Device to initiate automatic blower shut-down sequence when the blower is reduced to surge volume as indicated by motor current draw. Calibrate and set the set points for this device to prevent surge condition. Provide visual indication of reason for shut-down. Provide an override as necessary for blower start-up and shut-down.

3. Control system to also include an auxiliary contact for a common trouble alarm. Auxiliary contact to be energized when any malfunction occurs. Auxiliary contact to be interconnected with seal-in relays so that the alarm can be de-energized only on manual reset of particular malfunction alarm at respective control panel.

4. Provide motor starter status with automatic timeout on failure to start.

D. Elapsed Time Meter: Provide non-resettable run time meter.

E. Alarm Lights: Provide push-to-test transformer type pilot lights.

2.05 ACCESSORIES

A. Intake Filter/Silencer

1. 98% efficient on 10 micron or larger particles.

2. Conical canister or panel type, designed for the max capacity flow (highest temperature) of the blower plus 20%.

3. Galvanized or carbon steel housing and support system as shown on Plans.

4. Include weatherhead for outdoor mounting.

5. Filters to have "top-outlet" flanged connections with support legs.

6. Each filter / silencer shall be preloaded with one (1) filter element. One (1) spare filter element shall be provided for each blower provided.

7. Silencer shall be manufactured by Universal, Endustra, or equal.

B. Expansion Joints

1. Reinforced, flexible rubber expansion connectors shall be supplied to mate with the blower's outlet flange.

2. The connectors shall be reinforced EPDM, rated for 20 PSIG (20" Hg Vac) and 300 degrees F operation.

3. Expansion joint shall be manufactured by General Rubber Corp or equal.

C. Inlet Throttle Butterfly Valve

1. A wafer style butterfly valve for mounting on the blower inlet shall be provided and be of the same size as the blower inlet connection. Valve design shall have bi-directional flow, EPDM seat, 416 stainless steel shaft, and 200-PSI CWP rated. Valves 8" and smaller shall have a ten (10) position locking lever operator. Valves 12" and larger shall have a hand wheel operator.

2. Valve shall be manufactured by Pentair, Dezurik, or equal.

D. Discharge Check Valve

1. A wafer-style check valve to prevent backflow shall be provided for installation in the discharge piping of each blower. The check valve shall be sized to match the blower discharge piping. It shall be of the positive sealing, springless, double leaf style with Viton seats suitable for 400 degrees F.

2. Check valve shall be manufactured by Crane, Techno, Flexi-hinge, or equal.

E. Discharge Isolation Butterfly Valve

1. A wafer-style discharge butterfly valve shall be provided for installation in the downstream piping. It shall provide positive line shutoff during periods of blower maintenance. Valve design shall have bi-directional flow, EPDM seat, 416 stainless steel shaft, and 200-PSI CWP rated. Valves shall have a ten (10) position locking lever operator.

2. Valve shall be manufactured by Pentair, Dezurik, or equal.

F. Additional Accessories Required for Each Unit

1. Air Pressure Gauge, Blower Discharge: Marsh Type 100 Master-gauge, Marshalltown, or equal 4 ½ inches in diameter, 0 to 15 psi range, Ashcroft 1220, plain-screwed ring, ¼-inch back connection.

2. Flowmeter: Furnish ammeter calibrated for 0 to 120% of rated flow in cfm. Ammeter to include adjustable current overload sensor. Provide new current transformers mounted around the motor power leads. Calibration of flowmeter is solely the responsibility of the blower

control system supplier.

3. Filter Differential Pressure Gauge: Manometer – magnehelic type, panel mounted.

2.06 FACTORY ASSEMBLY AND PAINTING

A. Completely assemble blower unit and control panel at factory. Mount blowers and motors on common steel base and install related accessories such as couplings and guards.

B. Factory finish blower units with manufacturer's standard enamel using color selected by Owner from manufacturer's standard colors.

C. Do not paint control panel.

C. Provide protective coatings conforming with Section 09902 - Protective Coatings. The intent is to coat all of the interior and exterior surfaces of the equipment and other parts to protect all parts from corrosion as soon as possible.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install blower units in accordance with the Plans, approved manufacturer shop drawings and the manufacturer's installation instructions.

B. Adjust and lubricate as recommended by the manufacturer and leave in working condition.

C. Check alignment and vibration of each unit prior to placing in service. Vibration to be less than 1.25 mils in any plane.

D. Calibrate all devices including pressure indicators and ammeters.

E. Set surge point for blower control system based on available information from blower manufacturer.

3.02 FIELD QUALITY CONTROL

A. Required Manufacturer Services

1. Retain a qualified employee of the manufacturer to perform the following services:

   a. Oversee installation of the blower units specified herein.

   b. Inspect the completed installation and note deficiencies.

   c. Be present and assist the Contractor during start-up, adjusting, and site testing of completed installations.

   d. Furnish test forms and procedures for field testing.

   e. Instruct Owner personnel in the operation and maintenance of the blower units.

   f. Prepare manufacturer's installation report and submit within 30 days after completion of field testing. Include the following information:

      1) Field testing results.

      2) Description of installation deficiencies not resolved to the manufacturer's satisfaction.

      3) Description of problems-or-potential problems.

      4) Names of owner personnel who attended operations and maintenance training sessions.

      5) Record copy of materials used for training session including outline summary of course.

      6) Certificate stating the blower has been installed within the manufacturer's recommendations.

B. Field Testing

1. Demonstrate to the Owner's representatives that each blower will perform the following functions satisfactorily:

a. Automatically shut down and activate surge alarm when inlet guide vanes or butterfly valve restrict flow to less than 60% of flow when fully open as determined by flow proportional motor current indicator.

b. Operate with vibration of less than 1.5 mils measured at bearing housings.

C. The Contractor shall provide all test gear required at no extra cost to Owner.

D. Follow testing procedures recommended by the manufacturer and approved by Engineer.

3.03 START-UP AND ACCEPTANCE

A. Start-Up. Beneficial use will not occur until after the start-up activities have been performed and accepted by the City Engineer. Start-up activities include the following:

1. Receipt and acceptance by the City Engineer of draft Operation and Maintenance manuals, including the wiring and ladder diagrams.

2. Installation inspection by City operating, electrical and instrumentation staff followed by any corrective measures required by the Contractor.

3. Satisfactory operation of blower for 7 consecutive days under the City's control. If malfunctions or other operational problems halt the 7-day test period, the Contractor shall make appropriate corrections and restart the 7-day test period.

4. Provide the services of a factory-trained technician for a period of 4 hours to train the City's operating and maintenance personnel. Training session shall be scheduled and coordinated by the Contractor.

5. Receipt by the City Engineer of accessories and spare parts.

B. Acceptance. After the start-up operation has been successfully completed, the City will accept the blowers when final Operation and Maintenance manuals have been received, reviewed, and accepted by the City. Include ladder logic diagrams and wiring and termination diagrams for both power and instrumentation systems.

END OF SECTION

SECTION 11375

DIGESTER BLOWERS CONTROL RETROFIT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section.
B. Include payment in lump sum bid for work of which this is a component part.

1.02 SCOPE OF WORK

A. Keegan's Bayou WWTP: Provide manufacturer's replacement equipment control retrofits for six (6) existing digester blowers. The work includes, but is not limited to, removal and replacement of existing control panels, field devices, electrical wiring, wiring raceways, programming, testing, re-commissioning, demonstration & training for a complete and fully functional installation.

1.03 RELATED WORK

A. Division 13 – Controls & Instrumentation
B. Division 16 - Electrical

1.04 SYSTEM DESCRIPTION

A. Blower Control Panel complete with required field devices and control accessories shall be furnished, assembled, and installed by blower equipment manufacturer or authorized service representative.

B. The control panel provided shall replace existing controllers and installed at the same location. Each controller shall have the following general functions:

1. Permit local and remote, manual and automatic, start/stop and run control of individual blower equipment.

2. Provide subsystems which will protect the blower from damage.

3. Provide interfacing of plant process monitoring and control systems to the blowers.

C. The foregoing control panel functions are specified in greater detail in Part 2 of this Section.

1.05 QUALITY ASSURANCE

A. Factory test and certify specified protection and monitoring requirements.

B. Manufacturer/Installer shall prepare certified test reports describing the tests performed and documenting the results. The certified test report shall be provided to the Engineer for review and approval.

1.06 SUBMITTALS

A. Shop Drawings and Product Data

1. Comply with the general requirements of Section 01340—Shop Drawings, Product Data, and Samples and the supplemental requirements below.

2. Submit the following items for approval:

a. Manufacturer's standard drawings showing dimensions of the units.

b. Manufacturer's standard publications and data sheets illustrating controller construction and describing materials of construction.

c. Total weight of the blower unit including blower, motor, and base. Weight of the blower alone and motor alone.

B. Factory Test Reports.

1. Submit within 30 days of test completion and before shipment of the units.

C. Operation and Maintenance Data.

1. Comply with the requirements of Section 01782—Operations and Maintenance Data.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with the requirements of Section 01610—Basic Product Requirements.

B. Do not ship until Owner has approved factory test reports.

1.08 WARRANTY

A. Provide warranty under provisions of Section 01770 – Closeout Procedures.

B. Manufacturer shall furnish to the City a warranty written expressly from the manufacturer to the City of Houston, covering workmanship and material under normal use and service. The warranty shall cover 100 percent of parts and labor for at least one full year. The warranty period shall commence on the day of start-up acceptance by the City. Warranty shall be in printed form and previously published as the manufacturer's standard warranty for similar manufactured units.

PART 2 PRODUCTS

2.01 MANUFACTURER REQUIREMENTS

A. Acceptable Manufacturers

1. Dresser Roots

2. Dresser Roots Factory Authorized Service Company.

B. Comply with the requirements of Section 01630—Product Substitution Procedures if substituting blowers made by firms other than those named above.

C. Listing as an approved manufacturer will not relieve the manufacturer from conforming to Contract Specifications.

2.02 CONTROL SYSTEM

A. Control Panels (per each blower installation)

1. One (1) NEMA 12 Blower Control Panel & Enclosure, nominal 72" x 30" x 18"
2. One (1) NEMA 12 Lube Oil Pump contactor panel & enclosure rated for 480 VAC, 3 phase, 60hz service including contactor and means for service disconnect
3. 120 VAC, single phase, 60hz, 20A power supply
4. Siemens S7 Programmable Logic Controller (PLC) System,

complete integral low voltage power supply, PROFIBUS communication module, input/output (I/O) modules, and 6" color touchscreen human machine interface (HMI). Reference Division 13 for additional PLC system requirements.

5. Field device termination (terminal) blocks.
6. Integral fan powered cooling system.

B. Field Devices (one set per each blower installation). Provide the following manufacturer's OEM spec replacement field devices:

1. Inlet suction indicating transmitter, 4-20mA
2. Discharge pressure indicating transmitter, 4-20mA
3. Inlet air temperature transmitter, RTD
4. Discharge air temperature transmitter, RTD
5. Lube oil pressure transmitter, 4-20mA
6. Lube oil supply temperature transmitter, RTD
7. Lube oil return temperature transmitter, RTD
8. Compressor vibration accelerometer, 4-20mA
9. Discharge blow-off valve and actuator, 4-20mA
10. Discharge isolation valve actuator, 4-20mA

C. Blower Protection Control: Provide manufacturer's standard equipment protection functionality, including automatic shutdown on fault alarm. Retain, at minimum, all existing protection functionality within the retrofit. Provide the following new/upgraded functions:

1. Local audible/visual trouble alarm with silencing feature and remote contact closure for hardwired monitoring.
2. Local audible/visual fault alarm with silencing feature and remote contact closure for hardwired monitoring.

2.03 FACTORY ASSEMBLY AND PAINTING

A. Completely assemble control panel at factory.

B. Factory finish with manufacturer's standard enamel using color selected by Owner from manufacturer's standard colors.

PART 3 EXECUTION

3.01 INSTALLATION

A. Demolish and remove existing control panels. Install replacement control panels on existing housekeeping pads per approved manufacturer shop drawings and the manufacturer's installation instructions.

B. Disconnect and reconnect existing electrical feeder wiring, control wiring, communications in accordance with Division 16 requirements.

C. Replace field devices as indicated. Test and calibrate replacement field devices. Adjust calibration as required.

D. Provide all engineering, testing, de-bugging, start-up, training, and demonstration services required for a complete controls retrofit.

E. Provide engineering and technician support for integration (by others) of retrofit controls into the plant SCADA system. Provide coordinated configuration, testing, and demonstration of PROFIBUS network connectivity. Provide PLC point assignments and software access documentation of new control points. Coordinate SCADA testing, troubleshooting, and demonstration of SCADA interface for blower control retrofits.

3.02 FIELD QUALITY CONTROL

A. Required Services

1. Qualified employee of the manufacturer to perform the following services:

   a. Inspect the existing blowers prior to retrofit, document and existing deficiencies and submit report of findings.

   b. Oversee and implement control retrofits specified herein.

   c. Perform start-up, adjusting, and site testing of completed installations.

   d. Furnish test forms and procedures for field testing.

   e. Instruct Owner personnel in the operation and maintenance of the blower units. Training sessions shall not be less than 16 hours.

f. Prepare manufacturer's installation report and submit within 30 days after completion of field testing. Include the following information:

1) Field testing results.

2) Description of installation deficiencies not resolved to the manufacturer's satisfaction.

3) Description of problems-or-potential problems.

4) Names of owner personnel who attended operations and maintenance training sessions.

5) Record copy of materials used for training session including outline summary of course.

6) Certificate stating the blower has been installed within the manufacturer's recommendations.

B. Field Testing

1. Demonstrate to the Owner's representatives that each controller will perform the following functions satisfactorily:

a. Local and remote start/stop and status monitoring.
b. Local and remote indication of trouble alarm conditions.
c. Local and remote indication of fault alarm conditions.
d. Automatic shut-down of blower unit upon fault condition.

C. The Contractor shall provide all test gear required at no extra cost to Owner.

D. Follow testing procedures recommended by the manufacturer and approved by Engineer.

3.03 START-UP AND ACCEPTANCE

A. Start-Up. Beneficial use will not occur until after the start-up activities have been performed and accepted by the City Engineer. Start-up activities include the following:

1. Receipt and acceptance by the City Engineer of draft Operation and Maintenance manuals, including the wiring and ladder diagrams.

2. Installation inspection by City operating, electrical and instrumentation staff followed by any corrective measures required by the Contractor.

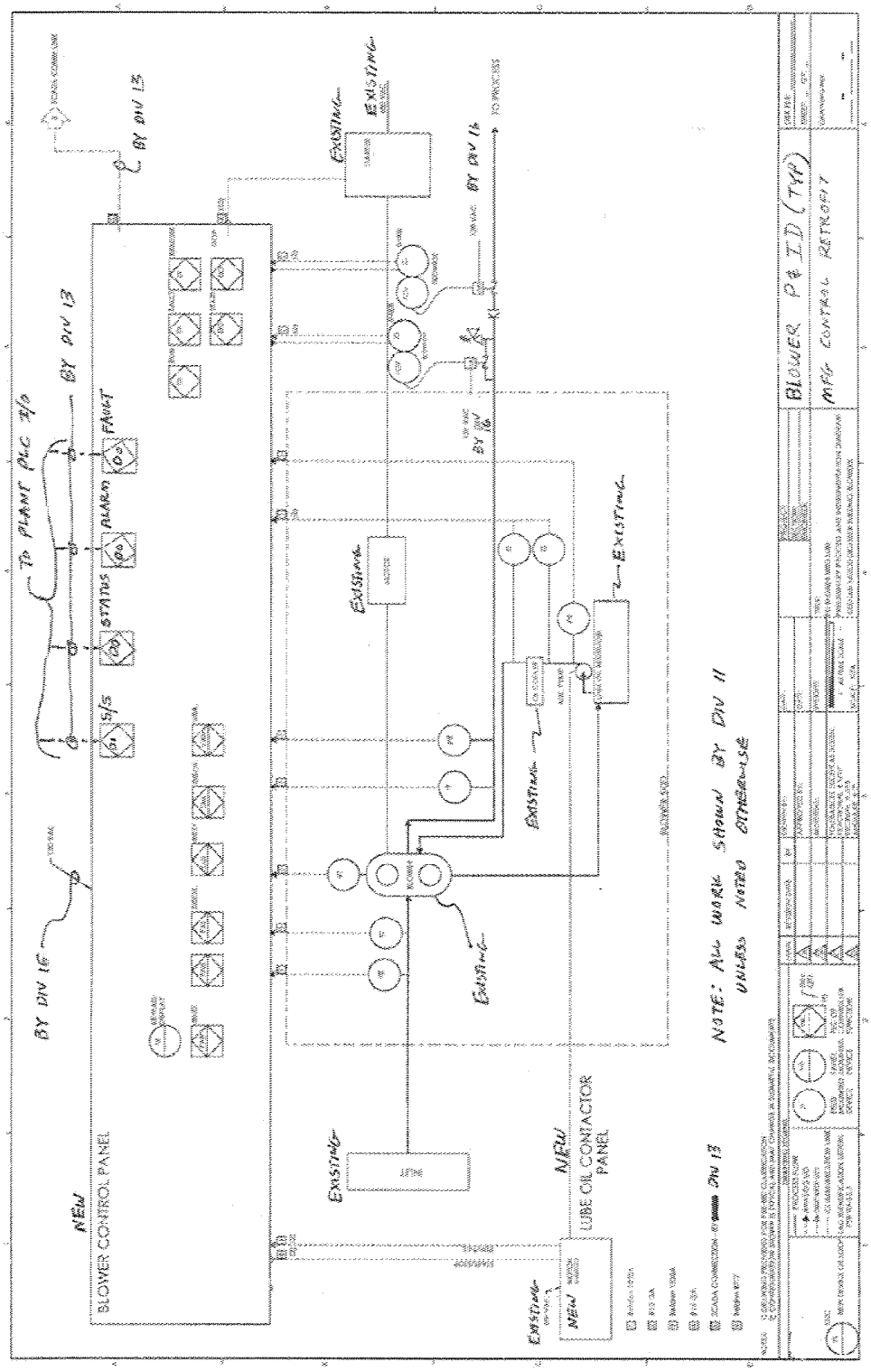
3. Satisfactory operation of blower for 7 consecutive days under the City's control. If malfunctions or other operational problems halt the 7-day test period, the Contractor shall make appropriate corrections and restart the 7-day test period.

4. Provide the services of a factory-trained technician for a period of 16 hours to train the City's operating and maintenance personnel. Training session shall be scheduled and coordinated by the Contractor.

5. Receipt by the City Engineer of accessories and spare parts.

B. Acceptance. After the start-up operation has been successfully completed, the City will accept the controller when final Operation and Maintenance manuals have been received, reviewed, and accepted by the City. Include ladder logic diagrams and wiring and termination diagrams for both power and instrumentation systems.

3.04 BLOWER CONTROL RETROFIT P&ID DIAGRAM (TYPICAL)



END OF SECTION

SECTION 11500

CHLORINATION MECHANICAL MIXERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnishing and installation of mechanical mixers and all accessories specified or required for rapid mixing of sodium hypochlorite.

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.

1.03 RELATED SECTIONS

A. All electrical components shall comply with Division 16- Electrical

1.04 QUALITY ASSURANCE.

A. Acceptable Manufacturer

1. All equipment covered by this Section shall be supplied by the same manufacturer to ensure that all parts work together and function in a coordinated manner.

2. The manufacturer shall have regularly and satisfactorily designed, engineered, manufactured, supplied, and serviced a minimum of five (5) of the design described in these Specifications, which are currently and have been in satisfactory and continuously operating with no substantial operational and maintenance problems in municipal wastewater treatment plants in the United States during the previous five (5) years. Experience records and references shall be provided if requested by the City Engineer.

3. Potential manufacturers not having the necessary satisfactory experience, as determined by the City Engineer must provide a five (5) year bond or cash deposit guaranteeing replacement in event of failure within the first five (5) years of operation.

4. The City Engineer reserves the right to reject any manufacturer based on an unsatisfactory experience record or the inability to meet specifications.

5. The equipment shall be as manufactured by Philadelphia Mixing Solutions , SPX Flow Technology Lightnin Brand, Hayward Gordon Cleveland Mixer or approved equal.

1.05 SUBMITTALS

A. Comply with the general requirements of Section 01340—Shop Drawings, Product Data, and Samples and the supplemental requirements below.

B. Shop Drawings:

1. Make, model, weight, and horsepower of each equipment assembly.

2. Manufacturer's catalog information, descriptive literature, specifications, and identification of materials of construction.

3. External utility requirements such as air, water, power, drain, etc., for each component.

4. Functional description of internal and external instrumentation and controls to be supplied including list of parameters monitored, controlled, or alarmed.

5. Control panel elevation drawings showing construction and placement of operator interface devices and other elements.

6. Power and control wiring diagrams, including terminals and numbers.

7. Shop and field painting systems proposed: Include manufacturer's descriptive technical catalog literature and specifications.

C. Quality Control Submittals:

1. Written certification that the factory-applied coating system(s) is identical to the requirements specified.

2. Special shipping, storage and protection, and handling instructions.

3. Manufacturer's written/printed installation instructions.

4. Routine maintenance requirements prior to plant startup.

5. Manufacturer's Calculations

   a. Gear rating calculations

   b. Bearing life calculations

   c. Calculations supporting all shaft and impeller design criteria (stresses and critical speed)

6. Manufacturer's Certifications

   a. Submit manufacturer's certification that Contract Documents have been examined by the manufacturer for proposed electrical, mechanical, and structural systems affecting performance of the equipment.

   b. Submit manufacturer's certification that the maximum power requirement, if used, shall not exceed the motor rating under operating conditions.

7. Operation and maintenance manual.

   a. Operation and maintenance manuals, prepared by the manufacturer, shall be provided for the System in accordance with Section 01782 – Operations and Maintenance Data.

PART 2 PRODUCTS

2.01 DESIGN CONDITIONS

A. Design mixer for operation in an open channel 5 feet wide with water depth varying between 6.06 feet (min) to 8.62 feet (max). The mixer shall be required to uniformly disperse and blend between 10 to 50 gph of sodium hypochlorite solution, which will be introduced into the open channel directly above the mixing zone.

B. The specific gravity of sodium hypochlorite is 1.20. The actual average daily flow 2.16 MGD. The permitted average daily flow is 7.05 MGD. The mixer mounting, shaft and impellers shall be designed to withstand the lateral and vertical forces exerted by moving water at the peak two-hour flow of 30 MGD.

2.02 MIXER REQUIREMENTS

A. Provide top entering mixer to serve as rapid sodium hypochlorite mixer. Mixer shall meet the following design criteria:

Basin Dimensions (to top of mounting surface):	5'x 7'x 10'
Liquid Level	6.06' (min); 8.62' (max)
Minimum Velocity Gradient @ 32 °F:	500 sec^{-1}
Water Temperature:	32 °F (min); 100 °F (max)
Minimum Number of Impellers:	Two (2)

B. Each mixer assembly shall consist of a heavy duty speed reducer, electric motor connected through a flexible coupling, pedestal, agitator shaft, and mixing impellers.

C. Gearbox

1. To ensure system responsibility and design integration the mixer gearbox coupled to the impeller shaft must be designed, manufactured and tested by the mixer supplier, or be of design specifically designed for mixing applications..

2. The mixer gear drive shall be built and rated in accordance with the current AGMA Standard 6010-E88. The AGMA calculated drive HP ratings shall be stamped on drive nameplate. Drive housing shall be of high quality close-grained cast iron, or fabricated steel, stress relieved and reinforced, and shall be provided with lifting lugs or holes. Each unit will be mounted on a pedestal base to locate the oil drain above the mounting deck. Minimum pedestal height is 13".

3. Gearing must be all helical or a combination of helical and spiral bevel. Helical gearing shall be of AGMA Quality 10 or better, per AGMA Standard 390.03a and ANSI/AGMS 2000-A88. Spiral bevel shall be to current acceptable AGAM Standard. All gearing must be contained in a single housing and lubricated by a common oil bath. Worm gears are not allowed. The full load operating noise levels of the mixer drives shall meet current OSHA occupational noise standards and/or AGMA Standard 299.01, and shall not exceed 85 dBA at 3 feet from any part of the drive assembly.

4. The mixer gear drive shall be designed with an output shaft system suitable for the loads imposed by the application. The output shaft shall be supported by two adapter-type antifriction bearings. The drive's minimum AGMA service factor, based upon motor nameplate horsepower, shall be 2.0.

5. The mixer gear manufacturer shall be a current member of the AGMA. All components of each gear drive shall be designed, manufactured and assembled in full compliance with all applicable AGMA requirements.

6. All drive bearings shall be of the antifriction type, ball or roller bearings. All bearings within the drive, including output shaft bearings, shall have minimum AFBMA L-10 lives of 100,000 hours when operating at full motor nameplate horsepower at design speed.

7. Lubrication of each speed reducer shall be by means of an integral oil pump or efficient oil splash mechanism. If used, the pump shall be accessible without requiring disassembly of the speed reducer. The drive shall be provided with a dipstick and/or a sight glass to observe oil level. Each drive must have an effective drywell feature to eliminate oil leakage down the output shaft. Output shaft bearings may be grease lubricated, including a high quality lip-seal to retain grease. All oil fill and rain lines and grease fittings shall be located so as to be easily accessible. All gearing must be contained within a single housing and lubricated by a common oil bath.

8. The lower mixer shaft shall be connected to the upper, or drive output shaft, by means of a rigid flanged coupling, of either the welded or interference fit hub type. Mating coupling faces shall have a rabbeted male and female piloted connection for accurate concentricity and shall not require match marks for alignment. For the uppermost coupling, located above the mounting surface, the top half of the rigid coupling may be of carbon steel construction; for any coupling located below level of tank top, its material of construction must match that of the agitator shaft.

9. The agitator shaft shall be of the specified grade of material. The shaft shall be designed such that the maximum stress shall not exceed 8,000 psi under maximum operating loads. It shall be of overhung design - the use of underwater steady bearings is not permitted. Lower shaft straightness, rigid coupling squareness, and output shaft accuracy must be such that the maximum total indicated run-out at the lower end of the shaft does not exceed 1/8 inch for every 10 feet of shaft length, as measured when rotating the shaft by hand.

D. Impeller

1. Provide high efficiency impellers with hook keyed construction on the hub.

2. Impellers shall be of such a type and operate at such a speed that equipment will operate without requiring dynamic balancing.

3. The impeller shall be dynamically and hydraulically stable and shall not cause the equipment to overload.

4. The mixing impeller(s) shall be constructed of the 316 stainless steel, shall be of bolted construction, and shall be connected to the agitator shaft with a hook key for maximum security. Mixer shall have two (2) pitched blade turbine type impellers, a minimum of 34 inches in diameter, with the lower impeller positioned not more than (36) inches above the basin floor .

5. The maximum stress in any impeller component shall not exceed 11,000 psi under maximum operating loads.

6. The shaft-impeller system design shall be such that its operating speed shall not exceed 65% of its first lateral critical speed. The use of stabilizing rings or fins will not influence this limitation.

E. Motor

1. Maximum Horsepower: 7.5 HP

2. Motor shall comply with the requirements of Specification Section 16171 – Low Voltage Motors.

3. The electric motor driver shall be rated for continuous duty in a humid corrosive environment with full mill and chemical duty features. Insulation shall be Class F, limited to Class B temperature rise at 40^0C ambient at 1.0 service factor. Service factor shall be 1.15. Motors shall be Inverter Duty, energy efficient type, in full compliance with the "Federal Energy Policy Act of 1992".

4. Motors shall be squirrel cage induction motors for operation on 3 phase, 60 HZ, 460V. Synchronous speed shall be maximum 1800 rpm. All motors shall be designed with applicable IEEE, NEMA, and ANSI standards.

5. Motors shall be connected to reducers' input shafts with easily accessible torsionally resilient flexible couplings. OSHA approved coupling guards shall be provided.

2.03 CONTROL SYSTEM

A. Provide a control panel that shall be a NEMA 4X, UL rated, Type 316 stainless steel rated enclosure (dead-front style with continuous hinge, exterior, lockable door) and include the following minimum devices for proper mixer operation.

1. Provide a two push-button start/stop station for turning mixer on/off.

2. Provide a flashing alarm strobe light to energize with "Motor Overtemp/Overload" signal.

3. Push-to-Test type indicator lights for each mixer:

a. "Power On" indicating light (white)

b. "Motor Overtemp/Overload" alarm light (amber)

B. Control panel shall be designed to accept 460 Volts, 60 Hz, 3-Phase incoming power. Control panel will be located in an exterior ambient environment. All exterior panel components shall be UV protected. Panel heating, cooling, and ventilation devices shall be provided as required for condensation and temperature control.

C. Control panel shall meet Division 16 requirements for electrical identification.

2.03 FIELD PAINTING

A. Prepare prime, finish coat and touch up all components as required to match after install is completed in accordance with Specification Section 09902 – Protective Coatings.

2.05 APPURTENANCES

A. Lifting Lugs. Provide suitably attached for all equipment assemblies and components weighing over 100 pounds.

B. Equipment Identification Plates. Provide 16-gauge Type 304 SS identification plates securely mounted on each separate equipment component and control panel(s) in a readily visible location. Plate shall bear $^{3}/_{8}$-inch high block type black enamel filled equipment identification number and letters.

PART 3 EXECUTION

3.01 EQUIPMENT INSTALLATION

A. Install Mixers in accordance with manufacturer's instructions.

3.02 FIELD QUALITY CONTROL

A. Required Manufacturer Services

1. Retain a qualified employee of the manufacturer to perform the following services:

a. Oversee installation of the mixer units specified herein.

b. Inspect the completed installation and note deficiencies.

c. Be present and assist the Contractor during start-up, adjusting, and site testing of completed installations.

d. Furnish test forms and procedures for field testing.

e. Instruct Owner personnel in the operation and maintenance of the mixer units.

f. Prepare manufacturer's installation report and submit within 30 days after completion of field testing. Include the following information:

1) Field testing results.

2) Description of installation deficiencies not resolved to the manufacturer's satisfaction.

3) Description of problems-or-potential problems.

4) Names of owner personnel who attended operations and maintenance training sessions.

5) Record copy of materials used for training session including outline summary of course.

6) Certificate stating the mixer has been installed within the manufacturer's recommendations.

B. Functional Test.

1. After Mechanical Mixers and associated equipment have been completely installed and working under the direction of the manufacturer, conduct field tests necessary to demonstrate that operation conforms to these Specifications. Supply water or wastewater, labor, equipment, and incidentals required to complete field tests.

2. Demonstrate with a Final Acceptance Test that these Specifications have been met by the equipment as installed. As a minimum, perform the following tests.

   a. That units have been properly installed and are in correct alignment.

   b. That units operate without overheating or overloading any parts and without objectionable vibration.

   c. That there are no mechanical defects in any of the parts.

   c. That the controls perform satisfactorily.

3. If the Mechanical Mixers' performance does not comply with Specifications, take corrective measures or remove and replace Mechanical Mixers with Mechanical Mixers which satisfy the conditions specified.

A. Start-Up. Beneficial use will not occur until after the start-up activities have been performed and accepted by the City Engineer. Start-up activities include the following:

1. Receipt and acceptance by the City Engineer of draft Operation and Maintenance manuals, including the wiring and ladder diagrams.

2. Installation inspection by City operating, electrical and instrumentation staff followed by any corrective measures required by the Contractor.

3. Satisfactory operation of Mechanical Mixers for 7 consecutive days under the City's control. If malfunctions or other operational problems halt the 7-day test period, the Contractor shall make appropriate corrections and restart the 7-day test period.

4. Provide the services of a factory-trained technician for a period of 4 hours to train the City's operating and maintenance personnel. Training session shall be scheduled and coordinated by the Contractor.

C. Acceptance. After the start-up operation has been successfully completed, the City will accept the Mechanical Mixers when final Operation and Maintenance manuals have been received, reviewed, and accepted by the City. Include ladder logic diagrams and wiring and termination diagrams for both power and instrumentation systems.

END OF SECTION

SECTION 13300

PROCESS INSTRUMENTATION AND CONTROLS – GENERAL PROVISIONS

PART 1: GENERAL

1.01 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section.
B. Include payment in lump sum bid for work of which this is a component part.

1.02 SCOPE OF WORK

A. Keegan's Bayou WWTP: Controls and Instrumentation work includes all work shown on the drawings and specified herein, including control points identified in Attachment "A" of this section, but not limited to:

1. Replacement of existing PLC based control panels at Clarifier Building, Blower Building #2, and the Sludge Dewatering Building.
2. Connection and integration of Manufacturer's New PLC-based control system for the new Grit Removal System including field wiring of manufacturer controls.
3. Connection and integration of Manufacturer's Replacement PLC-based control system for Digestion Blower System including field wiring of manufacturer controls.
4. Extension of existing facility fiber optic network loop from Clarifier Building to the new grit removal system.
5. Replacement of existing network communications switches to new fault-tolerant, managed network switches.
6. Automation of (4) new motor operated lift gate actuators at the existing clarifier influent flow splitter box.
7. Demolition of unused and abandoned PLC controls for previously demolished, and/or non-existent equipment including updating software programs and SCADA user interfaces.
8. Replacement of selected field devices.
9. Demolition of selected PLC control points and associated non-functional field devices.
10. Provisions for new operator workstations at the liquids building and the solids building.
11. Integration of PLC control points into a NEW SCADA user interface for the facility.

B. Greenridge WWTP: Controls and Instrumentation work includes all work shown on the drawings and specified herein, including control points identified in Attachment "B" of this section, but not limited to:

1. Provision of new PLC based control panel at new Blower Building.
2. Extension of existing fiber optic network loop from existing Operations & Maintenance Building to new Blower Building.
3. Connection and integration of Manufacturer's New control system for Digestion Blowers including field wiring of manufacturer controls.
4. Provision of new control points for Aeration motor drives and associated systems.
5. Removal and reconnection of existing control points for replacement sodium bisulfate pumps.
6. Provisions of control points for new sodium bisulfate storage tanks utilizing new field devices with existing spare PLC I/O points.
7. Replacement of existing Clarifier Scum Pumping Control Panel and provisions for new associated control points.
8. Integration of PLC control points into the EXISTING SCADA user interface for the facility.
9. Demolition of unused and abandoned PLC controls for previously demolished, and/or non-existent equipment including updating software programs and SCADA user interfaces.

C. A pre-approved Process Control System Integrator (PCSI) shall furnish all services and equipment defined herein and in other specification sections as listed in Paragraph 1.03, Related Work

D. The PSCI shall comply with the requirements of Section 13310 "SCADA Software Engineering Security and Quality Requirements".

E. All materials, equipment, labor, and services required to achieve a fully configured integrated and operational process control system shall be provided, including any and all necessary items not indicated herein.

F. In addition to system installations, PSCI Services include:

1. Field verification of existing control systems.
2. PLC configuration and software programming.
3. Operator workstation set-up, configuration, and software installation.
4. Human-Machine Interface (HMI) graphics creation and associated software programming.
5. Point-to-point checkout and system testing.
6. Control system commissioning, diagnostics, demonstration, and training.

G. The PCSI shall design and coordinate the process control system for proper operation with related equipment and materials furnished by other

suppliers under other sections of these specifications and with related existing equipment. Application software programming for the Programmable Logic Controller (PLC) System and programming/graphics development for the HMI shall be performed by the PCSI. Programming, configuration, and integration, including but not limited to Ethernet configuration and communications between all field I/O and PLC communications shall also be provided by the PCSI. In addition, the PCSI shall be responsible for providing all third party software/PLC code required to establish communication with the supplied hardware.

H. All configuration, integration, including but not limited to: loading of all software on computers, network equipment configuration, Ethernet configuration, and communications between servers and RTUs shall be provided by the PCSI. All programming of RTUs and HMI shall be by the PCSI. The Owner shall furnish the operating system software and the application software.

I. Auxiliary and accessory devices necessary for system operation or performance to interface with existing equipment or equipment provided by other suppliers under other sections of these specifications, shall be included whether or not they are shown on the drawings. These devices include, but are not limited to, transducers, current isolators, signal conditioners, interposing relays, power supplies, and fiber optic transceivers.

J. Substitution of functions or type of equipment specified shall not be acceptable. In order to ensure parts are interchangeable, maintain quality, interface between the various subsystems, and establish minimums with regard to ranges and accuracy, strict compliance with the above requirements shall be maintained. System design shall allow for the removal of individual devices from service without disrupting other devices in service.

K. Equipment shall be fabricated, assembled, installed, and placed in proper operating condition in full conformity with detail drawings, specifications, engineering data, instructions, and recommendations by the equipment manufacturer as approved by the Engineer.

L. The PCSI shall be responsible for calibrating all existing instruments that will interface with the new control system.

M. To facilitate the Owner's future operation and maintenance, products shall be by the same major manufacturer, with panel-mounted devices of the same type and model as far as possible.

N. The WWTP is an existing plant and all work shall be coordinated with its operating personnel to minimize impact on daily operation. Specifically, the contractor shall be responsible for providing a detailed daily plan to demonstrate how each of the PLCs shall be replaced or modified so that there is no operational down time experienced by the plant. This plan shall be a submitted for review and approval before any work is started on site. The actual sequence of the work is left to the contractor, but extensive pre-planning is necessary to accomplish the work. The following criteria must be used by the contractor when developing the PLC Replacement Plan:

a) PLC outages that result in more than one hour of operational downtime will not be allowed.

b) PLC outages of more than twice in an eight hour period will not be allowed.

c) Work on more than one PLC at a time will not be allowed.

d) The owner's personnel will operate all equipment in the plant, and the contractor will not operate equipment. Such work to place specific equipment into MANUAL operation will need to be coordinated with the owner at least 24 hours in advance. In cases where there are no existing devices to place equipment into a constant running operation (i.e. no Hand-Off-Auto switch), then the contractor shall improvise by using temporary wiring.

e) The PCSI contractor will use temporary measures to ensure that the flow pacing signals used to meter chemicals are maintained at all times, regardless of which PLCs are out of service.

O. The WWTP is a fully operational facility monitored and controlled by local panels and PLCs. After the switch over, the PCSI must demonstrate that all new equipment and reused existing equipment is connected to the new PLCs and the new computer system is fully functional as specified and shown on the Contract Drawings.

P. The Owner shall retain salvage rights to all material and equipment removed in the course of this work. All materials and equipment retained by the Owner shall be delivered to a point designated by the Owner in Houston, Texas. Any material or equivalent not retained by the Owner shall be removed from the site and disposed of by the General Contractor in accordance with applicable regulations and laws.

Q. All equipment and installations shall satisfy applicable Federal, State, and local codes.

R. The Contract Drawings and related specification sections provide additional details showing building plan layouts, instrument device specifications, functional requirements of the system, and interfacing with other equipment.

S. All materials, equipment, labor, and services necessary to achieve the monitoring and control functions described herein shall be provided in a timely manner so that the monitoring and control functions are available when the equipment is ready to be placed into service.

T. The PCSI shall coordinate and schedule all required testing with the General Contractor, Owner, and Engineer.

U. The PCSI shall coordinate and schedule all required training with the General Contractor, Owner, and Engineer.

The PCSI shall provide a monthly status report and updated project schedule to the General Contractor to be included in the General Contractor's overall project schedule.

1.03 RELATED WORK

A. The PCSI shall furnish all materials, labor, and services specified in the following specification sections as required ensuring that a single, coordinated system is supplied:

1. Section 13310 SCADA Software Engineering Security and Quality Requirements
2. Section 13315 Process Instrumentation and Controls – Products
3. Section 13441 Pump Station Controls
4. Section 13471 Control Cabinet Enclosures
5. Section 13500 Communication Backbone Cabling
6. Section 13510 Communication Horizontal Cabling
7. Section 13600 Control and Instrumentation Cable

B. Divisions requiring coordination shall include, but not be limited to, the following:

1. Division 1 General Requirements

2. Division 13 Special Construction

3. Division 15 Mechanical

4. Division 16 Electrical

C. The PCSI shall coordinate with all equipment suppliers, mechanical subcontractor, electrical subcontractor, and General Contractor.

1.04 COORDINATION MEETINGS

A. The PCSI shall schedule and administer a minimum of three mandatory coordination meetings. The PCSI shall make arrangements for meetings; prepare agenda with copies to participants at least one week before scheduled meetings. The meetings will be conducted at the WWTP and shall include, as a minimum, attendance by the Owner, Engineer, General Contractor's project engineer, PCSI's project engineer, and the electrical subcontractor.

1. The first coordination meeting shall be held in advance of the first PCSI shop drawing submittal. The purpose of the first meeting shall be for the PCSI to:

   a. Summarize their understanding of the project

   b. Discuss any proposed substitutions or alternatives

   c. Schedule testing and delivery milestone dates

   d. Provide a forum for the PCSI to coordinate hardware and software related issues

   e. Request any additional information required from the Owner and/or Engineer.

   The PCSI shall bring a draft version of shop drawings to the meeting to provide the basis for the Owner/Engineer's input into their development.

2. The second coordination meeting shall be held after the Field Instruments, Digital System Hardware, and Control Panels and Panel Mounted Equipment shop drawing submittals have been reviewed by the Engineer and returned to the PCSI. The purpose of the second meeting is to:

   a. Discuss comments made on the submittal packages

   b. Refine scheduled milestone dates

c. Coordinate equipment installation activities

3. The last coordination meeting shall be held one month prior to factory acceptance testing. The purpose of the last coordination meeting is to discuss any remaining coordination requirements.

4. A typical agenda may include, but is not limited to, the following:

a. Review minutes of previous meetings

b. Review of work progress

c. Field observations, problems, and decisions

d. Identification of problems, which impede planned progress

e. Review of submittal schedule and submittal status

f. Review of off-site fabrications and delivery schedules

g. Maintenance of progress schedule

h. Corrective measures to regain projected schedules

i. Planned activities for subsequent work period

j. Coordination of projected progress

k. Maintenance of quality and work standards

l. Effect of proposed changes on progress schedule and coordination

m. Other business relating to project

B. The costs associated with the coordination meetings, including auto expenses, meal expenses, etc., shall not be included as part of the work of this section.

1.05 SUBMITTALS

A. Submit shop drawings in accordance with Section 01300, Submittals. The shop drawings shall fully demonstrate that the equipment and services to

be furnished comply with the provisions of these specifications and provide a true and complete record of the equipment as manufactured and delivered. Each submittal shall be securely bound with an index and sectional dividers. All submittal drawings shall be legible and shall be 11 inches x 17 inches.

B. The Engineer shall determine whether a product is an "Approved Equal" based upon the information listed herein and the manufacturer's data sheets regarding the models specified. Alternate equipment must meet the criteria listed herein and any additional information in the manufacturer's data sheets in order to be accepted as an "Approved Equal". Supplier must furnish five working installation references for any alternate equipment along with owner, contact, and telephone number.

C. The submittals listed below shall be provided as a minimum. Other specification sections may require other submittals not listed here. Each submittal must be complete. No partial submittals will be accepted.

1. System Input/Output List

2. Project Plan

   The project plan shall be submitted and approved before any additional submittals (except I/O List) will be accepted.

3. Field Instruments

4. Digital System Hardware

5. Control Panels and Panel Mounted Equipment

6. Testing

7. Training

8. Loop Diagrams

9. Spares, Expendables, and Test Equipment

10. Operation and Maintenance (O&M) Manuals

D. Submittal Descriptions

1. System Input/Output List

a. Within 90 days of the contract award, the PCSI shall submit a System Input/Output List submittal containing a complete system Input/Output (I/O) list for equipment connected to the control system under this Contract. The I/O list shall be submitted in a Microsoft Excel electronic file format on a CD ROM and an 8 1/2-inch by 11-inch hard copy. The hard copy list shall be sorted first by ISA tag name and second by I/O type (i.e., AI, AO, DI, DO, etc.). The list shall contain, as a minimum, the following for each active point and spare point:

(1) Tag name

(2) Type of I/O (i.e., DI, DO, AI or AO)

(3) I/O point address (PLC name/address and point address)

(4) Point name (or SPARE)

(5) Point description

(6) High/Low range and engineering units

(7) Alarm limits

(8) Relay normal status contact configuration

(9) I/O terminal point physical location (panel name, rack, slot etc.)

(10) 2-wire or 4-wire instrument.

2. Project Plan

a. The Project Plan shall provide an overview of the proposed system including system architecture drawing, approach to work, proposed work schedule indicating milestones and potential meetings, project personnel and organization, details of factory testing and field testing, and details of training program. The Project Plan shall also include an acknowledgment of conformance to the specification on a paragraph-by-paragraph basis indicating any proposed deviations. The schedule shall be coordinated with the

project execution schedule and illustrate all major project milestones including the following:

(1) Schedule for all subsequent project submittals

(2) Schedule for all project design review meetings

(3) Schedule for manufacture, assembly and staging of all process control system equipment

(4) Schedule for all tests

(5) Schedule for shipment of all process control system equipment and peripheral devices

(6) Schedule for equipment start-up

(7) Schedule for all training

3. Existing System Replacement Work Plan

a. Provide in detail a step-by-step switchover plan from the existing system to the new PC/PLC-based monitoring and control system for the existing plant.

b. The submittal shall provide the coordination details among Owner, General Contractor, and subcontractors that may be affected by the switchover plan.

c. The submittal shall include a switchover schedule.

4. Field Instruments

a. This submittal shall provide complete documentation of all field instruments using ISA-S20 format. A complete Bill of Materials (BOM) listing all instrumentation equipment shall be provided.

b. Data Sheets

(1) Provide data sheets for each instrument listing model numbers, options, and ancillary devices that are being provided. The data sheets shall be provided with an index, proper identification, and cross-referencing. The data sheets shall include, but not be limited to, the following information:

(2) Plant Equipment Number and ISA tag number per the Loop Diagrams

(3) Product (item) name used herein and on the Contract Drawings

(4) Manufacturer's complete model number

(5) Location of the device

(6) Input output characteristics

(7) Range, size, and graduations

(8) Physical size with dimensions, enclosure NEMA classification and mounting details

(9) Materials of construction of all components

(10) Instrument sizing calculations where applicable

(11) Certified calibration data for all flow metering devices

c. Equipment Specification Sheets

(1) Provide equipment specification sheets, which, shall fully describe the device, the intended function, how it operates and its physical environmental and performance characteristics. Each data sheet shall have appropriate cross references to loop or equipment identification tags. As a minimum the specification sheets shall include the following:

i. Dimension, rigid clearances

ii. Mounting or installation details

iii. Connection

iv. Electrical power or air requirements

v. Materials of construction

vi. Environmental characteristics

vii. Complete information regarding the field instruments as required by ISA-S5.4 standards shall be provided under this contract.

5. Digital System Hardware

a. This submittal shall provide complete documentation of the proposed hardware (PLC's, RIO's, computers, communication equipment, cables, peripherals, etc.) A complete BOM listing all digital hardware equipment shall be provided.

b. The submittal shall include the following:

(1) System Block Diagram

A complete schematic system block diagram(s) showing the interconnections between major hardware components including, but not limited to:

i. Control centers

ii. Panels

iii. Power supplies

iv. Consoles

v. Computer and peripheral devices

vi. Telemetry equipment

vii. Local digital processors and like equipment

viii. Uninterruptible Power Supplies (UPS)

(2) The block diagram shall reflect the total integration of all digital devices in the system and any human machine interface (HMI) locations. Location of all components shall be clearly identified with appropriate cross-references.

(3) The diagram shall reference all interconnecting cabling requirements for digital components of the system including any data communication links.

c. Data Sheets

(1) A data sheet for each hardware component listing all model numbers, options, auxiliary and ancillary devices that are being provided.

(2) The data sheets shall be provided with an index, proper identification, and cross-referencing. They shall include, but not be limited to, the following information:

a) Equipment Number and ISA tag number

b) Product (item) name used herein and on the Contract Drawings

c) Manufacturer's complete model number

d) Location of the device

e) Input/output characteristics

f) Range, size, and graduations

g) Physical size with dimensions, enclosure NEMA classification and mounting details

h) Materials of construction of all components

i) Power supply device sizing calculations where applicable

d. The Digital System Hardware submittal shall also contain all planning information, site preparation instructions, grounding and bonding procedures, cabling diagrams, plug identifications, safety precautions or guards, and equipment layouts in order to enable the General Contractor to proceed with the detailed site preparation for all equipment.

6. Control Panels and Panel Mounted Equipment

a. This submittal shall provide complete documentation of all panel instruments, control panels, and control equipment not

submitted elsewhere. A complete BOM listing all instrumentation and control equipment shall be provided.

b. Provide data sheets for each component listing all model numbers, options, and ancillary devices that are being provided. The data sheets shall be provided with an index, proper identification, and cross-referencing. The data sheets shall include, but not be limited to, the following information:

(1) Plant Equipment Number and ISA tag number

(2) Product (item) name used herein and on the Contract Drawings

(3) Manufacturer's complete model number

(4) Location of the device

(5) Input output characteristics

(6) Range, size, and graduations

(7) Physical size with dimensions, enclosure NEMA classification and mounting details

(8) Materials of construction of all components

(9) Panel instrument or control device sizing calculations where applicable

c. Provide equipment specification sheets, which shall fully describe the device, the intended function, how it operates, and its physical environmental and performance characteristics. Each equipment specification sheet shall have appropriate cross references to loop or equipment identification tags with model number and information pertaining to the item highlighted. As a minimum the specification sheets shall include the following:

(1) Dimension, rigid clearances

(2) Mounting or installation details
(3) Connection

(4) Electrical power or air requirements

(5) Materials of construction

(6) Environmental characteristics

(7) Performance characteristics

d. Provide detailed drawings covering control panels, consoles and/or enclosures, which shall include:

(1) Cabinet assembly and layout drawings to scale. Drawings shall include both front and interior subpanel layouts.

(2) Material, fabrication, and painting specifications

(3) Color selection samples for selection by the Engineer

(4) Where graphic display panels are required, submit detailed layouts to scale, including symbols and line widths, as well as color selection samples and details of fabrication. Half-scale layouts shall be acceptable.

(5) Panel wiring diagrams showing all power connections to equipment within and on the panel, combined panel power draw requirements (volts, amps), breaker sizes, fuse sizes, and grounding. This wiring diagram shall be in ladder logic format and shall reference the appropriate loop drawing for continuations or details where required. Show all wire numbers and terminal block designations.

e. The submittal shall also contain all planning information, site preparation instructions, grounding and bonding procedures, cabling diagrams, plug identifications, safety precautions or guards, and equipment layouts in order to enable the General Contractor to proceed with the detailed site preparation for all equipment.

f. The submittal shall also include heat dissipation calculations for each enclosure.

7. Testing

a. A test plan shall be submitted after the Owner and/or Engineer have approved all hardware submittals. The test plan shall demonstrate that the PCSI has designed and configured a system that meets the design specifications. The test plan shall be submitted prior to the preparation of the detailed test procedures and submit outlines of the specific proposed tests. Submittals shall include examples of the proposed forms and checklists.

b. The system shall be tested using the system architecture drawing and a Bill of Materials of all hardware indicating manufacturer, model, and serial number. The documents for the test plan shall be structured so that the Engineer understands what the inputs are, what the predicted outputs should be and what the actual outputs are. The test plan shall have a sign off and date block for the PCSI, General Contractor, Owner, and Engineer.

c. The test plan should include the following as a minimum:

   (1) A BOM listing control system components' manufacturer, model and serial number.

   (2) System hardware summary

   (3) A testing schedule describing the specific tasks to be performed and the time allotted for each task

   (4) Communications tests to the various PLCs for discrete and analog I/O data transfer

   (5) 100 percent I/O point test including all spare points based upon the previously submitted system I/O list

d. Test procedures shall be submitted after the test plan submittal has been reviewed by the Engineer and returned stamped either Approved or Approved as Noted, Confirm. The submittal shall document the proposed procedures to be followed during the test. Procedures shall include test descriptions, forms, and checklists to be used to control and document the required tests. Testing shall not be started until all Testing Submittals have been approved.

e. For Test Documentation, submit a copy of the signed off test procedures upon completion of each required test.

8. Training

   a. Submit an overview of the proposed training plan. Each proposed course shall include:

      (1) An overview of the training plan explaining why specific courses are proposed

      (2) Course title and objectives

      (3) Prerequisite training and experience of attendees

      (4) Recommended attendees

      (5) Course Content A topical outline

      (6) Course Duration

      (7) Course Location Training center or jobsite

      (8) Course Format Lecture, laboratory demonstration, etc.

   b. The Engineer shall review the preliminary training plan submittal with the Owner.

   c. Upon receipt of the Owner's and Engineer's comments on the preliminary training plan, submit the specific proposed training plan. The training plan shall include:

      (1) Definition of each course

      (2) Specific course attendance

      (3) Schedule of training courses including dates, duration, and location of each class

      (4) Resumes of the instructors who will actually conduct the training

9. Loop Diagrams

a. Provide detailed loop diagrams on single 11 inches x 17 inches or 8.5 inches x 11 inches sheets for each monitoring or control loop. The submittal shall also be submitted in electronic format on a CD-ROM. The loop diagrams shall show all components of the loop both analog, digital, and discrete including all relays, switches, dropping resistors, etc. which are being provided for proper operation. Loop numbers used shall correspond to the loop numbers indicated in the contract documents. The format shall be the Instrument Society of America, Standard for Instrument Loop Diagrams, ISA-S5.4, and the following requirements:

(1) On each diagram present a tabular summary of:

i. The output capability of the transmitting instrument

ii. The input impedance of each receiving instrument

iii. Estimate of the loop wiring impedance based on wire sizes and approximate length used

iv. The total loop impedance

v. Reserve output capacity

(2) Show all interconnecting wiring between equipment, panels, terminal junction boxes and field mounted components. The diagrams shall show all components and panel terminal board identification numbers and all wire numbers. This diagram shall include all intermediate terminations between field elements and panels (e.g., terminal junction boxes). The diagrams shall be coordinated with the electrical contractor and bear mark showing this has been done.

(3) Show location of all devices

(4) Show instrument description showing type, manufacturer, model number, range, setpoints, and operation (e.g., fail open, open on energization, normally closed, etc.) as applicable.

(5) Show all instrument loop power or instrument air requirements back to termination on terminal block or bulkhead, fuse blocks (including fuse size), etc., as applicable.

(6) Show all grounding points within cabinets and panels and identify the connection point of individual components.

(7) Complete information regarding the field instruments as required by ISA-S5.4 standards shall be provided on the loop diagrams under this contract.

10. Spares, Expendables, and Test Equipment

a. This submittal shall include the following for each Subsystem:

(1) A list of, and descriptive literature for, spares, expendables, and test equipment as specified in Instrumentation Sections.

(2) A separate list of, and descriptive literature for, additional spares, expendables, and test equipment recommended by the PCSI

(3) Unit and total cost for the additional spare items recommended for each subsystem

(4) Storage instructions for all spare parts

(5) Any specialty software or hardware tools used during configuration of the project.

NOTE: These specialty tools must be turned over to the Owner.

11. Operation and Maintenance (O & M) Manuals

a. Provide O & M Manuals per section 13300-1.12.

b. The submittal shall also be submitted in electronic format on a CD-ROM

1.06 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM).

1. ASTM A269 Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

B. Instrument Society of America (ISA)

1. ISA S5.2 Binary Logic Diagrams for Process Operations

2. ISA S5.3 Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.

3. ISA S5.4 Instrument Loop Diagrams

C. American National Standards Institute (ANSI)

1. ANSI X3.5 Flowchart Symbols and Their Usage in Information Processing

D. National Electrical Manufacturers Association (NEMA)

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

1.07 PCSI QUALIFICATIONS

A. The PCSI shall perform all work necessary to select, furnish, configure, customize, debug, install, connect, calibrate, and place into operation all hardware and software specified within this specification and other related divisions of this specification.

B. The PCSI shall be a "systems house" regularly engaged in the design and installation of computer systems and their associated subsystems as they apply to the municipal water or wastewater industry. For the purposes of this specification section, a "systems house" shall be interpreted to mean an organization that complies with all of the following criteria:

1. Employs a Texas Registered Professional Control Systems Engineer or Texas Registered Professional Electrical Engineer to supervise or perform the work required by this specification section.

2. Employs personnel on this project who have successfully completed a manufacturer's training course on the configuration and implementation of the specific programmable controllers, computers, and software proposed for this project.

3. Has performed work of similar or greater complexity on at least three projects within the last five years and has implemented and completed at least one of the three projects with the proposed HMI software.

4. Has been in the water/wastewater industry performing the type of work specified in this specification section for a minimum of five continuous years.

C. The PCSI shall maintain a fully equipped office/production facility with full time employees capable of fabricating, configuring, installing, calibrating, troubleshooting, and testing the system specified herein. Qualified repair personnel shall be available and capable of reaching the facility within 24 hours.

D. Actual installation of the system need not be performed by the PCSI's employees; however, the PCSI shall provide the onsite technical supervision of the installation.

E. The PCSI shall furnish equipment which is the product of one manufacturer to the maximum practical extent. Where this is not practical, all equipment of a given type shall be the product of one manufacturer.

F. The General Contractor must select a pre-approved PCSI from the list below. Only pre-approved PCSI companies are accepted.

BL Technology, Inc.
13171 Misty Willow Drive
Houston, TX, 77070
Attn: Robert Lee
Phone: 281-970-8191

Boyer Inc.
8904 Fairbanks N. Houston
Houston, TX 77064
Attn: Jack Levy
Phone: 713-466-5395

MCC Weimar

Weimar Manufacturing
505 South Eagle Street
Weimar, TX 78962
Attn: Frank Macaulay
Phone: 979-725-8527

G. Being listed in this specification section does not relieve any potential PCSI from meeting the qualifications specified in this section.

H. Listed PCSI companies are not required to submit a qualification proposal. Companies interested in being pre-approved as a PCSI, shall submit three (3) copies of a qualification proposal to the Engineer no later than two weeks before the bid opening date. Additional pre-approved PCSI companies will be listed by Addendum no later than seven (7) days before the bid opening date.

1. The qualification proposal shall provide details and a description of how the supplier proposes to fulfill the requirements set forth in this Specification. The supplier shall present the proposal in sufficient detail so that proper evaluation regarding the experience and capabilities of the supplier can be performed.

   a. The proposal shall contain evidence that the supplier has sufficient financial resources to meet the obligations incidental to the performance of the work including available bonding. (This requirement may be provided in the form of a verifiable or certified financial report for the company's latest fiscal year).

   b. The proposal shall contain a list of personnel available for assignment to the responsible positions of Project Manager, Project Engineer, Lead Programmer, Installation Supervisor, and Area Service Representative. Also, include a concise resume of each individual's education, work experience, and accomplishments.

   c. The proposal shall contain the following specific information:

      (1) Maintenance services available for hardware and software: Evaluation will be based on the supplier's capability to provide the required routine and emergency services. The supplier's proposal is to describe the capabilities and location of his/her nearest (to job site) service organization. It is the

intent of the Specification to obtain all system maintenance services from the supplier. If the supplier intends to subcontract all or portions of the service requirements, it must be stated as such along with the name and address of the organization.

(2) Technical validation examples of recently completed and similar scope projects: The supplier shall provide information regarding type, size, complexity, and performance of five (5) systems recently completed, along with names, addresses, and telephone numbers of persons qualified to verify supplier's statements approximate cost of the instrumentation system supplied, project completion date and description. Evaluation shall be based on the similarity of system requirements and supplier's performance.

(3) A description of how the supplier plans to execute the various functions and locations where the various portions of the work will be performed, coordinated and managed (e.g., design, engineering, manufacturing, programming, testing and scheduling). The vendor is required to state in his/her proposal those functions, which he/she intends to subcontract to other organizations and include the name, address and capabilities of these organizations.

d. The supplier shall be required to demonstrate a minimum of five (5) years recent, past experience in the design, manufacture and commissioning of instrumentation and control systems of comparable size, type and complexity to the proposed project. The supplier shall be required to have his/her own in house capability to handle complete system engineering, fabrication, and testing.

e. The supplier shall indicate that he/she has in his/her employ capable personnel for detailed engineering, coordination, drafting, procurement and expediting, scheduling, construction, testing, inspection, installation, training start up service for calibration and commissioning and warranty compliance for the period specified.

1.08 DELIVERY, STORAGE AND HANDLING

A. Provide Delivery, Storage, and Handling requirements per Specification Section 01600 and as specified below:

B. Shipping Precautions

1. After completion of shop assembly, factory test, and approval, all equipment, cabinets, panels, and consoles shall be packed in protective crates and enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling at jobsite.

2. Special instructions for proper field handling, storage, and installation required by the manufacturer for proper protection, shall be securely attached to the packaging for each piece of equipment prior to shipment. The instructions shall be stored in resealable plastic bags or other acceptable means of protection.

3. None of the control equipment shall be shipped to the site until the room(s) are environmentally suitable.

C. Identification

1. Each component shall be tagged to identify its location, tag number and function in the system. Identification shall be prominently displayed on the outside of the package.

2. Each piece of equipment supplied shall have a permanent stainless steel tag firmly attached and permanently and indelibly marked with the instrument tag number, as given in the Drawings.

D. Storage

1. Equipment shall not be stored out of doors. Equipment, including in line equipment, shall be stored in dry permanent shelters and adequately protected against mechanical injury. If any apparatus has been damaged, the General Contractor, at his own cost and expense, shall repair such damage. If any equipment has been subject to possible damage by water, it shall be thoroughly dried and put through such tests as directed by the Engineer. Any repair

or replacement shall be at the cost and expense of the General Contractor.

1.09 PROJECT/SITE REQUIREMENTS

A. Environmental Requirements. Air-conditioned areas require NEMA Type 12 ventilated enclosures. Equipment below grade shall be NEMA Type 4X. All other areas require NEMA Type 4X stainless steel enclosures. Refer to Division 16 for area environmental hazardous classifications. All instrumentation enclosures and all instruments mounted outdoors shall be furnished with sun shields.

B. Elevation. Equipment shall be designed to operate at a ground elevation of approximately 1500 feet above mean sea level.

C. Temperature. Indoor areas' equipment shall be suitable for 10 to 35 C degrees ambient. Outdoor areas' equipment shall be suitable for 30 to 50 C degrees ambient. Storage temperatures shall range from zero to 50 C degrees ambient. Additional cooling or heating shall be furnished if required by the equipment.

D. Relative Humidity. Air-conditioned area equipment shall be suitable for 20 to 95 percent relative, non condensing humidity. All other equipment shall be suitable for 0 to 100 percent relative, condensing humidity.

E. Power Supply. 120 volts AC sources of electric supply shall be unregulated industrial panel boards.

1.10 MAINTENANCE

A. Spare Parts

1. Spare parts shall be as defined in the related specification sections. All spare parts shall be new and unused.

2. All spare parts shall be individually packaged and labeled.

3. Provide one (1) gallon of touch up paint, in one quart containers, for each type and color used for all cabinets, panels, consoles, etc., supplied under the related specification sections.

4. The spares listed above shall be packed in a manner suitable for long term storage and shall be adequately protected against corrosion, humidity, and temperature.

1.11 WARRANTY

A. Provide equipment warranties per Section 01740, Warranties and Bonds, and herein.

1.12 O & M MANUALS

A. Prior to final acceptance of the system and owner training, operating and maintenance manuals covering instruction and maintenance on each type of equipment shall be furnished in accordance with Section 01730, Operating and Maintenance Data.

B. The instructions shall be bound in three ring binders with Drawings reduced or folded for inclusion and shall provide the following as a minimum:

1. A comprehensive index

2. A complete "As Constructed" set of approved shop Drawings

3. A complete list of the equipment supplied, including serial numbers, ranges, and pertinent data

4. Full specifications for each item

5. System schematic drawings "As Constructed," illustrating all components, piping and electrical connections of the systems supplied under this Section

6. Detailed service, maintenance, and operation instructions for each item supplied

7. Special maintenance requirements particular to this system clearly defined, along with special calibration and test procedures

8. Operating instructions which incorporate a functional description of the entire system, with references to the systems schematic Drawings and instructions

9. Complete parts lists with stock numbers and name, address, and telephone number of the local supplier

C. The final documentation shall be new documentation written specifically for this project, but may include standard and modified standard documentation. Modifications to existing hardware or software manuals

shall be made on the respective pages or inserted adjacently to the modified pages. All standard documentation furnished shall have all portions that apply clearly indicated. All portions that do not apply shall be lined out.

D. The manuals shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustrated parts shall be numbered for identification. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.

E. If the PCSI transmits any documentation or other technical information, which he considers proprietary, such information shall be designated. Documentation or technical information which is designated as being proprietary will be used only for the design, construction, operation, or maintenance of the system and, to the extent permitted by law, will not be published or otherwise disclosed.

F. The final documentation requirements are as follows:

1. As-built documentation shall include all previous submittals, as described in this Specification, updated to reflect the as built system. Any errors in or modifications to the System resulting from the Factory and/or Field Acceptance Tests shall be incorporated in this documentation.

2. The Hardware Maintenance documentation shall describe the detailed preventive and corrective procedures required to keep the System in good operating condition. Within the complete Hardware Maintenance documentation, all hardware maintenance manuals shall make reference to appropriate diagnostics, where applicable, and all necessary timing diagrams shall be included. A maintenance manual or a set of manuals shall be furnished for all delivered hardware, including peripherals. The Hardware Maintenance documentation shall include, as a minimum, the following information:

   a. Operation Information This information shall include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.

b. Preventive Maintenance Instructions These instructions shall include all applicable visual examinations, hardware testing, diagnostic routines, and the adjustments necessary for periodic preventive maintenance of the System.

c. Corrective Maintenance Instructions These instructions shall include guides for locating malfunctions down to the card replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause, and instructions for remedying the malfunction.

d. Parts Information This information shall include the identification of each replaceable or field repairable module. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any repairable or replaceable part. Cross references between the Instrumentation System Supplier's part number and manufacturer's part numbers shall be provided.

e. System Backup/Restore - This information shall include a detailed description of the procedure for backing up the computer system (including PC and PLC); reloading using a backup; and completely restoring a PC and/or PLC from a backup.

1.13 PROGRAMMING

A. Schedule a meeting with City of Houston Public Works Automation Monitoring (713-775-2636) or other designated City personnel to discuss PLC programming philosophy for the project.

B. Program PLCs to reflect the philosophy provided by City of Houston.

C. Schedule a follow-up meeting to review proposed programming.

D. After new PLCs are operational, schedule an additional meeting to review operation of PLCs.

PART 2: PRODUCTS

2.01 GENERAL

A. Process Control System:

1. All instrumentation supplied shall be of the manufacturer's latest design and shall produce or be activated by signals that are established standards for the water and wastewater industries.

2. All electronic instrumentation shall be of the solid state type and shall utilize linear transmission signals of 4 to 20 mA DC (milliampere direct current), however, signals between instruments within the same panel or cabinet may be 1-5V DC (volts direct current), or the like.

3. Output of equipment not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero-based signals will be allowed.

4. All instruments shall be provided with mounting hardware, floor stands, wall brackets, or instrument racks as shown on the Drawings or as required.

5. Equipment installed in a hazardous area shall meet Class, Group, and Division as shown on the Electrical Drawings, to comply with the National Electrical Code.

6. All indicators and recorder readouts shall be linear in process units, unless otherwise noted.

7. All transmitters shall be provided with either integral indicators or conduit mounted indicators in process units, accurate to two percent (2%).

8. Electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and suitably coated to prevent contamination by dust, moisture and fungus. Solid state components shall be conservatively rated for their purpose to assure optimum long-term performance and dependability over ambient atmosphere fluctuations and 0 to 95% percent relative humidity. The field mounted equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.

9. All equipment, cabinets, and devices furnished hereunder shall be heavy duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as

possible, and shall consist of equipment models that are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.

10. The field mounted digital system equipment and system components shall be designed for installation in dusty, humid, and corrosive service conditions.

11. All electronic/digital equipment shall be provided with radio frequency interference protection and shall be FCC approved.

B. Electrical

1. All equipment shall be designed to operate on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

2. Panels containing networking equipment and PLC equipment shall be powered by two separate 24VDC power supplies. One pair of redundant 24VDC power supplies shall be furnished for the networking equipment and a separate pair of redundant 24VDC power supplies shall be furnished for loop powered instrumentation devices and PLC equipment.

3. Materials and equipment used shall be UL approved wherever such approved equipment and materials are available.

4. All equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting when power is restored.

C. Software

1. PLC Configuration and Programming Software
   a. Provide Siemens SIMATIC STEP 7 (TIA Portal) latest version, or pre-approved equal, licensed to City of Houston.
   b. Program PLC microprocessors controlling new equipment and systems per automated sequences of operation as described within respective Sections of this Specification.

c. Program PLC microprocessors controlling existing equipment and systems for remote monitoring & manual control as directed by City Engineer.

2. Human Machine Interface (HMI) Software

a. Provide SIMATIC WinCC, latest version, or pre-approved equal, licensed to City of Houston
b. Provide sufficient software and licensing copies for two (2) on-site HMI workstations.
c. Install, configure, and program HMI software in accordance with paragraph 1.13 of this Section.
d. Include configuration and creation of graphical process screens customized for process flow of the plant.
e. Include configuration and implementation of process alarm handlers.
f. Include configuration and implementation of automatic historical operational database.
g. Include software update and configuration of remote monitoring station HMI.

2.02 LIGHTNING/SURGE PROTECTION

A. Lightning/Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level, and be maintenance free and self-restoring. Instruments shall be housed in a suitable metallic case, properly grounded. Ground wires for all surge protectors shall be connected to a good earth ground, and where practical, each ground wire run individually and insulated from each other. These protectors shall be mounted within the instrument enclosure or a separate NEMA 4 junction box coupled to the enclosure.

B. Either a two or three-stage protection circuit, depending on the application, shall furnish I/O protection.

C. All wiring, hardware, and connection means shall comply with the National Electric Code and/or applicable local codes.

D. All suppressors shall have integral mounting brackets to attach 35mm DIN rail conforming to DIN EN50022, with the exception of conduit mounted devices.

E. The suppressor shall be mounted as close to the equipment it is protecting as possible.

F. Mounting guidelines will be followed as indicated in installation instruction provided by the manufacturer.

G. Wires shall be attached to the suppressor by means of a cable-clamping terminal block activated by a screw. Connections shall be gas-tight, and the terminal block shall be fabricated of non-ferrous, non-corrosive materials.

H. All wiring points and plug connections shall be "touch safe" with no live voltages that can make contact with a misplaced finger in accordance with IEC 529.

I. Analog and discrete and data protection DIN rail mounted, pluggable devices shall meet the following.

1. Surge suppression modules for 24V and 110V circuits shall be UL listed or recognized.

2. Surge protection shall consist of a multistage hybrid circuit with staging inductors or resistors to properly coordinate the components.

3. DIN rail mounted surge protection modules shall consist of two parts; a base terminal block and a plug protection module. Replacing a plug shall not require the removal of any wires nor shall it interrupt the signal. Base and plug shall have the ability to be coded to accept only the correct voltage plug.

4. Surge protection for analog or discrete I/O shall be designed to withstand a maximum 10 kA test current of a 8/20 microsecond waveform according to IEC 1024 Application Guide A and ANSI/IEEE C62.41 Category C Area.

5. Surge protection for hazardous area locations will conform to EN 50 020/DIN EN 50 020/VDE 0170/0171 part 7: 1996-04. Surge protection for hazardous areas shall have at least 500V isolation between intrinsic safety ground and earth ground.

6. Both plugs and bases shall have a rating of IP20 according to IEC 529. Bases shall have an integral label holder to mark each terminal block.

7. Operating temperature range shall be at least -40 □C to +80□C.

8. Bases shall include metal mounting foot, which provides ground connection to DIN-rail.

9. Manufacturers:

   a. Analog: Phoenix Contact model series PT 2 x 2. One plug and base required for two analog loops. Discrete 5-24V: Phoenix Contact model series PT 4 x 1. One plug and base required for every four discrete signals. Discrete 60-230V: Phoenix Contact model series PT 2 x 1 VA. One plug and base required for every two discrete signals.

   b. Dehn, with models to match the Phoenix Contact device ratings.

   c. Approved Equal.

J. Analog and discrete DIN rail mounted, non-pluggable, high density devices shall meet the following

1. Surge protection shall consist of a multistage hybrid circuit with staging inductors or resistors to properly coordinate the components. Series resistance shall not exceed 4.7 ohms (+/- 10%).

2. DIN rail mounted surge protection housing width shall not exceed 6.2mm.
3. Surge protection for analog and digital I/O shall be designed to withstand a 5 kA test current of a (8/20)s waveform according to IEC 1024 Application Guide A and ANSI/IEEE C62.41 (Line to Ground). Surge handling capability of Line 1 + Line 2 shall be 10 kA of (8/20)s waveform.

4. Operating temperature range shall be at least -40C to +85C.

5. Maximum load current through the surge protection module shall not exceed 250 milliamps for analog and digital signal protection.

6. Cutoff frequency for analog modules shall be 3 MHz for a 50-ohm system and 1 MHz for a 150-ohm system. Cutoff frequency for digital modules shall be 2 MHz for a 50-ohm system and 600 KHz for a 150-ohm system.

7. Wire size range shall between 24 and 14 AWG.

8. Ex-I modules shall contain only diode and gas tube (no MOV) and shall be isolated from ground by 500VDC as required by EN 50 020.

9. Manufacturers

   a. Phoenix Contact model series TT-2-PE-24DC, TT-2/2-24DC, or TT-EX(I)-24DC. Phoenix Contact model series PT 2 x Ex(I)-24DC. One plug and base required for two analog loops or four discrete signals.
   b. Dehn, with models to match the Phoenix Contact device ratings.

   c. Approved Equal.

K. Analog Signals (Conduit Mounted)

1. Surge protection shall consist of a multistage hybrid circuit utilizing only diodes and gas discharge tubes but no metal oxide varistors (MOVs).

2. Surge protection for analog and digital I/O shall be designed to withstand a 10 kA test current of a (8/20) μs waveform according to IEC 1024 Application Guide A and ANSI/IEEE C62.41 Category C Area.

3. Surge protection shall not have more than 10 ohms of series resistance.
4. Surge protection shall have a response time less than 1μs.

5. Maximum operating voltage shall not exceed 28 VDC.

6. Surge protection shall not have a cutoff frequency less than 400kHz (for a 600 ohm system) to allow HART protocol and other superimposed smart digital signals to function.

7. Surge protection module shall have an operating temperature range of at least -40°C to +65°C.

8. Maximum load current through the surge protection module shall not exceed 250 mA.

9. Manufacturers:

a. Phoenix Contact model series PIPETRAB. Protection circuit is mounted in 3/4" stainless steel pipe nipple.

b. Dehn, with models to match the Phoenix Contact device ratings.

c. Approved Equal.

PART 3: EXECUTION

3.01 GENERAL INSTALLATION

A. The process control system, instrumentation, and accessory equipment shall be installed in accordance with the manufacturer's instructions. The locations of equipment, transmitters, alarms, and similar devices shown on the drawings are approximate only. Exact locations shall be as approved by the Engineer during construction. All information relevant to the placing of process control work shall be obtained in the field. In case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

B. Two complete sets of approved shop drawings shall be kept at the job site during all on site construction. Both sets shall be marked up identically to reflect any modifications made during field installation or start up. All markings shall be verified and initialed by the Engineer or his designated representative.

C. Following completion of installation and the Operational Readiness Test, one set of the marked up drawings shall be provided to the Engineer; the other set shall be retained by the Supplier for incorporation of the mark ups into final as built documentation.

D. The instrumentation installation details on the Contract Drawings indicate the designed installation for the instruments specified. Where specific installation details are not specified or shown on the Drawings, the American Petroleum Institute (API) Recommended Practice 550 shall be followed as applicable.

E. All work shall be executed in full accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the General Contractor shall bear full responsibility for such violations and assume all costs arising therefrom.

F. All equipment used in areas designated as hazardous shall be designed for the Class, Group, and Division as required on the Electrical Drawings for the locations. All work shall be in strict accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the Supplier shall bear full responsibility for such violations and assume all costs arising therefrom.

G. Unless specifically shown in the Contract Drawings, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands as detailed on the installation detail drawings or an Engineer approved equal mounting rack or stand. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, valve manifolds for calibration, testing, and blow down service shall also be provided. For slurries, chemical or corrosive fluids, inline diaphragm seals shall be provided.

H. All piping to and from field instrumentation shall be provided with necessary unions, test tees, couplings, adapters, and shut off valves.

I. Field instruments that require power supplies shall be provided with local electrical shutoffs and fuses as required.

J. Brackets and hangers required for equipment mounting shall be provided and shall be installed in a workmanlike manner and not interfere with any other equipment.

K. The PCSI shall investigate each space in the building through which equipment must pass to reach its final location. If necessary, the PCSI shall be required to ship material in sections sized to permit passing through restricted areas in the building. The PCSI shall also investigate and make any field modifications to the allocated space for each cabinet, enclosure, and panel to assure proper space and access (front, rear, and side).

L. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded at the source end as directed by the manufacturer of the instrumentation equipment. In no case shall there be more than one ground point for each shield.

M. Lifting rings shall be removed from cabinets/assemblies. Hole plugs the same color as the cabinet shall be provided for the holes.

N. The PCSI, acting through the General Contractor, shall coordinate the installation, the placing and location of system components, and their connections to the process equipment panels, cabinets and devices, subject to the Engineer's approval. The PCSI shall be responsible for ensuring that all field wiring for power and signal circuits is done correctly in accordance with best industry practice and provide for all necessary system grounding to ensure a satisfactory functioning installation. The General Contractor hereunder shall schedule and coordinate his work under this Section with that of the electrical work specified under applicable Sections of Division 16.

O. The PCSI shall provide service by the PLC service representative to verify that the entire PLC system is installed per the manufacturer's requirements. The PCSI shall supply certified copies of all the tests/field reports supplied by the PLC service representative to the Owner for their records.

P. The PCSI shall provide service by a factory-trained representative to verify that the entire local area network (LAN) is installed per the manufacturer's requirements. The PCSI shall include in his bid the cost of the factory trained representative to inspect all LAN terminations and the cost of testing the LAN to verify that it is installed and operating correctly (e.g., data being transferred from node to node, no excessive timeouts, minimal collisions, etc.) The PCSI shall provide certified copies of all tests and legible copies of all field reports generated by the factory-trained representative to the Owner for their records.

3.02 TESTS (GENERAL)

A. The PCSI shall test all equipment at the factory prior to shipment. Unless otherwise specified in the individual specification sections, all equipment provided by the PCSI shall be tested at the factory as a single fully integrated system.

B. As a minimum, the testing shall include the following:

1. Unwitnessed Factory Test (UFT)

2. Functional Demonstration Test (FDT)

C. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and, upon the system's or subsystem's producing the correct result (effect), the specific test requirement shall be satisfied.

D. All tests shall be conducted in accordance with prior Engineer approved procedures, forms, and checklists. Each specific test shall be described and followed by a section for sign off by the appropriate party after its satisfactory completion.

E. Copies of these sign off test procedures, forms, and checklists will constitute the required test documentation.

F. Provide all special testing materials and equipment. Whenever possible, perform tests using actual process variables, equipment, and data. When it is not practical to test with real process variables, equipment, and data, provide suitable means of simulation. Define these simulation techniques in the test procedures.

G. The General Contractor shall require the PCSI to coordinate all testing with the Engineer, all affected Subcontractors, and the Owner.

H. The Engineer reserves the right to test or retest all specified functions whether or not explicitly stated in the prior approved Test Procedures.

I. The Engineer's decision shall be final regarding the acceptability and completeness of all testing.

J. No equipment shall be shipped until the Engineer has received all test results and approved the system.

K. The PCSI shall furnish servicemen and all special calibration and test equipment to perform the field tests.

L. Correction of Deficiencies

1. All deficiencies in workmanship and/or items not meeting specified testing requirements shall be corrected to meet specification requirements at no additional cost to the Owner.

2. Testing, as specified herein, shall be repeated after correction of deficiencies is made until the specified requirements are met. This work shall be performed at no additional cost to the Owner.

3.03 UNWITNESSED FACTORY TESTS (UFT)

A. The entire system, except primary elements, final control elements, and field mounted transmitters, shall be interconnected and tested to ensure the system operates as specified. All analog and discrete input/output points not interconnected at this time shall be simulated to ensure proper operation of all alarms, monitoring devices/functions, and control

devices/functions. All process control strategies shall be simulated to ensure proper operation according to approved shop drawing.

B. All panels and assemblies shall be inspected and tested to verify that they are in conformance with related submittals, specifications, and Contract Drawings.

C. During the tests all digital system hardware and software shall have operated continuously for five days without a failure to verify the system is capable of continuous operation. The unwitnessed test results shall be submitted to the Engineer for approval prior to the start of the Witnessed Factory Test (WFT).

3.04 FUNCTIONAL DEMONSTRATION TEST (FDT)

A. Prior to startup, the entire installed instrument and control system shall be certified that it is ready for operation. All preliminary testing, inspection, and calibration shall be complete. The FDT will be a test by the PCSI.

B. Once the facility has been started up and is operating, a witnessed FDT shall be performed on the complete system to demonstrate that it is operating and in compliance with these Specifications. Each specified function shall be demonstrated on a paragraph-by-paragraph, loop-by-loop, and site-by-site basis.

C. Loop-specific and non-loop-specific tests shall be the same as specified under WFT except that the entire installed system shall be tested and all functionality demonstrated.

D. Updated versions of the documentation specified to be provided during the factory tests shall be made available to the Engineer at the job-site both before and during the tests. In addition, one copy of all O&M Manuals shall be made available to the Engineer at the job-site both before and during testing.

E. The daily schedule specified to be followed during the factory tests shall also be followed during the FDT.

F. The system shall operate for 100 continuous hours without failure before this test shall be considered successful.

G. Demonstrate communication failure and recovery

H. Demonstrate total power failure and recovery. NOTE: The UPS shall be removed for this test.

I. Demonstrate a catastrophic failure and recovery of a workstation and a RTU (PLC).

J. Demonstrate procedure for backing up the workstation, and RTU (PLC); reload using a backup; and completely restore a workstation and RTU (PLC) from a backup.

3.05 TRAINING

A. General

1. The cost of training programs for the Owner's personnel shall be included in the Contract price. Where practical, the training and instruction shall be directly related to the system being supplied. The training shall be provided based on time and not courses to allow the Owner the flexibility to utilize the training time at his discretion.

2. Training shall be conducted at the Owner's facilities.

3. All Technicians, Operators, Engineers, and Managers of the Facility shall require training on the Process Control System (PCS). The training courses shall address operation, maintenance, and troubleshooting of the system provided. The courses shall be designed specifically for the type of personnel attending, such as Operators, Engineers, etc.

4. All training schedules shall be coordinated with, and at the convenience of, the Owner. Shift training may be required to correspond to the Owner's working schedule.

5. Provide detailed training manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.

6. The trainer shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, all training materials shall be delivered to Owner.

END OF SECTION

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-400	CLARIFICATION	REPLACE EXISTING WITH NEW SIEMENS S7 PLC	FLOW SPLITTER GATE A		X				REMOVE	EXISTING	RTU0250D	XT0250ZLC431	1
			FLOW SPLITTER GATE A		X				REMOVE	EXISTING	RTU0250D	XT0250ZLP431	1
			FLOW SPLITTER GATE B		X				REMOVE	EXISTING	RTU0250D	XT0250ZLC432	1
			FLOW SPLITTER GATE B		X				REMOVE	EXISTING	RTU0250D	XT0250ZLP432	1
			FLOW SPLITTER GATE C		X				REMOVE	EXISTING	RTU0250D	XT0250ZLC433	1
			FLOW SPLITTER GATE C		X				REMOVE	EXISTING	RTU0250D	XT0250ZLP433	1
			FLOW SPLITTER GATE D		X				REMOVE	EXISTING	RTU0250D	XT0250ZLC434	1
			FLOW SPLITTER GATE D		X				REMOVE	EXISTING	RTU0250D	XT0250ZLP434	1
			LPC-400 CPU STATUS				X		REUSE	EXISTING	RTU0250D	YT0250XLF400	2
			FLOW SPLITTER BOX PH	X					REMOVE	EXISTING	RTU0250D	IT0250AI401	1
			FLOW SPLITTER BOX SOLIDS	X					NEW	LEVEL SENSOR	RTU0250D	IT0250OI401	3
			FLOW SPLITTER GATE #1 OPEN INDICATOR		X				NEW	MOTORIZED ACTUATOR	RTU0250D	XT0250ZIH401	3
			FLOW SPLITTER GATE #1 CLOSE INDICATOR		X						RTU0250D	XT0250ZIL401	3
			FLOW SPLITTER GATE #2 OPEN INDICATOR		X				NEW	MOTORIZED ACTUATOR	RTU0250D	XT0250ZIH402	3
			FLOW SPLITTER GATE #2 CLOSE INDICATOR		X						RTU0250D	XT0250ZIL402	3
			FLOW SPLITTER GATE #3 OPEN INDICATOR		X				NEW	MOTORIZED ACTUATOR	RTU0250D	XT0250ZIH403	3
			FLOW SPLITTER GATE #3 CLOSE INDICATOR		X						RTU0250D	XT0250ZIL403	3
			FLOW SPLITTER GATE #4 OPEN INDICATOR		X				NEW	MOTORIZED ACTUATOR	RTU0250D	XT0250ZIH404	3
			FLOW SPLITTER GATE #4 CLOSE INDICATOR		X						RTU0250D	XT0250ZIL404	3
			CLARIFIER RAKE DRIVE #1 CONTR		X				REUSE	EXISTING	RTU0250D	YT0250HS431	2
			CLARIFIER DRIVE #1 MODE		X				REUSE	EXISTING	RTU0250D	XT0250XLA431	2
			CLARIFIER DRIVE #1 STATUS		X				REUSE	EXISTING	RTU0250D	XT0250XLR431	2
			CLARIFIER #1 AMMONIA ANALYZER	X					REMOVE	EXISTING	RTU0250D	IT0250NI431	1
			CLARIFIER #1 SLUDGE LOW LEVEL		X				REMOVE	EXISTING	RTU0250D	XT0250LAL431A	1
			CLARIFIER #1 SLUDGE HIGH LEVE		X				REMOVE	EXISTING	RTU0250D	XT0250LAH431B	1
			CLARIFIER #1 SLUDGE HI HI LEV		X				REMOVE	EXISTING	RTU0250D	XT0250LAHH431C	1
			CLARIFIER 1 FAILURE		X				REUSE	EXISTING	RTU0250D	XT0250XLF431	2
			CLARIFIER RAKE DRIVE #2 CONTR				X		REUSE	EXISTING	RTU0250D	YT0250HS432	2
			CLARIFIER DRIVE #2 MODE		X				REUSE	EXISTING	RTU0250D	XT0250XLA432	2
			CLARIFIER DRIVE #2 STATUS		X				REUSE	EXISTING	RTU0250D	XT0250XLR432	2
			CLARIFIER #2 AMMONIA ANALYZER	X					REMOVE	EXISTING	RTU0250D	IT0250NI432	1
			CLARIFIER #2 SLUDGE LOW LEVEL		X				REMOVE	EXISTING	RTU0250D	XT0250LAL432A	1
			CLARIFIER #2 SLUDGE HIGH LEVE		X				REMOVE	EXISTING	RTU0250D	XT0250LAH432B	1
			CLARIFIER #2 SLUDGE HI HI LEV		X				REMOVE	EXISTING	RTU0250D	XT0250LAHH432C	1
			CLARIFIER 2 FAILURE		X				REUSE	EXISTING	RTU0250D	XT0250XLF432	2
			CLARIFIER RAKE DRIVE #3 CONTR				X		REUSE	EXISTING	RTU0250D	YT0250HS433	2
			CLARIFIER DRIVE #3 MODE		X				REUSE	EXISTING	RTU0250D	XT0250XLA433	2
			CLARIFIER DRIVE #3 STATUS		X				REUSE	EXISTING	RTU0250D	XT0250XLR433	2
			CLARIFIER #3 SLUDGE LOW LEVEL		X				REMOVE	EXISTING	RTU0250D	XT0250LAL433A	1
			CLARIFIER #3 SLUDGE HIGH LEVE		X				REMOVE	EXISTING	RTU0250D	XT0250LAH433B	1

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-400	CLARIFICATION	REPLACE EXISTING WITH NEW SIEMENS S7 PLC	CLARIFIER #3 SLUDGE HI HI LEV		X				REMOVE	EXISTING	RTU0250D	XT0250LAHH433C	1
			CLARIFIER DRIVE #3 TORQUE	X					REUSE	EXISTING	RTU0250D	IT0250NI433	2
			CLARIFIER 3 FAILURE		X				REUSE	EXISTING	RTU0250D	XT0250XLF433	2
			CLARIFIER RAKE DRIVE #4 CONTR				X		REUSE	EXISTING	RTU0250D	YT0250HS434	2
			CLARIFIER DRIVE #4 MODE		X				REUSE	EXISTING	RTU0250D	XT0250XLA434	2
			CLARIFIER DRIVE #4 STATUS		X				REUSE	EXISTING	RTU0250D	XT0250XLR434	2
			CLARIFIER #4 SLUDGE LOW LEVEL		X				REMOVE	EXISTING	RTU0250D	XT0250LAL434A	1
			CLARIFIER #4 SLUDGE HIGH LEVE		X				REMOVE	EXISTING	RTU0250D	XT0250LAH434B	1
			CLARIFIER #4 SLUDGE HI HI LEV		X				REMOVE	EXISTING	RTU0250D	XT0250LAHH434C	1
			CLARIFIER DRIVE #4 TORQUE	X					REUSE	EXISTING	RTU0250D	IT0250NI434	2
			CLARIFIER 4 FAILURE		X				REUSE	EXISTING	RTU0250D	XT0250XLF434	2
	RAS TRANSFER		RAS WW LEVEL CONTROLLER INPUT				X		REUSE	EXISTING	RTU0250D	YT0250PVS400	2
			RAS WET WELL LEVEL CONTROL				X		REUSE	EXISTING	RTU0250D	YT0250SS400	2
			RAS WW LEVEL CONTROLLER AUTO		X				REUSE	EXISTING	RTU0250D	XT0250XLA400A	2
			RAS WW LEVEL CONTROLLER GAIN			X			REUSE	EXISTING	RTU0250D	OT0250GN400	2
			RAS WW LEVEL CONTROLLER RESET			X			REUSE	EXISTING	RTU0250D	OT0250RS400	2
			RAS BASIN LEVEL P.V. (RTU0250D)	X					REUSE	EXISTING	RTU0250D	IT0250LPV400	2
			RAS WETWELL A LEVEL	X					REUSE	EXISTING	RTU0250D	IT0250LI400A	2
			RAS WETWELL B LEVEL	X					REUSE	EXISTING	RTU0250D	IT0250LI400B	2
			RAS 1 FLOW SET POINT			X			REUSE	EXISTING	RTU0250D	OT0250FSP401	2
			RAS 2 FLOW CONTROLLER GAIN			X			REUSE	EXISTING	RTU0250D	OT0250GN401	2
			RAS 1 FLOW CONTROLLER RESET			X			REUSE	EXISTING	RTU0250D	OT0250RS401	2
			RAS 2 FLOW SET POINT			X			REUSE	EXISTING	RTU0250D	OT0250FSP402	2
			RAS 4 FLOW CONTROLLER GAIN			X			REUSE	EXISTING	RTU0250D	OT0250GN402	2
			RAS 2 FLOW CONTROLLER RESET			X			REUSE	EXISTING	RTU0250D	OT0250RS402	2
			RAS 3 FLOW SET POINT			X			REUSE	EXISTING	RTU0250D	OT0250FSP403	2
			RAS 3 FLOW CONTROLLER GAIN			X			REUSE	EXISTING	RTU0250D	OT0250GN403	2
			RAS 3 FLOW CONTROLLER RESET			X			REUSE	EXISTING	RTU0250D	OT0250RS403	2
			RAS 4 FLOW SET POINT			X			REUSE	EXISTING	RTU0250D	OT0250FSP404	2
			RAS 1 FLOW CONTROLLER GAIN			X			REUSE	EXISTING	RTU0250D	OT0250GN404	2
			RAS 4 FLOW CONTROLLER RESET			X			REUSE	EXISTING	RTU0250D	OT0250RS404	2
			RAS FLOW #1	X					REUSE	EXISTING	RTU0250D	IT0250FI401	2
			RAS FLOW #2	X					REUSE	EXISTING	RTU0250D	IT0250FI402	2
			RAS FLOW #3	X					REUSE	EXISTING	RTU0250D	IT0250FI403	2
			RAS FLOW #4	X					REUSE	EXISTING	RTU0250D	IT0250FI404	2
			RAS 1 FLOW CONTROL AUTO				X		REUSE	EXISTING	RTU0250D	YT0250SS401	2
			RAS 2 FLOW CONTROL AUTO				X		REUSE	EXISTING	RTU0250D	YT0250SS402	2
			RAS 3 FLOW CONTROL AUTO				X		REUSE	EXISTING	RTU0250D	YT0250SS403	2
			RAS 4 FLOW CONTROL AUTO				X		REUSE	EXISTING	RTU0250D	YT0250SS404	2
			RAS 1 FLOW CONTROLLER MODE AU		X				REUSE	EXISTING	RTU0250D	XT0250XLA401A	2

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-400	RAS TRANSFER	REPLACE EXISTING WITH NEW SIEMENS S7 PLC	RAS 2 FLOW CONTROLLER MODE AU		X				REUSE	EXISTING	RTU0250D	XT0250XLA402A	2
			RAS 3 FLOW CONTROLLER MODE AU		X				REUSE	EXISTING	RTU0250D	XT0250XLA403A	2
			RAS 4 FLOW CONTROLLER MODE AU		X				REUSE	EXISTING	RTU0250D	XT0250XLA404A	2
			STAGE 1 AIR LIFT FCV #1 CONTROL			X			REUSE	EXISTING	RTU0250D	OT0250ZC401	2
			STAGE 1 AIR LIFT FCV #2 CONTROL			X			REUSE	EXISTING	RTU0250D	OT0250ZC402	2
			STAGE 1 AIR LIFT FCV #3 CONTROL			X			REUSE	EXISTING	RTU0250D	OT0250ZC403	2
			STAGE 1 AIR LIFT FCV #4 CONTROL			X			REUSE	EXISTING	RTU0250D	OT0250ZC404	2
			STAGE 1 AIR LIFT FCV #1 MODE		X				REUSE	EXISTING	RTU0250D	XT0250XLA401	2
			STAGE 1 AIR LIFT FCV #2 MODE		X				REUSE	EXISTING	RTU0250D	XT0250XLA402	2
			STAGE 1 AIR LIFT FCV #3 MODE		X				REUSE	EXISTING	RTU0250D	XT0250XLA403	2
			STAGE 1 AIR LIFT FCV #4 MODE		X				REUSE	EXISTING	RTU0250D	XT0250XLA404	2
			STAGE 1 AIR LIFT FCV #1 POSIT	X					REUSE	EXISTING	RTU0250D	IT0250ZI401	2
			STAGE 1 AIR LIFT FCV #2 POSIT	X					REUSE	EXISTING	RTU0250D	IT0250ZI402	2
			STAGE 1 AIR LIFT FCV #3 POSIT	X					REUSE	EXISTING	RTU0250D	IT0250ZI403	2
			STAGE 1 AIR LIFT FCV #4 POSIT	X					REUSE	EXISTING	RTU0250D	IT0250ZI404	2
			STAGE 1 ALP AIR FLOW	X					REUSE	EXISTING	RTU0250D	IT0250FI330	2
			STAGE 1 DIFFERENTIAL PRESSURE	X					REUSE	EXISTING	RTU0250D	IT0250DPI330	2
			RAS WETWELL A SOLIDS	X					REUSE	EXISTING	RTU0250D	IT0250OI420A	2
			RAS WETWELL B SOLIDS	X					REUSE	EXISTING	RTU0250D	IT0250OI420B	2
	WAS TRANSFER		WAS FLOW	X					REUSE	EXISTING	RTU0250D	IT0250FI420	2
			WAS TOTALIZER RESET				X		REUSE	EXISTING	RTU0250D	YT0250PB420	2
			TOTAL WASTED SLUDGE MASS	X					REUSE	EXISTING	RTU0250D	IT0250MQI420	2
			WAS PUMP CONTROL AUTO				X		REUSE	EXISTING	RTU0250D	YT0250SS420	2
			WAS PUMP SEQUENCER FAIL		X				REUSE	EXISTING	RTU0250D	XT0250XLF420	2
			WAS PUMP #1 CONTROL				X		REUSE	EXISTING	RTU0250D	YT0250HS421	2
			WAS PUMP 1 CONTROL START				X		REUSE	EXISTING	RTU0250D	YT0250HS421A	2
			WAS PUMP 1		X				REUSE	EXISTING	RTU0250D	XT0250XLF421	2
			WAS PUMP 1 RUN TIME	X					REUSE	EXISTING	RTU0250D	IT0250RNT421	2
			WAS PUMP 1 STOPPED		X				REUSE	EXISTING	RTU0250D	XT0250XLS421	2
			WAS PUMP 1 FORWARD/REVERSE		X				REUSE	EXISTING	RTU0250D	XT0250SS421	2
			WAS PUMP #1 MODE		X				REUSE	EXISTING	RTU0250D	XT0250XLA421	2
			WAS PUMP #1 RUNNING FRD/REV		X				REUSE	EXISTING	RTU0250D	XT0250XLR421A	2
			WAS PUMP #1 RUNNING REVERSE		X				REUSE	EXISTING	RTU0250D	XT0250XLR421B	2
			WAS PUMP #1 JAMMED		X				REUSE	EXISTING	RTU0250D	XT0250XLJ421	2
			WAS PUMP #2 CONTROL				X		REUSE	EXISTING	RTU0250D	YT0250HS422	2
			WAS PUMP 2 CONTROL START				X		REUSE	EXISTING	RTU0250D	YT0250HS422A	2
			WAS PUMP 2		X				REUSE	EXISTING	RTU0250D	XT0250XLF422	2
			WAS PUMP 2 RUN TIME	X					REUSE	EXISTING	RTU0250D	IT0250RNT422	2
			WAS PUMP 2 STOPPED		X				REUSE	EXISTING	RTU0250D	XT0250XLS422	2
			WAS PUMP 2 FORWARD/REVERSE		X				REUSE	EXISTING	RTU0250D	XT0250SS422	2

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-400	WAS TRANSFER	REPLACE EXISTING WITH NEW SIEMENS S7 PLC	WAS PUMP #2 MODE		X				REUSE	EXISTING	RTU0250D	XT0250XLA422	2
			WAS PUMP #2 RUNNING FRD/REV		X				REUSE	EXISTING	RTU0250D	XT0250XLR422A	2
			WAS PUMP #2 RUNNING REVERSE		X				REUSE	EXISTING	RTU0250D	XT0250XLR422B	2
			WAS PUMP #2 JAMMED		X				REUSE	EXISTING	RTU0250D	XT0250XLJ422	2
			WAS PUMP #3 CONTROL				X		REUSE	EXISTING	RTU0250D	YT0250HS423	2
			WAS PUMP 3 CONTROL START				X		REUSE	EXISTING	RTU0250D	YT0250HS423A	2
			WAS PUMP 3		X				REUSE	EXISTING	RTU0250D	XT0250XLF423	2
			WAS PUMP 3 RUN TIME	X					REUSE	EXISTING	RTU0250D	IT0250RNT423	2
			WAS PUMP 3 STOPPED		X				REUSE	EXISTING	RTU0250D	XT0250XLS423	2
			WAS PUMP 3 FORWARD/REVERSE		X				REUSE	EXISTING	RTU0250D	XT0250SS423	2
			WAS PUMP #3 MODE		X				REUSE	EXISTING	RTU0250D	XT0250XLA423	2
			WAS PUMP #3 RUNNING FRD/REV		X				REUSE	EXISTING	RTU0250D	XT0250XLR423A	2
			WAS PUMP #3 RUNNING REVERSE		X				REUSE	EXISTING	RTU0250D	XT0250XLR423B	2
			WAS PUMP #3 JAMMED		X				REUSE	EXISTING	RTU0250D	XT0250XLJ423	2
			WAS PUMP #4 CONTROL				X		REUSE	EXISTING	RTU0250D	YT0250HS424	2
			WAS PUMP 4 CONTROL START				X		REUSE	EXISTING	RTU0250D	YT0250HS424A	2
			WAS PUMP 4		X				REUSE	EXISTING	RTU0250D	XT0250XLF424	2
			WAS PUMP 4 RUN TIME	X					REUSE	EXISTING	RTU0250D	IT0250RNT424	2
			WAS PUMP 4 STOPPED		X				REUSE	EXISTING	RTU0250D	XT0250XLS424	2
			WAS PUMP 4 FORWARD/REVERSE		X				REUSE	EXISTING	RTU0250D	XT0250SS424A	2
			WAS PUMP 4 FORWARD/REVERSE		X				REUSE	EXISTING	RTU0250D	XT0250SS424B	2
			WAS PUMP #4 MODE		X				REUSE	EXISTING	RTU0250D	XT0250XLA424	2
			WAS PUMP #4 RUNNING FRDREV		X				REUSE	EXISTING	RTU0250D	XT0250XLR424A	2
			WAS PUMP #4 RUNNING REVERSE		X				REUSE	EXISTING	RTU0250D	XT0250XLR424B	2
			WAS PUMP #4 JAMMED		X				REUSE	EXISTING	RTU0250D	XT0250XLJ424	2

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-200	SCREENING	REPLACE EXISTING WITH NEW SIEMENS S7 PLC	SCREEN 1 STATUS		X				REUSE	EXISTING	RTU0250D	XT0250YL201	2
			SCREEN 1 HI TORQUE ALARM		X				REUSE	EXISTING	RTU0250D	XT0250XA201	2
			SCREEN 1 HI DIFFERENTIAL LEVEL ALARM		X				REUSE	EXISTING	RTU0250D	XT0250XA201A	2
			SCREEN 1 OVERLOAD ALARM		X				REUSE	EXISTING	RTU0250D	XT0250XA201B	2
			SCREEN 2 STATUS		X				REUSE	EXISTING	RTU0250D	XT0250YL202	2
			SCREEN 2 HI TORQUE ALARM		X				REUSE	EXISTING	RTU0250D	XT0250XA202	2
			SCREEN 2 HI DIFFERENTIAL ALARM		X				REUSE	EXISTING	RTU0250D	XT0250XA202A	2
			SCREEN 2 OVERLOAD ALARM		X				REUSE	EXISTING	RTU0250D	XT0250XA202B	2
			SCREEN CONVEYOR STATUS		X				REUSE	EXISTING	RTU0250D	XT0250YL203	2
			SCREEN NO. 1 RUN TIME	X					REUSE	EXISTING	RTU0250D	IT0250QR201	2
			SCREEN NO. 2 RUN TIME	X					REUSE	EXISTING	RTU0250D	IT0250QR202	2
			SCREEN CONVEYOR RUN TIME	X					REUSE	EXISTING	RTU0250D	IT0250QR203	2
			FLUSH W SOLENOID VLV ALTERNATING TIME	X					REUSE	EXISTING	RTU0250D	IT0250TMR222	2
			CHANNEL 1 DIFFERENTIAL LEVEL	X					NEW	LEVEL SENSOR	RTU0250D	IT0250LI201	3
			CHANNEL 2 DIFFERENTIAL LEVEL	X					NEW	LEVEL SENSOR	RTU0250D	IT0250LI202	3
			EQUIPMENT FAIL		X				REUSE	EXISTING	RTU0250D	XT0250XA203	2
			BYPASS CHANNEL HIGH LEVEL		X				NEW	LEVEL SENSOR	RTU0250D	XT0250LAH204	3
	GRIT REMOVAL		GRIT DRIVE STATUS		X				REMOVE	EXISTING	RTU0250D	XT0250YL207	1
			GRIT DRIVE FAIL		X				REMOVE	EXISTING	RTU0250D	XT0250XA207	1
			MOMENTARY START PB FROM HMI (SCADA)				X		REMOVE	EXISTING	RTU0250D	YT0250MSS00	1
			INLET VALVE OPEN ALARM		X				REMOVE	EXISTING	RTU0250D	XT0250ZSOA210	1
			INLET VALVE CLOSE ALARM		X				REMOVE	EXISTING	RTU0250D	XT0250ZSCA210	1
			GRIT CLASSIFIER AUTO/MANUAL				X		REMOVE	EXISTING	RTU0250D	YT0250HSS09A	1
			GRIT PUMP 221 AUTO/MANUAL				X		REMOVE	EXISTING	RTU0250D	YT0250HSS21A	1
			GRIT PUMP 222 AUTO/MANUAL				X		REMOVE	EXISTING	RTU0250D	YT0250HSS22A	1
			INLET VALVE CLOSE		X				REMOVE	EXISTING	RTU0250D	XT0250ZSC210	1
			INLET VALVE OPEN		X				REMOVE	EXISTING	RTU0250D	XT0250ZSO210	1
			INLET VALVE IN REMOTE MODE (PLC CONTROL)		X				REMOVE	EXISTING	RTU0250D	XT0250HS210	1
			GRIT CLASSIFIER STATUS		X				REMOVE	EXISTING	RTU0250D	XT0250YL209	1
			GRIT CLASSIFIER FAIL		X				REMOVE	EXISTING	RTU0250D	XT0250XA209	1
			GRIT CLASSIFIER REMOTE STATUS		X				REMOVE	EXISTING	RTU0250D	XT0250HS209	1
			GRIT PUMP 221 STATUS		X				REMOVE	EXISTING	RTU0250D	XT0250YL221	1
			GRIT PUMP 221 FAIL		X				REMOVE	EXISTING	RTU0250D	XT0250XA221	1
			GRIT PUMP 221 REMOTE STATUS		X				REMOVE	EXISTING	RTU0250D	XT0250HS221	1
			GRIT PUMP 222 STATUS		X				REMOVE	EXISTING	RTU0250D	XT0250YL222	1
			GRIT PUMP 222 FAIL		X				REMOVE	EXISTING	RTU0250D	XT0250XA222	1
			GRIT PUMP 222 REMOTE STATUS		X				REMOVE	EXISTING	RTU0250D	XT0250HS222	1
			GRIT CHAMBER SOLENOID VALVE				X		REMOVE	EXISTING	RTU0250D	YT0250SOV208	1
			INLET VALVE OPEN (NOT AVAILABLE)				X		REMOVE	EXISTING	RTU0250D	YT0250HSO210	1
			INLET VALVE CLOSE (NOT AVAILABLE)				X		REMOVE	EXISTING	RTU0250D	YT0250HSC210	1

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-200	GRIT REMOVAL	REPLACE EXISTING WITH NEW SIEMENS S7 PLC	GRIT CLASSIFIER START/STOP				X		REMOVE	EXISTING	RTU0250D	YT0250HS209A	1
			GRIT CLASSIFIER CONTROL SV-209				X		REMOVE	EXISTING	RTU0250D	YT0250KIC209	1
			GRIT PUMP 221 START/STOP				X		REMOVE	EXISTING	RTU0250D	YT0250HS221A	1
			GRIT PUMP SUCTION SVA-221 OPEN/CLOSE				X		REMOVE	EXISTING	RTU0250D	YT0250KIC221	1
			GRIT PUMP DISCHARGE SVB-221 VALVE OP/CL				X		REMOVE	EXISTING	RTU0250D	YT0250KIC221A	1
			GRIT PUMP 222 START/STOP				X		REMOVE	EXISTING	RTU0250D	YT0250HS222A	1
			GRIT PUMP SUCTION SVA-222 VALVE OP/CL				X		REMOVE	EXISTING	RTU0250D	YT0250KIC222	1
			GRIT PUMP DISCHARGE SVB-222 VALVE OP/CL				X		REMOVE	EXISTING	RTU0250D	YT0250KIC222A	1
			INLET VALVE POSITION		X				REMOVE	EXISTING	RTU0250D	XT0250ZSCO210	1
			STAGE 2 AIR LIFT FCU CONTROL (RTUD)			X			REMOVE	EXISTING	RTU0250D	OT0250ZC400D	1
			FLUIDIZING TIME (BEFORE OPEN INLET VLVE)	X					REMOVE	EXISTING	RTU0250D	IT0250TMR220	1
			FLUSHING (S&D) VALVE WAITING TIME	X					REMOVE	EXISTING	RTU0250D	IT0250TMR224	1
			FLUSH VLV OPEN. TIME BEFORE STARTING PMP	X					REMOVE	EXISTING	RTU0250D	IT0250TMR226	1
			FLUSH VLV OPEN. TIME AFTER STOPPING PUMP	X					REMOVE	EXISTING	RTU0250D	IT0250TMR228	1
			TIME BEFORE TURNING OFF GRIT CLASSIFIER	X					REMOVE	EXISTING	RTU0250D	IT0250TMR230	1
			GRIT SYST MASTER CYCLE TIME (UP TO 2 HRS	X					REMOVE	EXISTING	RTU0250D	IT0250TMR200	1
			GRIT PUMP RUNNING TIME	X					REMOVE	EXISTING	RTU0250D	IT0250TMR202	1
			GRIT DRIVE RUN TIME	X					REMOVE	EXISTING	RTU0250D	IT0250QR207	1
			GRIT CLASSIFIER RUN TIME	X					REMOVE	EXISTING	RTU0250D	IT0250QR209	1
			GRIT PUMP 221 RUN TIME	X					REMOVE	EXISTING	RTU0250D	IT0250QR221	1
			GRIT PUMP 222 RUN TIME	X					REMOVE	EXISTING	RTU0250D	IT0250QR222	1

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-200	GRIT REMOVAL	NEW MFG PLC CONTOL PANEL	GRIT SYS #1 INLET GATE OPEN		X				NEW	VALVE ACTUATOR	RTU0250I1	XT0250YH202A	4
			GRIT SYS #1 INLET GATE CLOSE		X						RTU0250I1	XT0250YL207A	4
			GRIT SYS #1 CYCLE START		X				NEW	MOMENTARY SWITCH	RTU0250I1	XT0250HMS215A	4
			GRIT SYS #1 CYCLE RESET		X				NEW	MOMENTARY SWITCH	RTU0250I1	XT0250HMS216A	4
			GRIT SYS #1 ALARM				X		NEW	RELAY	RTU0250I1	YT0250ZA207A	4
			GRIT SYS #1 ALARM RESET		X				NEW	MOMENTARY SWITCH	RTU0250I1	XT0250HMS217A	4
			GRIT SYS #1 PADDLE DRIVE AUTO		X				NEW	HAND SWITCH	RTU0250I1	XT0250HS200A	4
			GRIT SYS #1 PADDLE DRIVE STATUS		X				NEW	MOTOR STARTER	RTU0250I1	XT0250MY201A	4
			GRIT SYS #1 PADDLE DRIVE FAULT		X						RTU0250I1	XT0250MA212A	4
			GRIT SYS #1 PADDLE DRIVE RUN				X				RTU0250I1	YT0250MZ200A	4
			GRIT SYS #1 GRIT PUMP HAND		X				NEW	HAND SWITCH	RTU0250I1	XT0250HS203A	4
			GRIT SYS #1 GRIT PUMP AUTO		X						RTU0250I1	XT0250HS204A	4
			GRIT SYS #1 GRIT PUMP FAULT		X				NEW	MOTOR STARTER	RTU0250I1	YT0250MA213A	4
			GRIT SYS #1 GRIT PUMP STATUS		X						RTU0250I1	XT0250MY205A	4
			GRIT SYS #1 GRIT PUMP RUN				X				RTU0250I1	YT0250MZ201A	4
			GRIT SYS #1 VAC PRIME				X		NEW	CONTACTOR	RTU0250I1	YT0250YZ203A	4
			GRIT SYS #1 PINCH VALVE				X		NEW	CONTACTOR	RTU0250I1	YT0250YZ204A	4
			GRIT SYS #1 PRIMING SENS		X				NEW	PRIMING SENSOR	RTU0250I1	XT0250XY206A	4
			GRIT SYS #1 PRIMING SENS PWR RLY				X		NEW	RELAY	RTU0250I1	YT0250YZ202A	4
			GRIT SYS #1 CONVEYER HAND		X				NEW	HAND SWITCH	RTU0250I1	XT0250HS208A	4
			GRIT SYS #1 CONVEYER AUTO		X						RTU0250I1	XT0250HS209A	4
			GRIT SYS #1 CONVEYER FAULT		X				NEW	MOTOR STARTER	RTU0250I1	XT0250MA214A	4
			GRIT SYS #1 CONVEYER STATUS		X						RTU0250I1	XT0250MY210A	4
			GRIT SYS #1 CONVEYER RUN				X				RTU0250I1	YT0250MZ205A	4
			GRIT SYS #1 FLUSH WATER HAND		X				NEW	HAND SWITCH	RTU0250I1	XT0250HS218A	4
			GRIT SYS #1 FLUSH WATER AUTO		X						RTU0250I1	XT0250HS219A	4
			GRIT SYS #1 FLUSH WATER VALVE				X		NEW	RELAY	RTU0250I1	YT0250YZ206A	4
			GRIT SYS #1 SPARE DI		X				LABEL	AS SPARE	RTU0250I1	XT0250XX211A	4
			GRIT SYS #1 SPARE DO				X		LABEL	AS SPARE	RTU0250I1	YT0250XZ208A	4
			GRIT SYS #1 SPARE DO				X		LABEL	AS SPARE	RTU0250I1	YT0250XZ209A	4
			GRIT SYS #1 SPARE DO				X		LABEL	AS SPARE	RTU0250I1	YT0250XZ210A	4
			GRIT SYS #1 SPARE DO						LABEL	AS SPARE	RTU0250I1	YT0250XZ211A	4

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-200	GRIT REMOVAL	NEW MFG PLC CONTOL PANEL	GRIT SYS #2 INLET GATE OPEN		X				NEW	VALVE ACTUATOR	RTU0250I2	XT0250YH202B	4
			GRIT SYS #2 INLET GATE CLOSE		X						RTU0250I2	XT0250YL207B	4
			GRIT SYS #2 CYCLE START		X				NEW	MOMENTARY SWITCH	RTU0250I2	XT0250HMS215B	4
			GRIT SYS #2 CYCLE RESET		X				NEW	MOMENTARY SWITCH	RTU0250I2	XT0250HMS216B	4
			GRIT SYS #2 ALARM				X		NEW	RELAY	RTU0250I2	YT0250ZA207B	4
			GRIT SYS #2 ALARM RESET		X				NEW	MOMENTARY SWITCH	RTU0250I2	XT0250HMS217B	4
			GRIT SYS #2 PADDLE DRIVE AUTO		X				NEW	HAND SWITCH	RTU0250I2	XT0250HS200B	4
			GRIT SYS #2 PADDLE DRIVE STATUS		X				NEW	MOTOR STARTER	RTU0250I2	XT0250MY201B	4
			GRIT SYS #2 PADDLE DRIVE FAULT		X						RTU0250I2	XT0250MA212B	4
			GRIT SYS #2 PADDLE DRIVE RUN				X				RTU0250I2	YT0250MZ200B	4
			GRIT SYS #2 GRIT PUMP HAND		X				NEW	HAND SWITCH	RTU0250I2	XT0250HS203B	4
			GRIT SYS #2 GRIT PUMP AUTO		X						RTU0250I2	XT0250HS204B	4
			GRIT SYS #2 GRIT PUMP FAULT		X				NEW	MOTOR STARTER	RTU0250I2	YT0250MA213B	4
			GRIT SYS #2 GRIT PUMP STATUS		X						RTU0250I2	XT0250MY205B	4
			GRIT SYS #2 GRIT PUMP RUN				X				RTU0250I2	YT0250MZ201B	4
			GRIT SYS #2 VAC PRIME				X		NEW	CONTACTOR	RTU0250I2	YT0250YZ203B	4
			GRIT SYS #2 PINCH VALVE				X		NEW	CONTACTOR	RTU0250I2	YT0250YZ204B	4
			GRIT SYS #2 PRIMING SENS		X				NEW	PRIMING SENSOR	RTU0250I2	XT0250XY206B	4
			GRIT SYS #2 PRIMING SENS PWR RLY				X		NEW	RELAY	RTU0250I2	YT0250YZ202B	4
			GRIT SYS #2 CONVEYER HAND		X				NEW	HAND SWITCH	RTU0250I2	XT0250HS208B	4
			GRIT SYS #2 CONVEYER AUTO		X						RTU0250I2	XT0250HS209B	4
			GRIT SYS #2 CONVEYER FAULT		X				NEW	MOTOR STARTER	RTU0250I2	XT0250MA214B	4
			GRIT SYS #2 CONVEYER STATUS		X						RTU0250I2	XT0250MY210B	4
			GRIT SYS #2 CONVEYER RUN				X				RTU0250I2	YT0250MZ205B	4
			GRIT SYS #2 FLUSH WATER HAND		X				NEW	HAND SWITCH	RTU0250I2	XT0250HS218B	4
			GRIT SYS #2 FLUSH WATER AUTO		X						RTU0250I2	XT0250HS219B	4
			GRIT SYS #2 FLUSH WATER VALVE				X		NEW	RELAY	RTU0250I2	YT0250YZ206B	4
			GRIT SYS #2 SPARE DI		X				LABEL	AS SPARE	RTU0250I2	XT0250XX211B	4
			GRIT SYS #2 SPARE DO				X		LABEL	AS SPARE	RTU0250I2	YT0250XZ208B	4
			GRIT SYS #2 SPARE DO				X		LABEL	AS SPARE	RTU0250I2	YT0250XZ209B	4
			GRIT SYS #2 SPARE DO				X		LABEL	AS SPARE	RTU0250I2	YT0250XZ210B	4
			GRIT SYS #2 SPARE DO						LABEL	AS SPARE	RTU0250I2	YT0250XZ211B	4

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-700/800	WASTE SLUDGE DIGESTION & THICKENING	REPLACE EXISTING WITH NEW SIEMENS S7 PLC	PT SLUDGE PUMP 1 CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS721A	2
			PT SLUDGE PUMP 2 CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS722A	2
			PT SLUDGE PUMP 3 CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS723A	2
			STS PUMP 1 CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS731A	2
			STS PUMP 2 CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS732A	2
			STS PUMP 3 CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS733A	2
			ROTARY SCREEN 1 CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS751A	2
			ROTARY SCREEN 2 CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS752A	2
			ROTARY SCREEN 3 CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS753A	2
			SCREEN CONVEYOR CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS757A	2
			DS PUMP 2 CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS822A	2
			DS PUMP 3 CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS823A	2
			GRAVITY THICKENER 1 FAILURE				X		REUSE	EXISTING	RTU0250G	YT0250XLF701	2
			GRAVITY THICKENER 2 FAILURE				X		REUSE	EXISTING	RTU0250G	YT0250XLF702	2
			PT SLUDGE PUMP 1 FAILURE				X		REUSE	EXISTING	RTU0250G	YT0250XLF721	2
			PT SLUDGE PUMP 2 FAILURE				X		REUSE	EXISTING	RTU0250G	YT0250XLF722	2
			PT SLUDGE PUMP 3 FAILURE				X		REUSE	EXISTING	RTU0250G	YT0250XLF723	2
			ST SLUDGE PUMP 1 FAILURE				X		REUSE	EXISTING	RTU0250G	YT0250XLF731	2
			ST SLUDGE PUMP 2 FAILURE				X		REUSE	EXISTING	RTU0250G	YT0250XLF732	2
			ST SLUDGE PUMP 3 FAILURE				X		REUSE	EXISTING	RTU0250G	YT0250XLF733	2
			ROTARY SCREEN 1 FAILURE				X		REUSE	EXISTING	RTU0250G	YT0250XLF751	2
			ROTARY SCREEN 2 FAILURE				X		REUSE	EXISTING	RTU0250G	YT0250XLF752	2
			ROTARY SCREEN 3 FAILURE				X		REUSE	EXISTING	RTU0250G	YT0250XLF753	2
			ROTARY SCREEN CONVEYOR FAILUR				X		REUSE	EXISTING	RTU0250G	YT0250XLF757	2
			DIGESTER SLUDGE PUMP 1 FAILU				X		REUSE	EXISTING	RTU0250G	YT0250XLF821	2
			DIGESTER SLUDGE PUMP 2 FAILU				X		REUSE	EXISTING	RTU0250G	YT0250XLF822	2
			DIGESTER SLUDGE PUMP 3 FAILU				X		REUSE	EXISTING	RTU0250G	YT0250XLF823	2
			THICK.PUMP CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250SS700	2
			SLUDGE TANK PUMP SELECTOR				X		REUSE	EXISTING	RTU0250G	YT0250SS789	2
			PRIM THICKENER MODE R/L		X				REUSE	EXISTING	RTU0250G	XT0250XLA701	2
			PRIM THICKENER STATUS		X				REUSE	EXISTING	RTU0250G	XT0250XLR701	2
			SEC. THICKENER MODE R/L		X				REUSE	EXISTING	RTU0250G	XT0250XLA702	2
			SEC. THICKENER STATUS		X				REUSE	EXISTING	RTU0250G	XT0250XLR702	2
			PRIM THICK SLDG PMP #1 MANUAL		X				REUSE	EXISTING	RTU0250G	XT0250XLA721	2
			PRIM THICK SLDG PMP #1 STATUS		X				REUSE	EXISTING	RTU0250G	XT0250XLR721	2
			PRIM THICK SLDG PMP #2 MANUAL		X				REUSE	EXISTING	RTU0250G	XT0250XLA722	2
			PRIM THICK SLDG PMP #2 STATUS		X				REUSE	EXISTING	RTU0250G	XT0250XLR722	2
			PRIM THICK SLDG PMP #3 MANUAL		X				REUSE	EXISTING	RTU0250G	XT0250XLA723	2
			PRIM THICK SLDG PMP #3 STAUS		X				REUSE	EXISTING	RTU0250G	XT0250XLR723	2
			SEC THICK SLDG PMP #1 MANUAL		X				REUSE	EXISTING	RTU0250G	XT0250XLA731	2

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-700/800	WASTE SLUDGE DIGESTION & THICKENING	REPLACE EXISTING WITH NEW SIEMENS S7 PLC	SEC THICK SLDG PMP #1 STATUS		X				REUSE	EXISTING	RTU0250G	XT0250XLR731	2
			SEC THICK SLDG PMP #2 MANUAL		X				REUSE	EXISTING	RTU0250G	XT0250XLA732	2
			SEC THICK SLDG PMP #2 STATUS		X				REUSE	EXISTING	RTU0250G	XT0250XLR732	2
			SEC THICK SLDG PMP #3 MANUAL		X				REUSE	EXISTING	RTU0250G	XT0250XLA733	2
			SEC THICK SLDG PMP #3 STATUS		X				REUSE	EXISTING	RTU0250G	XT0250XLR733	2
			ROTARY SCREEN #1 MODE		X				REUSE	EXISTING	RTU0250G	XT0250XLA751	2
			ROTARY SCREEN #1 STATUS		X				REUSE	EXISTING	RTU0250G	XT0250XLR751	2
			ROTARY SCREEN #2 MODE		X				REUSE	EXISTING	RTU0250G	XT0250XLA752	2
			ROTARY SCREEN #2 STATUS		X				REUSE	EXISTING	RTU0250G	XT0250XLR752	2
			ROTARY SCREEN #3 MODE		X				REUSE	EXISTING	RTU0250G	XT0250XLA753	2
			ROTARY SCREEN #3 STATUS		X				REUSE	EXISTING	RTU0250G	XT0250XLR753	2
			ROTARY SCREEN CONVEYOR MODE		X				REUSE	EXISTING	RTU0250G	XT0250XLA757	2
			ROTARY SCREEN CONVEYOR STATUS		X				REUSE	EXISTING	RTU0250G	XT0250XLR757	2
			DIGESTER #1 INLET SLIDE GATE		X				REMOVE	EXISTING	RTU0250G	XT0250ZSC801A	1
			DIGESTER #1 INLET SLIDE GATE		X				REMOVE	EXISTING	RTU0250G	XT0250ZSP801A	1
			DIGESTER #1 DISCH. SLIDE GAT		X				REMOVE	EXISTING	RTU0250G	XT0250ZSC801B	1
			DIGESTER #1 DISCH. SLIDE GAT		X				REMOVE	EXISTING	RTU0250G	XT0250ZSP801B	1
			DIGESTER #2 INLET SLIDE GATE		X				REMOVE	EXISTING	RTU0250G	XT0250ZSC802A	1
			DIGESTER #2 INLET SLIDE GATE		X				REMOVE	EXISTING	RTU0250G	XT0250ZSP802A	1
			DIGESTER #2 DISCH. SLIDE GAT		X				REMOVE	EXISTING	RTU0250G	XT0250ZSC802B	1
			DIGESTER #2 DISCH. SLIDE GAT		X				REMOVE	EXISTING	RTU0250G	XT0250ZSP802B	1
			DIGESTER #3 INLET SLIDE GATE		X				REMOVE	EXISTING	RTU0250G	XT0250ZSC803A	1
			DIGESTER #3 INLET SLIDE GATE		X				REMOVE	EXISTING	RTU0250G	XT0250ZSP803A	1
			DIGESTER #3 DISCH. SLIDE GAT		X				REMOVE	EXISTING	RTU0250G	XT0250ZSC803B	1
			DIGESTER #3 DISCH. SLIDE GAT		X				REMOVE	EXISTING	RTU0250G	XT0250ZSP803B	1
			DIGESTER #4 INLET SLIDE GATE		X				REMOVE	EXISTING	RTU0250G	XT0250ZSC804A	1
			DIGESTER #4 INLET SLIDE GATE		X				REMOVE	EXISTING	RTU0250G	XT0250ZSP804A	1
			DIGESTER #4 DISCH. SLIDE GAT		X				REMOVE	EXISTING	RTU0250G	XT0250ZSC804B	1
			DIGESTER #4 DISCH. SLIDE GAT		X				REMOVE	EXISTING	RTU0250G	XT0250ZSP804B	1
			DIGESTER #5 INLET SLIDE GATE		X				REMOVE	EXISTING	RTU0250G	XT0250ZSC805A	1
			DIGESTER #5 INLET SLIDE GATE		X				REMOVE	EXISTING	RTU0250G	XT0250ZSP805A	1
			DIGESTER PUMP #1 MODE		X				REUSE	EXISTING	RTU0250G	XT0250XLA821	2
			DIGESTER PUMP #1 STATUS		X				REUSE	EXISTING	RTU0250G	XT0250XLR821	2
			DIGESTER PUMP #2 MODE		X				REUSE	EXISTING	RTU0250G	XT0250XLA822	2
			DIGESTER PUMP #2 STATUS		X				REUSE	EXISTING	RTU0250G	XT0250XLR822	2
			DIGESTER PUMP #3 MODE		X				REUSE	EXISTING	RTU0250G	XT0250XLA823	2
			DIGESTER PUMP #3 STATUS		X				REUSE	EXISTING	RTU0250G	XT0250XLR823	2
			SLUDGE ROTARY SCREEN #4 STATU		X				REUSE	EXISTING	RTU0250G	XT0250XLR754	2
			SLUDGE ROTARY SCREEN #5 STATU		X				REUSE	EXISTING	RTU0250G	XT0250XLR755	2
			SLUDGE ROTARY SCREEN #4 FAILU		X				REUSE	EXISTING	RTU0250G	XT0250XLA754	2

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-700/800	WASTE SLUDGE DIGESTION & THICKENING	REPLACE EXISTING WITH NEW SIEMENS S7 PLC	SLUDGE ROTARY SCREEN #5 FAILU		X				REUSE	EXISTING	RTU0250G	XT0250XLA755	2
			SLUDGE ROTARY SCREEN #6 STATU		X				REUSE	EXISTING	RTU0250G	XT0250XLR756	2
			SLUDGE ROTARY SCREEN #6 FAILU		X				REUSE	EXISTING	RTU0250G	XT0250XLA756	2
			PRIMARY THICKENER DRIVE CONTR				X		REUSE	EXISTING	RTU0250G	YT0250HS701	2
			SEC. THICKENER DRIVE CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS702	2
			PRIMARY SLUDGE PUMP #1 CONTRO				X		REUSE	EXISTING	RTU0250G	YT0250HS721	2
			PRIMARY SLUDGE PUMP #2 CONTRO				X		REUSE	EXISTING	RTU0250G	YT0250HS722	2
			PRIMARY SLUDGE PUMP #3 CONTRO				X		REUSE	EXISTING	RTU0250G	YT0250HS723	2
			SEC. SLUDGE PUMP #1 CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS731	2
			SEC. SLUDGE PUMP #2 CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS732	2
			SEC. SLUDGE PUMP #3 CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS733	2
			ROTARY SCREEN #1 CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS751	2
			ROTARY SCREEN #2 CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS752	2
			ROTARY SCREEN #3 CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS753	2
			ROTARY SCREEN CONVEYOR CONTRO				X		REUSE	EXISTING	RTU0250G	YT0250HS757	2
			DIGESTER PUMP #1 CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS821	2
			DIGESTER PUMP #2 CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS822	2
			DIGESTER PUMP #3 CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250HS823	2
			LPC-700/800 CPU STATUS				X		REUSE	EXISTING	RTU0250G	YT0250XLF780	2
			SLUDGE TANK LEVEL CONTROL				X		REUSE	EXISTING	RTU0250G	YT0250SS906	2
			ROTARY SCREEN COMPACTOR		X				REUSE	EXISTING	RTU0250G	XT0250XLR760	2
			ROTARY SCREEN CONVEYOR		X				REUSE	EXISTING	RTU0250G	XT0250XLR761	2
			ROTARY SCREEN CONVEYOR		X				REUSE	EXISTING	RTU0250G	status9022	2
			TOTAL WAS MASS SET POINT			X			REUSE	EXISTING	RTU0250G	OT0250MQSP420	2
			PTS PUMP SOLIDS CNTRL SIGNAL	X					REUSE	EXISTING	RTU0250G	IT0250OI700	2
			PTS PUMP SOLIDS CNTRL SET PT.			X			REUSE	EXISTING	RTU0250G	OT0250OSP700	2

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-700/800	WASTE SLUDGE DIGESTION & THICKENING	REPLACE EXISTING WITH NEW SIEMENS S7 PLC	THICK 1 LOW LEVEL TRIP			X			REUSE	EXISTING	RTU0250G	OT0250LSL701	2
			THICK 2 LOW LEVEL TRIP			X			REUSE	EXISTING	RTU0250G	OT0250LSL702	2
			SLUDGE TANK STAGE 1 STOP LVL			X			REUSE	EXISTING	RTU0250G	OT0250LSH906A	2
			SLUDGE TANK STAGE 2 STOP LVL			X			REUSE	EXISTING	RTU0250G	OT0250LSH906B	2
			SLUDGE TANK STAGE 3 STOP LVL			X			REUSE	EXISTING	RTU0250G	OT0250LSH906C	2
			SLUDGE TK STAGE 1 START LVL			X			REUSE	EXISTING	RTU0250G	OT0250LSL906A	2
			RAS WET WELL LEVEL SET POINT			X			REUSE	EXISTING	RTU0250G	OT0250LSP400	2
			SLUDGE TK STAGE 2 START LVL			X			REUSE	EXISTING	RTU0250G	OT0250LSL906B	2
			SLUDGE TK STAGE 3 START LVL			X			REUSE	EXISTING	RTU0250G	OT0250LSL906C	2
			DIG. BASIN TOTAL AIR FLOW	X					REUSE	EXISTING	RTU0250G	IT0250FI800	2
			PRIMARY THICKENER #1 LEVEL	X					REUSE	EXISTING	RTU0250G	IT0250LI701	2
			PRIMARY THICKENER #2 LEVEL	X					REUSE	EXISTING	RTU0250G	IT0250LI702	2
			SEC. THICKENER SOLIDS	X					REUSE	EXISTING	RTU0250G	IT0250OI701	2
			SEC. THICKENER SOLIDS	X					REUSE	EXISTING	RTU0250G	IT0250OI702	2
			THICKENER DRIVE #1 TORQUE	X					REUSE	EXISTING	RTU0250G	IT0250NI701	2
			THICKENER DRIVE #2 TORQUE	X					REUSE	EXISTING	RTU0250G	IT0250NI702	2
			PRIM. THICKENER PUMP DISCHARG	X					REUSE	EXISTING	RTU0250G	IT0250FI724	2
			SEC. THICKENER PUMP DISCH.	X					REUSE	EXISTING	RTU0250G	IT0250FI734	2
			BLOWER BLDG. 2 AIR FLOW DP	X					REUSE	EXISTING	RTU0250G	IT0250DPI800	2
			DIGESTER PUMP DISCHARGE	X					REUSE	EXISTING	RTU0250G	IT0250FI820	2
			DIGESTER BASIN #1 LEVEL	X					NEW	LEVEL SENSOR	RTU0250G	IT0250LI801	3
			DIGESTER BASIN #2 LEVEL	X					NEW	LEVEL SENSOR	RTU0250G	IT0250LI802	3
			DIGESTER BASIN #3 LEVEL	X					NEW	LEVEL SENSOR	RTU0250G	IT0250LI803	3
			DIGESTER BASIN #4 LEVEL	X					NEW	LEVEL SENSOR	RTU0250G	IT0250LI804	3
			DIGESTER BASIN #5 LEVEL	X					NEW	LEVEL SENSOR	RTU0250G	IT0250LI805	3
			DIGESTER SOLIDS ANALYZER 1	X					REMOVE	EXISTING	RTU0250G	IT0250OI801	1
			DIGESTER SOLIDS ANALYZER 2	X					REMOVE	EXISTING	RTU0250G	IT0250OI802	1
			DIGESTER SOLIDS ANALYZER 3	X					REMOVE	EXISTING	RTU0250G	IT0250OI803	1
			PTS PUMP START DELAY TIMER			X			REUSE	EXISTING	RTU0250G	OT0250TMR720A	2
			PTS PUMP STOP DELAY TIMER			X			REUSE	EXISTING	RTU0250G	OT0250TMR720B	2

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-700/800	DIGESTER BLOWERS	REPLACE EXISTING WITH NEW SIEMENS S7 PLC	BLOWER 801 CONTROL				X		NEW	BLOWER CONTROL PNL	RTU0250G	YT0250HS801	5
			BLOWER 801 MODE		X						RTU0250G	XT0250XLA801	5
			BLOWER 801 STATUS		X						RTU0250G	XT0250XLR801	5
			BLOWER 801 ALARM		X						RTU0250G	XT0250YA801	5
			BLOWER 801 FAULT		X						RTU0250G	XT0250YF801	5
			BLOWER 801 MOTOR CURRENT	X					EXISTING	CURRENT XFMR	RTU0250G	IT0250II801	2
			BLOWER 801 MOTOR VIBRATION		X				EXISTING	ACCELEROMETER	RTU0250G	XT0250VAH801A	2
			BLOWER 801 LUBE OIL PRESSURE		X				REMOVE	EXISTING	RTU0250G	XT0250PAL801	1
			BLOWER 801 LUBE OIL TEMPERATU		X				REMOVE	EXISTING	RTU0250G	XT0250TAH801A	1
			BLOWER 801 MOTOR BEARING TEMP		X				REMOVE	EXISTING	RTU0250G	XT0250TAH801B	1
			BLOWER 801 MOTOR WINDING TEMP		X				REMOVE	EXISTING	RTU0250G	XT0250TAH801C	1
			BLOWER 801 BEARING TEMPERATUR		X				REMOVE	EXISTING	RTU0250G	XT0250TAH801D	1
			BLOWER 801 VIBRATION		X				REMOVE	EXISTING	RTU0250G	XT0250VAH801B	1
			BLOWER 801 DIFF PRESSURE	X					REMOVE	EXISTING	RTU0250G	IT0250PDI801	1
			BLOWER 801 DISCH PRESSURE	X					REMOVE	EXISTING	RTU0250G	IT0250PI801	1
			BLOWER 802 CONTROL				X		NEW	BLOWER CONTROL PNL	RTU0250G	YT0250HS802	5
			BLOWER 802 MODE		X						RTU0250G	XT0250XLA802	5
			BLOWER 802 STATUS		X						RTU0250G	XT0250XLR802	5
			BLOWER 802 ALARM		X						RTU0250G	XT0250YA802	5
			BLOWER 802 FAULT		X						RTU0250G	XT0250YF802	5
			BLOWER 802 MOTOR CURRENT	X					EXISTING	CURRENT XFMR	RTU0250G	IT0250II802	2
			BLOWER 802 MOTOR VIBRATION		X				EXISTING	ACCELEROMETER	RTU0250G	XT0250VAH802A	2
			BLOWER 802 LUBE OIL PRESSURE		X				REMOVE	EXISTING	RTU0250G	XT0250PAL802	1
			BLOWER 802 LUBE OIL TEMPERATU		X				REMOVE	EXISTING	RTU0250G	XT0250TAH802A	1
			BLOWER 802 MOTOR BEARING TEMP		X				REMOVE	EXISTING	RTU0250G	XT0250TAH802B	1
			BLOWER 802 MOTOR WINDING TEMP		X				REMOVE	EXISTING	RTU0250G	XT0250TAH802C	1
			BLOWER 802 BEARING TEMPERATUR		X				REMOVE	EXISTING	RTU0250G	XT0250TAH802D	1
			BLOWER 802 VIBRATION		X				REMOVE	EXISTING	RTU0250G	XT0250VAH802B	1
			BLOWER 802 DIFF. PRESSURE	X					REMOVE	EXISTING	RTU0250G	IT0250PDI802	1
			BLOWER 802 DISCH. PRESSURE	X					REMOVE	EXISTING	RTU0250G	IT0250PI802	1
			BLOWER 803 CONTROL				X		NEW	BLOWER CONTROL PNL	RTU0250G	YT0250HS803	5
			BLOWER 803 MODE		X						RTU0250G	XT0250XLA803	5
			BLOWER 803 STATUS		X						RTU0250G	XT0250XLR803	5
			BLOWER 803 ALARM		X						RTU0250G	XT0250YA803	5
			BLOWER 803 FAULT		X						RTU0250G	XT0250YF803	5
			BLOWER 803 MOTOR CURRENT	X					EXISTING	CURRENT XFMR	RTU0250G	IT0250II803	2
			BLOWER 803 MOTOR VIBRATION		X				EXISTING	ACCELEROMETER	RTU0250G	XT0250VAH803A	2
			BLOWER 803 LUBE OIL PRESSURE		X				REMOVE	EXISTING	RTU0250G	XT0250PAL803	1
			BLOWER 803 LUBE OIL TEMPERATU		X				REMOVE	EXISTING	RTU0250G	XT0250TAH803A	1
			BLOWER 803 MOTOR BEARING TEMP		X				REMOVE	EXISTING	RTU0250G	XT0250TAH803B	1

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-700/800	DIGESTER BLOWERS	REPLACE EXISTING WITH NEW SIEMENS S7 PLC	BLOWER 803 MOTOR WINDING TEMP		X				REMOVE	EXISTING	RTU0250G	XT0250TAH803C	1
			BLOWER 803 BEARING TEMPERATUR		X				REMOVE	EXISTING	RTU0250G	XT0250TAH803D	1
			BLOWER 803 VIBRATION		X				REMOVE	EXISTING	RTU0250G	XT0250VAH803B	1
			BLOWER 803 DIFF. PRESSURE	X					REMOVE	EXISTING	RTU0250G	IT0250PDI803	1
			BLOWER 803 DISCH. PRESSURE	X					REMOVE	EXISTING	RTU0250G	IT0250PI803	1
			BLOWER 804 CONTROL				X		NEW	BLOWER CONTROL PNL	RTU0250G	YT0250HS804	5
			BLOWER 804 MODE		X						RTU0250G	XT0250XLA804	5
			BLOWER 804 STATUS		X						RTU0250G	XT0250XLR804	5
			BLOWER 804 ALARM		X						RTU0250G	XT0250YA804	5
			BLOWER 804 FAULT		X						RTU0250G	XT0250YF804	5
			BLOWER 804 MOTOR CURRENT	X					EXISTING	CURRENT XFMR	RTU0250G	IT0250II804	2
			BLOWER 804 MOTOR VIBRATION		X				EXISTING	ACCELEROMETER	RTU0250G	XT0250VAH804A	2
			BLOWER 804 LUBE OIL PRESSURE		X				REMOVE	EXISTING	RTU0250G	XT0250PAL804	1
			BLOWER 804 LUBE OIL TEMPERATU		X				REMOVE	EXISTING	RTU0250G	XT0250TAH804A	1
			BLOWER 804 MOTOR BEARING TEMP		X				REMOVE	EXISTING	RTU0250G	XT0250TAH804B	1
			BLOWER 804 MOTOR WINDING TEMP		X				REMOVE	EXISTING	RTU0250G	XT0250TAH804C	1
			BLOWER 804 BEARING TEMPERATUR		X				REMOVE	EXISTING	RTU0250G	XT0250TAH804D	1
			BLOWER 804 VIBRATION		X				REMOVE	EXISTING	RTU0250G	XT0250VAH804B	1
			BLOWER 804 DIFF. PRESSURE	X					REMOVE	EXISTING	RTU0250G	IT0250PDI804	1
			BLOWER 804 DISCH. PRESSURE	X					REMOVE	EXISTING	RTU0250G	IT0250PI804	1
			BLOWER 811 CONTROL				X		NEW	BLOWER CONTROL PNL	RTU0250G	YT0250HS811	5
			BLOWER 811 SLOW/FAST MODE		X						RTU0250G	XT0250XLA811A	5
			BLOWER 811 STATUS SLOW/F		X						RTU0250G	XT0250XLR811A	5
			BLOWER 811 FAST MODE		X						RTU0250G	XT0250XLA811B	5
			BLOWER 811 STATUS FAST		X						RTU0250G	XT0250XLR811B	5
			BLOWER 811 ALARM		X						RTU0250G	XT0250YA811	5
			BLOWER 811 FAULT		X						RTU0250G	XT0250YF811	5
			BLOWER 811 MOTOR CURRENT	X					EXISTING	CURRENT XFMR	RTU0250G	IT0250II811	2
			BLOWER 811 MOTOR VIBRATION		X				EXISTING	ACCELEROMETER	RTU0250G	XT0250VAH811A	2
			BLOWER 811 LUBE OIL PRESSURE		X				REMOVE	EXISTING	RTU0250G	XT0250PAL811	1
			BLOWER 811 LUBE OIL TEMP.		X				REMOVE	EXISTING	RTU0250G	XT0250TAH811A	1
			BLOWER 811 MOTOR BEARING TEMP		X				REMOVE	EXISTING	RTU0250G	XT0250TAH811B	1
			BLOWER 811 MOTOR WINDING TEMP		X				REMOVE	EXISTING	RTU0250G	XT0250TAH811C	1
			BLOWER 811 BEARING TEMP.		X				REMOVE	EXISTING	RTU0250G	XT0250TAH811D	1
			BLOWER 811 VIBRATION		X				REMOVE	EXISTING	RTU0250G	XT0250VAH811B	1
			BLOWER 811 DIFF. PRESSURE	X					REMOVE	EXISTING	RTU0250G	IT0250PDI811	1
			BLOWER 811 DISCH. PRESSURE	X					REMOVE	EXISTING	RTU0250G	IT0250PI811	1

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-700/800	DIGESTER BLOWERS	REPLACE EXISTING WITH NEW SIEMENS S7 PLC	BLOWER 812 CONTROL				X		NEW	BLOWER CONTROL PNL	RTU0250G	YT0250HS812	5
			BLOWER 812 SLOW/FAST MODE		X						RTU0250G	XT0250XLA812A	5
			BLOWER 812 STATUS SLOW/F		X						RTU0250G	XT0250XLR812A	5
			BLOWER 812 FAST MODE		X						RTU0250G	XT0250XLA812B	5
			BLOWER 812 STATUS FAST		X						RTU0250G	XT0250XLR812B	5
			BLOWER 812 ALARM		X						RTU0250G	XT0250YA812	5
			BLOWER 812 FAULT		X						RTU0250G	XT0250YF812	5
			BLOWER 812 MOTOR CURRENT	X					EXISTING	CURRENT XFMR	RTU0250G	IT0250II812	2
			BLOWER 812 MOTOR VIBRATION		X				EXISTING	ACCELEROMETER	RTU0250G	XT0250VAH812A	2
			BLOWER 812 LUBE OIL PRESSURE		X				REMOVE	EXISTING	RTU0250G	XT0250PAL812	1
			BLOWER 812 LUBE OIL TEMP.		X				REMOVE	EXISTING	RTU0250G	XT0250TAH812A	1
			BLOWER 812 MOTOR BEARING TEMP		X				REMOVE	EXISTING	RTU0250G	XT0250TAH812B	1
			BLOWER 812 MOTOR WINDING TEMP		X				REMOVE	EXISTING	RTU0250G	XT0250TAH812C	1
			BLOWER 812 BEARING TEMP.		X				REMOVE	EXISTING	RTU0250G	XT0250TAH812D	1
			BLOWER 812 VIBRATION		X				REMOVE	EXISTING	RTU0250G	XT0250VAH812B	1
			BLOWER 812 DIFF. PRESSURE	X					REMOVE	EXISTING	RTU0250G	IT0250PDI812	1
			BLOWER 812 DISCH. PRESSURE	X					REMOVE	EXISTING	RTU0250G	IT0250PI812	1
			BLOWER 813 CONTROL				X		REMOVE	EXISTING PLC I/O & WIRING. BLOWER 813 WAS NEVER INSTALLED	RTU0250G	YT0250HS813	1
			BLOWER 813 SLOW/FAST MODE		X						RTU0250G	XT0250XLA813A	1
			BLOWER 813 STATUS SLOW/F		X						RTU0250G	XT0250XLR813A	1
			BLOWER 813 FAST MODE		X						RTU0250G	XT0250XLA813B	1
			BLOWER 813 STATUS FAST		X						RTU0250G	XT0250XLR813B	1
			BLOWER 813 ALARM		X						RTU0250G	XT0250YA813	1
			BLOWER 813 FAULT		X						RTU0250G	XT0250YF813	1
			BLOWER 813 MOTOR CURRENT	X							RTU0250G	IT0250II813	1
			BLOWER 813 MOTOR VIBRATION		X						RTU0250G	XT0250VAH813A	1
			BLOWER 813 LUBE OIL PRESSURE		X						RTU0250G	XT0250PAL813	1
			BLOWER 813 LUBE OIL TEMP.		X						RTU0250G	XT0250TAH813A	1
			BLOWER 813 MOTOR BEARING TEMP		X						RTU0250G	XT0250TAH813B	1
			BLOWER 813 MOTOR WINDING TEMP		X						RTU0250G	XT0250TAH813C	1
			BLOWER 813 BEARING TEMP.		X						RTU0250G	XT0250TAH813D	1
			BLOWER 813 VIBRATION		X						RTU0250G	XT0250VAH813B	1
			BLOWER 813 DIFF. PRESSURE	X							RTU0250G	IT0250PDI813	1
			BLOWER 813 DISCH. PRESSURE	X							RTU0250G	IT0250PI813	1

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-700/800	DIGESTER BLOWERS	NEW MFG PLC CONTOL PANEL	BLOWER 801 INLET SUCTION	X					NEW	PRES SENSOR	RTU0250G1	ASSIGNED BY MFG	6
			BLOWER 801 DISCH PRES	X					NEW	PRES SENSOR	RTU0250G1	ASSIGNED BY MFG	6
			BLOWER 801 INLET AIR TEMP	X					NEW	TEMP SENSOR	RTU0250G1	ASSIGNED BY MFG	6
			BLOWER 801 DISCH AIR TEMP	X					NEW	TEMP SENSOR	RTU0250G1	ASSIGNED BY MFG	6
			BLOWER 801 LUBE OIL PRESSURE	X					NEW	PRES SENSOR	RTU0250G1	ASSIGNED BY MFG	6
			BLOWER 801 LUBE OIL SUPPLY TEMP	X					NEW	TEMP SENSOR	RTU0250G1	ASSIGNED BY MFG	6
			BLOWER 801 LUBE OIL RETURN TEMP	X					NEW	TEMP SENSOR	RTU0250G1	ASSIGNED BY MFG	6
			BLOWER 801 BLOWER VIBRATION	X					NEW	ACCELEROMETER	RTU0250G1	ASSIGNED BY MFG	6
			BLOWER 801 BLOW OFF VALVE			X			NEW	CONTROL VALVE	RTU0250G1	ASSIGNED BY MFG	6
			BLOWER 801 ISOLATION VALVE			X			NEW	VALVE ACTUATOR	RTU0250G1	ASSIGNED BY MFG	6
			BLOWER 801 BLWR IB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G1	ASSIGNED BY MFG	6
			BLOWER 801 BLWR OB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G1	ASSIGNED BY MFG	6
			BLOWER 801 MTR IB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G1	ASSIGNED BY MFG	6
			BLOWER 801 MTR OB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G1	ASSIGNED BY MFG	6
			BLOWER 801 START/STOP				X		EXISTING	MOTOR STARTER	RTU0250G1	ASSIGNED BY MFG	6
			BLOWER 801 RUN/FAIL		X						RTU0250G1	ASSIGNED BY MFG	6
			BLOWER 801 REMOTE		X						RTU0250G1	ASSIGNED BY MFG	6
		NEW MFG PLC CONTOL PANEL	BLOWER 802 INLET SUCTION	X					NEW	PRES SENSOR	RTU0250G2	ASSIGNED BY MFG	6
			BLOWER 802 DISCH PRES	X					NEW	PRES SENSOR	RTU0250G2	ASSIGNED BY MFG	6
			BLOWER 802 INLET AIR TEMP	X					NEW	TEMP SENSOR	RTU0250G2	ASSIGNED BY MFG	6
			BLOWER 802 DISCH AIR TEMP	X					NEW	TEMP SENSOR	RTU0250G2	ASSIGNED BY MFG	6
			BLOWER 802 LUBE OIL PRESSURE	X					NEW	PRES SENSOR	RTU0250G2	ASSIGNED BY MFG	6
			BLOWER 802 LUBE OIL SUPPLY TEMP	X					NEW	TEMP SENSOR	RTU0250G2	ASSIGNED BY MFG	6
			BLOWER 802 LUBE OIL RETURN TEMP	X					NEW	TEMP SENSOR	RTU0250G2	ASSIGNED BY MFG	6
			BLOWER 802 BLOWER VIBRATION	X					NEW	ACCELEROMETER	RTU0250G2	ASSIGNED BY MFG	6
			BLOWER 802 BLOW OFF VALVE			X			NEW	CONTROL VALVE	RTU0250G2	ASSIGNED BY MFG	6
			BLOWER 802 ISOLATION VALVE			X			NEW	VALVE ACTUATOR	RTU0250G2	ASSIGNED BY MFG	6
			BLOWER 802 BLWR IB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G2	ASSIGNED BY MFG	6
			BLOWER 802 BLWR OB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G2	ASSIGNED BY MFG	6
			BLOWER 802 MTR IB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G2	ASSIGNED BY MFG	6
			BLOWER 802 MTR OB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G2	ASSIGNED BY MFG	6
			BLOWER 802 START/STOP				X		EXISTING	MOTOR STARTER	RTU0250G2	ASSIGNED BY MFG	6
			BLOWER 802 RUN/FAIL		X						RTU0250G2	ASSIGNED BY MFG	6
			BLOWER 802 REMOTE		X						RTU0250G2	ASSIGNED BY MFG	6

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-700/800	DIGESTER BLOWERS	NEW MFG PLC CONTOL PANEL	BLOWER 803 INLET SUCTION	X					NEW	PRES SENSOR	RTU0250G3	ASSIGNED BY MFG	6
			BLOWER 803 DISCH PRES	X					NEW	PRES SENSOR	RTU0250G3	ASSIGNED BY MFG	6
			BLOWER 803 INLET AIR TEMP	X					NEW	TEMP SENSOR	RTU0250G3	ASSIGNED BY MFG	6
			BLOWER 803 DISCH AIR TEMP	X					NEW	TEMP SENSOR	RTU0250G3	ASSIGNED BY MFG	6
			BLOWER 803 LUBE OIL PRESSURE	X					NEW	PRES SENSOR	RTU0250G3	ASSIGNED BY MFG	6
			BLOWER 803 LUBE OIL SUPPLY TEMP	X					NEW	TEMP SENSOR	RTU0250G3	ASSIGNED BY MFG	6
			BLOWER 803 LUBE OIL RETURN TEMP	X					NEW	TEMP SENSOR	RTU0250G3	ASSIGNED BY MFG	6
			BLOWER 803 BLOWER VIBRATION	X					NEW	ACCELEROMETER	RTU0250G3	ASSIGNED BY MFG	6
			BLOWER 803 BLOW OFF VALVE			X			NEW	CONTROL VALVE	RTU0250G3	ASSIGNED BY MFG	6
			BLOWER 803 ISOLATION VALVE			X			NEW	VALVE ACTUATOR	RTU0250G3	ASSIGNED BY MFG	6
			BLOWER 803 BLWR IB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G3	ASSIGNED BY MFG	6
			BLOWER 803 BLWR OB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G3	ASSIGNED BY MFG	6
			BLOWER 803 MTR IB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G3	ASSIGNED BY MFG	6
			BLOWER 803 MTR OB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G3	ASSIGNED BY MFG	6
			BLOWER 803 START/STOP				X		EXISTING	MOTOR STARTER	RTU0250G3	ASSIGNED BY MFG	6
			BLOWER 803 RUN/FAIL		X						RTU0250G3	ASSIGNED BY MFG	6
			BLOWER 803 REMOTE		X						RTU0250G3	ASSIGNED BY MFG	6
		NEW MFG PLC CONTOL PANEL	BLOWER 804 INLET SUCTION	X					NEW	PRES SENSOR	RTU0250G4	ASSIGNED BY MFG	6
			BLOWER 804 DISCH PRES	X					NEW	PRES SENSOR	RTU0250G4	ASSIGNED BY MFG	6
			BLOWER 804 INLET AIR TEMP	X					NEW	TEMP SENSOR	RTU0250G4	ASSIGNED BY MFG	6
			BLOWER 804 DISCH AIR TEMP	X					NEW	TEMP SENSOR	RTU0250G4	ASSIGNED BY MFG	6
			BLOWER 804 LUBE OIL PRESSURE	X					NEW	PRES SENSOR	RTU0250G4	ASSIGNED BY MFG	6
			BLOWER 804 LUBE OIL SUPPLY TEMP	X					NEW	TEMP SENSOR	RTU0250G4	ASSIGNED BY MFG	6
			BLOWER 804 LUBE OIL RETURN TEMP	X					NEW	TEMP SENSOR	RTU0250G4	ASSIGNED BY MFG	6
			BLOWER 804 BLOWER VIBRATION	X					NEW	ACCELEROMETER	RTU0250G4	ASSIGNED BY MFG	6
			BLOWER 804 BLOW OFF VALVE			X			NEW	CONTROL VALVE	RTU0250G4	ASSIGNED BY MFG	6
			BLOWER 804 ISOLATION VALVE			X			NEW	VALVE ACTUATOR	RTU0250G4	ASSIGNED BY MFG	6
			BLOWER 804 BLWR IB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G4	ASSIGNED BY MFG	6
			BLOWER 804 BLWR OB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G4	ASSIGNED BY MFG	6
			BLOWER 804 MTR IB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G4	ASSIGNED BY MFG	6
			BLOWER 804 MTR OB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G4	ASSIGNED BY MFG	6
			BLOWER 804 START/STOP				X		EXISTING	MOTOR STARTER	RTU0250G4	ASSIGNED BY MFG	6
			BLOWER 804 RUN/FAIL		X						RTU0250G4	ASSIGNED BY MFG	6
			BLOWER 804 REMOTE		X						RTU0250G4	ASSIGNED BY MFG	6

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-700/800	DIGESTER BLOWERS	NEW MFG PLC CONTOL PANEL	BLOWER 811 INLET SUCTION	X					NEW	PRES SENSOR	RTU0250G11	ASSIGNED BY MFG	6
			BLOWER 811 DISCH PRES	X					NEW	PRES SENSOR	RTU0250G11	ASSIGNED BY MFG	6
			BLOWER 811 INLET AIR TEMP	X					NEW	TEMP SENSOR	RTU0250G11	ASSIGNED BY MFG	6
			BLOWER 811 DISCH AIR TEMP	X					NEW	TEMP SENSOR	RTU0250G11	ASSIGNED BY MFG	6
			BLOWER 811 LUBE OIL PRESSURE	X					NEW	PRES SENSOR	RTU0250G11	ASSIGNED BY MFG	6
			BLOWER 811 LUBE OIL SUPPLY TEMP	X					NEW	TEMP SENSOR	RTU0250G11	ASSIGNED BY MFG	6
			BLOWER 811 LUBE OIL RETURN TEMP	X					NEW	TEMP SENSOR	RTU0250G11	ASSIGNED BY MFG	6
			BLOWER 811 BLOWER VIBRATION	X					NEW	ACCELEROMETER	RTU0250G11	ASSIGNED BY MFG	6
			BLOWER 811 BLOW OFF VALVE			X			NEW	CONTROL VALVE	RTU0250G11	ASSIGNED BY MFG	6
			BLOWER 811 ISOLATION VALVE			X			NEW	VALVE ACTUATOR	RTU0250G11	ASSIGNED BY MFG	6
			BLOWER 811 BLWR IB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G11	ASSIGNED BY MFG	6
			BLOWER 811 BLWR OB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G11	ASSIGNED BY MFG	6
			BLOWER 811 MTR IB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G11	ASSIGNED BY MFG	6
			BLOWER 811 MTR OB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G11	ASSIGNED BY MFG	6
			BLOWER 811 START/STOP				X		EXISTING	MOTOR STARTER	RTU0250G11	ASSIGNED BY MFG	6
			BLOWER 811 FAST/SLOW				X				RTU0250G11	ASSIGNED BY MFG	6
			BLOWER 811 RUN/FAIL		X						RTU0250G11	ASSIGNED BY MFG	6
			BLOWER 811 FAST STATUS		X						RTU0250G11	ASSIGNED BY MFG	6
			BLOWER 811 SLOW STATUS		X						RTU0250G11	ASSIGNED BY MFG	6
			BLOWER 811 REMOTE		X						RTU0250G12	ASSIGNED BY MFG	6
		NEW MFG PLC CONTOL PANEL	BLOWER 812 INLET SUCTION	X					NEW	PRES SENSOR	RTU0250G12	ASSIGNED BY MFG	6
			BLOWER 812 DISCH PRES	X					NEW	PRES SENSOR	RTU0250G12	ASSIGNED BY MFG	6
			BLOWER 812 INLET AIR TEMP	X					NEW	TEMP SENSOR	RTU0250G12	ASSIGNED BY MFG	6
			BLOWER 812 DISCH AIR TEMP	X					NEW	TEMP SENSOR	RTU0250G12	ASSIGNED BY MFG	6
			BLOWER 812 LUBE OIL PRESSURE	X					NEW	PRES SENSOR	RTU0250G12	ASSIGNED BY MFG	6
			BLOWER 812 LUBE OIL SUPPLY TEMP	X					NEW	TEMP SENSOR	RTU0250G12	ASSIGNED BY MFG	6
			BLOWER 812 LUBE OIL RETURN TEMP	X					NEW	TEMP SENSOR	RTU0250G12	ASSIGNED BY MFG	6
			BLOWER 812 BLOWER VIBRATION	X					NEW	ACCELEROMETER	RTU0250G12	ASSIGNED BY MFG	6
			BLOWER 812 BLOW OFF VALVE			X			NEW	CONTROL VALVE	RTU0250G12	ASSIGNED BY MFG	6
			BLOWER 812 ISOLATION VALVE			X			NEW	VALVE ACTUATOR	RTU0250G12	ASSIGNED BY MFG	6
			BLOWER 812 BLWR IB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G12	ASSIGNED BY MFG	6
			BLOWER 812 BLWR OB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G12	ASSIGNED BY MFG	6
			BLOWER 812 MTR IB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G12	ASSIGNED BY MFG	6
			BLOWER 812 MTR OB BEAR TEMP	X					EXISTING	TEMP SENSOR	RTU0250G12	ASSIGNED BY MFG	6
			BLOWER 812 START/STOP				X		EXISTING	MOTOR STARTER	RTU0250G12	ASSIGNED BY MFG	6
			BLOWER 812 FAST/SLOW				X				RTU0250G12	ASSIGNED BY MFG	6
			BLOWER 812 RUN/FAIL		X						RTU0250G12	ASSIGNED BY MFG	6
			BLOWER 812 FAST STATUS		X						RTU0250G12	ASSIGNED BY MFG	6
			BLOWER 812 SLOW STATUS		X						RTU0250G12	ASSIGNED BY MFG	6
			BLOWER 812 REMOTE		X						RTU0250G12	ASSIGNED BY MFG	6

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-900	WASTE SLUDGE DEWATERING AND DISPOSAL	REPLACE EXISTING WITH NEW SIEMENS S7 PLC	BULK POLY. VOL. ALARM SET PT()			X			REMOVE	EXISTING	RTU0250H	OT0250VASP901	1
			BULK POLYMER TANK VOLUME	X					REMOVE	EXISTING	RTU0250H	IT0250VOL901	1
			DIL. POLYMER TANK 1 VOLUME	X					REMOVE	EXISTING	RTU0250H	IT0250VOL941	1
			DIL. POLYMER TANK 2 VOLUME	X					REMOVE	EXISTING	RTU0250H	IT0250VOL942	1
			POLYMER BATCH COUNTER()	X					REMOVE	EXISTING	RTU0250H	IT0250BQI900	1
			CENTRIFUDGE 1 MASS RATE()	X					REMOVE	EXISTING	RTU0250H	IT0250MI951	1
			CENTRIFUDGE 2 MASS RATE()	X					REMOVE	EXISTING	RTU0250H	IT0250MI952	1
			CENTRIFUDGE 3 MASS RATE()	X					REMOVE	EXISTING	RTU0250H	IT0250MI953	1
			CENTRIFUDGE 4 MASS RATE	X					REMOVE	EXISTING	RTU0250H	IT0250MI954	1
			CENTRATE 1 SOLIDS SET POINT()			X			REMOVE	EXISTING	RTU0250H	OT0250OSP911	1
			CENTRATE 2 SOLIDS SET POINT()			X			REMOVE	EXISTING	RTU0250H	OT0250OSP912	1
			CENTRATE 3 SOLIDS SET POINT()			X			REMOVE	EXISTING	RTU0250H	OT0250OSP913	1
			CENTRATE 4 SOLIDS SET POINT()			X			REMOVE	EXISTING	RTU0250H	OT0250OSP914	1
			CENTRIFUDGE 1 MASS SET POINT()			X			REMOVE	EXISTING	RTU0250H	OT0250MSP951	1
			CENTRIFUDGE 2 MASS SET POINT()			X			REMOVE	EXISTING	RTU0250H	OT0250MSP952	1
			CENTRIFUDGE 3 MASS SET POINT()			X			REMOVE	EXISTING	RTU0250H	OT0250MSP953	1
			CENTRIFUDGE 4 MASS SET POINT()			X			REMOVE	EXISTING	RTU0250H	OT0250MSP954	1
			POLYMER PUMP 1 FLOW - GAIN()			X			REMOVE	EXISTING	RTU0250H	OT0250GN911	1
			POLYMER PUMP 2 FLOW - GAIN()			X			REMOVE	EXISTING	RTU0250H	OT0250GN912	1
			POLYMER PUMP 3 FLOW - GAIN()			X			REMOVE	EXISTING	RTU0250H	OT0250GN913	1
			POLYMER PUMP 4 FLOW - GAIN()			X			REMOVE	EXISTING	RTU0250H	OT0250GN914	1
			CENTRATE 1 SOLIDS - GAIN()			X			REMOVE	EXISTING	RTU0250H	OT0250GN911A	1
			CENTRATE 2 SOLIDS-GAIN()			X			REMOVE	EXISTING	RTU0250H	OT0250GN912A	1
			CENTRATE 3 SOLIDS-GAIN()			X			REMOVE	EXISTING	RTU0250H	OT0250GN913A	1
			CENTRATE 4 SOLIDS-GAIN()			X			REMOVE	EXISTING	RTU0250H	OT0250GN914A	1
			CENTRIFUDGE 1 FLOW - GAIN()			X			REMOVE	EXISTING	RTU0250H	OT0250GN951	1
			CENTRIFUDGE 2 FLOW - GAIN()			X			REMOVE	EXISTING	RTU0250H	OT0250GN952	1
			CENTRIFUDGE 3 FLOW - GAIN()			X			REMOVE	EXISTING	RTU0250H	OT0250GN953	1
			CENTRIFUDGE 4 FLOW - GAIN()			X			REMOVE	EXISTING	RTU0250H	OT0250GN954	1
			CENTRIFUDGE 1 MASS - GAIN()			X			REMOVE	EXISTING	RTU0250H	OT0250GN951A	1
			CENTRIFUDGE 2 MASS - GAIN()			X			REMOVE	EXISTING	RTU0250H	OT0250GN952A	1
			CENTRIFUDGE 3 MASS - GAIN()			X			REMOVE	EXISTING	RTU0250H	OT0250GN953A	1
			CENTRIFUDGE 4 MASS - GAIN()			X			REMOVE	EXISTING	RTU0250H	OT0250GN954A	1
			POLYMER 1 FLOW - RESET()			X			REMOVE	EXISTING	RTU0250H	OT0250RS0911	1
			POLYMER 2 FLOW - RESET()			X			REMOVE	EXISTING	RTU0250H	OT0250RS0912	1
			POLYMER 3 FLOW - RESET()			X			REMOVE	EXISTING	RTU0250H	OT0250RS0913	1
			POLYMER 4 FLOW - RESET()			X			REMOVE	EXISTING	RTU0250H	OT0250RS0914	1
			CENTRATE 1 SOLIDS - RESET()			X			REMOVE	EXISTING	RTU0250H	OT0250RS911A	1
			CENTRATE 2 SOLIDS - RESET()			X			REMOVE	EXISTING	RTU0250H	OT0250RS912A	1
			CENTRATE 3 SOLIDS - RESET()			X			REMOVE	EXISTING	RTU0250H	OT0250RS913A	1

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-900	WASTE SLUDGE DEWATERING AND DISPOSAL	REPLACE EXISTING WITH NEW SIEMENS S7 PLC	CENTRATE 4 SOLIDS - RESET()			X			REMOVE	EXISTING	RTU0250H	OT0250RS914A	1
			CENTRIFUDGE 1 FLOW - RESET			X			REMOVE	EXISTING	RTU0250H	OT0250RS951	1
			CENTRIFUDGE 2 FLOW - RESET			X			REMOVE	EXISTING	RTU0250H	OT0250RS952	1
			CENTRIFUDGE 3 FLOW - RESET			X			REMOVE	EXISTING	RTU0250H	OT0250RS953	1
			CENTRIFUDGE 4 FLOW - RESET			X			REMOVE	EXISTING	RTU0250H	OT0250RS954	1
			CENTRIFUDGE 1 MASS - RESET			X			REMOVE	EXISTING	RTU0250H	OT0250RS951A	1
			CENTRIFUDGE 2 MASS - RESET			X			REMOVE	EXISTING	RTU0250H	OT0250RS952A	1
			CENTRIFUDGE 3 MASS - RESET			X			REMOVE	EXISTING	RTU0250H	OT0250RS953A	1
			CENTRIFUDGE 4 MASS - RESET			X			REMOVE	EXISTING	RTU0250H	OT0250RS954A	1
			POLY. PUMP #1 SPEED CONTROL			X			REMOVE	EXISTING	RTU0250H	OT0250SC911	1
			POLY. PUMP #2 SPEED CONTROL			X			REMOVE	EXISTING	RTU0250H	OT0250SC912	1
			POLY. PUMP #3 SPEED CONTROL			X			REMOVE	EXISTING	RTU0250H	OT0250SC913	1
			POLY. PUMP #4 SPEED CONTROL			X			REMOVE	EXISTING	RTU0250H	OT0250SC914	1
			CENTRIF. PUMP #1 SPEED CONTRO			X			REMOVE	EXISTING	RTU0250H	OT0250SC951	1
			CENTRIF. PUMP #2 SPEED CONTRO			X			REMOVE	EXISTING	RTU0250H	OT0250SC952	1
			CENTRIF. PUMP #3 SPEED CONTRO			X			REMOVE	EXISTING	RTU0250H	OT0250SC953	1
			CENTRIF. PUMP #4 SPEED CONTRO			X			REMOVE	EXISTING	RTU0250H	OT0250SC954	1
			CENTRIF. DRIVE 1 SPEED CONTRO			X			REMOVE	EXISTING	RTU0250H	OT0250SC961	1
			CENTRIF. DRIVE 2 SPEED CONTRO			X			REMOVE	EXISTING	RTU0250H	OT0250SC962	1
			CENTRIF. DRIVE 3 SPEED CONTRO			X			REMOVE	EXISTING	RTU0250H	OT0250SC963	1
			CENTRIF. DRIVE 4 SPEED CONTRO			X			REMOVE	EXISTING	RTU0250H	OT0250SC964	1
			CENTRIF. DRIVE 1 TORQUE CONTR			X			REMOVE	EXISTING	RTU0250H	OT0250NC961	1
			CENTRIF. DRIVE 2 TORQUE CONTR			X			REMOVE	EXISTING	RTU0250H	OT0250NC962	1
			CENTRIF. DRIVE 3 TORQUE CONTR			X			REMOVE	EXISTING	RTU0250H	OT0250NC963	1
			CENTRIF. DRIVE 4 TORQUE CONTR			X			REMOVE	EXISTING	RTU0250H	OT0250NC964	1
			SLUDGE RECEIVING STA. FLOW	X					REMOVE	EXISTING	RTU0250H	XT0250FIT740	1
			BULK POLYMER STORAGE TANK #1	X					REMOVE	EXISTING	RTU0250H	IT0250LI901	1
			SLUDGE FEED TANK #1 LEVEL	X					REMOVE	EXISTING	RTU0250H	IT0250LI906	1
			POLYMER DAY TANK #1 LEVEL	X					REMOVE	EXISTING	RTU0250H	IT0250LI941	1
			POLYMER DAY TANK #2 LEVEL	X					REMOVE	EXISTING	RTU0250H	IT0250LI942	1
			SLUDGE RECEIVING STA. LEVEL	X					REMOVE	EXISTING	RTU0250H	XT0250LIT740	1
			CENTRIFUDGE #1 MOTOR CURRENT	X					REMOVE	EXISTING	RTU0250H	IT0250II961	1
			CENTRIFUDGE #2 MOTOR CURRENT	X					REMOVE	EXISTING	RTU0250H	IT0250II962	1
			CENTRIFUDGE #3 MOTOR CURRENT	X					REMOVE	EXISTING	RTU0250H	IT0250II963	1
			CENTRIFUDGE #4 MOTOR CURRENT	X					REMOVE	EXISTING	RTU0250H	IT0250II964	1
			CENTRIFUDGE #1 DRIVE TORQUE	X					REMOVE	EXISTING	RTU0250H	IT0250NI961	1
			CENTRIFUDGE #2 DRIVE TORQUE	X					REMOVE	EXISTING	RTU0250H	IT0250NI962	1
			CENTRIFUDGE #3 DRIVE TORQUE	X					REMOVE	EXISTING	RTU0250H	IT0250NI963	1
			CENTRIFUDGE #4 DRIVE TORQUE	X					REMOVE	EXISTING	RTU0250H	IT0250NI964	1
			POLYMER FEED TO CENTRIFUGE #1	X					REMOVE	EXISTING	RTU0250H	IT0250FI911	1

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-900	WASTE SLUDGE DEWATERING AND DISPOSAL	REPLACE EXISTING WITH NEW SIEMENS S7 PLC	POLYMER FEED TO CENTRIFUGE #2	X					REMOVE	EXISTING	RTU0250H	IT0250FI912	1
			POLYMER FEED TO CENTRIFUGE #3	X					REMOVE	EXISTING	RTU0250H	IT0250FI913	1
			POLYMER FEED TO CENTRIFUGE #4	X					REMOVE	EXISTING	RTU0250H	IT0250FI914	1
			CENTRIFUDGE #1 FEEDRATE	X					REMOVE	EXISTING	RTU0250H	IT0250FI951	1
			CENTRIFUDGE #2 FEEDRATE	X					REMOVE	EXISTING	RTU0250H	IT0250FI952	1
			CENTRIFUDGE #3 FEEDRATE	X					REMOVE	EXISTING	RTU0250H	IT0250FI953	1
			CENTRIFUDGE #4 FEEDRATE	X					REMOVE	EXISTING	RTU0250H	IT0250FI954	1
			CENTRIFUDGE FEED #1 S. SOLIDS	X					REMOVE	EXISTING	RTU0250H	IT0250OI951	1
			CENTRIFUDGE FEED #2 S. SOLIDS	X					REMOVE	EXISTING	RTU0250H	IT0250OI952	1
			CENTRIFUDGE FEED #3 S. SOLIDS	X					REMOVE	EXISTING	RTU0250H	IT0250OI953	1
			CENTRIFUDGE FEED #4 S. SOLIDS	X					REMOVE	EXISTING	RTU0250H	IT0250OI954	1
			CENTR. 1 CENTRATE SOLIDS	X					REMOVE	EXISTING	RTU0250H	IT0250OI961	1
			CENTR. 2 CENTRATE SOLIDS	X					REMOVE	EXISTING	RTU0250H	IT0250OI962	1
			CENTR. 3 CENTRATE SOLIDS	X					REMOVE	EXISTING	RTU0250H	IT0250OI963	1
			CENTR. 4 CENTRATE SOLIDS	X					REMOVE	EXISTING	RTU0250H	IT0250OI964	1
			POLYMER FEED PUMP #1 SPEED	X					REMOVE	EXISTING	RTU0250H	IT0250SI911	1
			POLYMER FEED PUMP #2 SPEED	X					REMOVE	EXISTING	RTU0250H	IT0250SI912	1
			POLYMER FEED PUMP #3 SPEED	X					REMOVE	EXISTING	RTU0250H	IT0250SI913	1
			POLYMER FEED PUMP #4 SPEED	X					REMOVE	EXISTING	RTU0250H	IT0250SI914	1
			CENTRIFUDGE FEED PUMP #1 SPEE	X					REMOVE	EXISTING	RTU0250H	IT0250SI951	1
			CENTRIFUDGE FEED PUMP #2 SPEE	X					REMOVE	EXISTING	RTU0250H	IT0250SI952	1
			CENTRIFUDGE FEED PUMP #3 SPEE	X					REMOVE	EXISTING	RTU0250H	IT0250SI953	1
			CENTRIFUDGE FEED PUMP #4 SPEE	X					REMOVE	EXISTING	RTU0250H	IT0250SI954	1
			CENTRIFUDGE #1 DRIVE SPEED	X					REMOVE	EXISTING	RTU0250H	IT0250SI961	1
			CENTRIFUDGE #2 DRIVE SPEED	X					REMOVE	EXISTING	RTU0250H	IT0250SI962	1
			CENTRIFUDGE #3 DRIVE SPEED	X					REMOVE	EXISTING	RTU0250H	IT0250SI963	1
			CENTRIFUDGE #4 DRIVE SPEED	X					REMOVE	EXISTING	RTU0250H	IT0250SI964	1
			SLUDGE CAKE PUMP #1 SPEED	X					REMOVE	EXISTING	RTU0250H	IT0250SI965	1
			SLUDGE CAKE PUMP #2 SPEED	X					REMOVE	EXISTING	RTU0250H	IT0250SI966	1
			SLUDGE CAKE PUMP #3 SPEED	X					REMOVE	EXISTING	RTU0250H	IT0250SI967	1
			SLUDGE CAKE PUMP #1 SPEED	X					REMOVE	EXISTING	RTU0250H	IT0250SI968	1
			BULK POLY. STO. TANK #2 LEVEL	X					REMOVE	EXISTING	RTU0250H	IT0250LI902	1
			POLYMER DAY TANK #3 LEVEL	X					REMOVE	EXISTING	RTU0250H	IT0250LI943	1
			POLYMER DAY TANK #4 LEVEL	X					REMOVE	EXISTING	RTU0250H	IT0250LI944	1

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC-900	WASTE SLUDGE DEWATERING AND DISPOSAL	REPLACE EXISTING WITH NEW SIEMENS S7 PLC	CONC POLY TANK LEVEL	X					NEW	LEVEL SENSOR	RTU0250H	IT0250LT900	7
			CONC POLY PUMP #1 STATUS		X				EXISTING	MOTOR STARTER	RTU0250H	XT0250YY901	7
			CONC POLY PUMP #2 STATUS		X						RTU0250H	XT0250YY902	7
			CONC POLY #1 FLOW RATE	X					NEW	FLOW METER	RTU0250H	IT0250FT903	7
			CONC POLY #1 FLOW VOLUME		X						RTU0250H	XT0250FG904	7
			CONC POLY #2 FLOW RATE	X					NEW	FLOW METER	RTU0250H	IT0250FT905	7
			CONC POLY #2 FLOW VOLUME		X						RTU0250H	XT0250FG906	7
			DIL POLY #1 TANK LEVEL	X					NEW	LEVEL SENSOR	RTU0250H	IT0250LT907	7
			DIL POLY #1 TANK HI ALARM		X				NEW	LEVEL SWITCH	RTU0250H	XT0250LAH908	7
			DIL POLY #1 TANK LO ALARM		X				NEW	LEVEL SWITCH	RTU0250H	XT0250LAL909	7
			DIL POLY #2 TANK LEVEL	X					NEW	LEVEL SENSOR	RTU0250H	IT0250LT910	7
			DIL POLY #2 TANK HI ALARM		X				NEW	LEVEL SWITCH	RTU0250H	XT0250LAH911	7
			DIL POLY #2 TANK LO ALARM		X				NEW	LEVEL SWITCH	RTU0250H	XT0250LAL912	7
			DIL POLY PUMP #1 STATUS		X				EXISTING	VARIABLE SPEED DRIVE	RTU0250H	XT0250YY913	7
			DIL POLY PUMP #1 START/STOP				X				RTU0250H	YT0250YZ914	7
			DIL POLY PUMP #1 LOCAL/REMOTE		X						RTU0250H	XT0250HS915	7
			DIL POLY PUMP #1 SPEED SETPOINT			X					RTU0250H	OT0250SZ916	7
			DIL POLY PUMP #1 SPEED FEEDBACK	X							RTU0250H	IT0250SI917	7
			DIL POLY PUMP #1 FAULT		X						RTU0250H	XT0250YA918	7
			DIL POLY PUMP #2 STATUS		X				EXISTING	VARIABLE SPEED DRIVE	RTU0250H	XT0250YY919	7
			DIL POLY PUMP #2 START/STOP				X				RTU0250H	YT0250YZ920	7
			DIL POLY PUMP #2 LOCAL/REMOTE		X						RTU0250H	XT0250HS921	7
			DIL POLY PUMP #2 SPEED SETPOINT			X					RTU0250H	OT0250SZ922	7
			DIL POLY PUMP #2 SPEED FEEDBACK	X							RTU0250H	IT0250SI923	7
			DIL POLY PUMP #2 FAULT		X						RTU0250H	XT0250YA924	7
			DIL POLY PUMP #3 STATUS		X				EXISTING	VARIABLE SPEED DRIVE	RTU0250H	XT0250YY925	7
			DIL POLY PUMP #3 START/STOP				X				RTU0250H	YT0250YZ926	7
			DIL POLY PUMP #3 LOCAL/REMOTE		X						RTU0250H	XT0250HS927	7
			DIL POLY PUMP #3 SPEED SETPOINT			X					RTU0250H	OT0250SZ928	7
			DIL POLY PUMP #3 SPEED FEEDBACK	X							RTU0250H	IT0250SI929	7
			DIL POLY PUMP #3 FAULT		X						RTU0250H	XT0250YA930	7
			DIL POLY PUMP #4 STATUS		X				EXISTING	VARIABLE SPEED DRIVE	RTU0250H	XT0250YY931	7
			DIL POLY PUMP #4 START/STOP				X				RTU0250H	YT0250YZ932	7
			DIL POLY PUMP #4 LOCAL/REMOTE		X						RTU0250H	XT0250HS933	7
			DIL POLY PUMP #4 SPEED SETPOINT			X					RTU0250H	OT0250SZ934	7
			DIL POLY PUMP #4 SPEED FEEDBACK	X							RTU0250H	IT0250SI935	7
			DIL POLY PUMP #4 FAULT		X						RTU0250H	XT0250YA936	7
			SLUDGE XFER PUMP #1 STATUS		X				EXISTING	VARIABLE SPEED DRIVE	RTU0250H	XT0250YY937	7
			SLUDGE XFER PUMP #1 SPEED	X							RTU0250H	IT0250SI938	7
			SLUDGE XFER PUMP #1 FAULT		X						RTU0250H	XT0250YA939	7

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
LPC9	WASTE SLUDGE DEWATERING AND DISPOSAL	REPLACE EXISTING WITH NEW SIEMENS S7 PLC	SLUDGE XFER PUMP #1 FLOW RATE	X					NEW	FLOW METER	RTU0250H	IT0250FT940	7
			SLUDGE XFER PUMP #1 FLOW VOLUME		X						RTU0250H	XT0250FQ941	7
			SLUDGE XFER PUMP #2 STATUS		X				EXISTING	VARIABLE SPEED DRIVE	RTU0250H	XT0250YY942	7
			SLUDGE XFER PUMP #2 SPEED	X							RTU0250H	IT0250SI943	7
			SLUDGE XFER PUMP #2 FAULT		X						RTU0250H	XT0250YA944	7
			SLUDGE XFER PUMP #2 FLOW RATE	X					NEW	FLOW METER	RTU0250H	IT0250FT945	7
			SLUDGE XFER PUMP #2 FLOW VOLUME		X						RTU0250H	XT0250FQ946	7
			SLUDGE XFER PUMP #3 STATUS		X				EXISTING	VARIABLE SPEED DRIVE	RTU0250H	XT0250YY947	7
			SLUDGE XFER PUMP #3 SPEED	X							RTU0250H	IT0250SI948	7
			SLUDGE XFER PUMP #3 FAULT		X						RTU0250H	XT0250YA949	7
			SLUDGE XFER PUMP #3 FLOW RATE	X					NEW	FLOW METER	RTU0250H	IT0250FT950	7
			SLUDGE XFER PUMP #3 FLOW VOLUME		X						RTU0250H	XT0250FQ951	7
			SLUDGE XFER PUMP #4 STATUS		X				EXISTING	VARIABLE SPEED DRIVE	RTU0250H	XT0250YY952	7
			SLUDGE XFER PUMP #4 SPEED	X							RTU0250H	IT0250SI953	7
			SLUDGE XFER PUMP #4 FAULT		X						RTU0250H	XT0250YA954	7
			SLUDGE XFER PUMP #4 FLOW RATE	X					NEW	FLOW METER	RTU0250H	IT0250FT955	7
			SLUDGE XFER PUMP #4 FLOW VOLUME		X						RTU0250H	XT0250FQ956	7
			BELT PRESS #1 STATUS		X				EXISTING	LOCAL CONTROL PANEL	RTU0250H	XT0250YY957	7
			BELT PRESS #1 SPEED	X							RTU0250H	IT0250SI958	7
			BELT PRESS #1 E-STOP STATUS		X						RTU0250H	XT0250YA959	7
			BELT PRESS #1 OIL PRES	X					NEW	PRESSURE TRANSDUCER	RTU0250H	IT0250PT960	7
			BELT PRESS #1 WATER PRES	X					NEW	PRESSURE TRANSDUCER	RTU0250H	IT0250PT961	7
			BELT PRESS #2 STATUS		X				EXISTING	LOCAL CONTROL PANEL	RTU0250H	XT0250YY962	7
			BELT PRESS #2 SPEED	X							RTU0250H	IT0250SI963	7
			BELT PRESS #2 E-STOP STATUS		X						RTU0250H	XT0250YA964	7
			BELT PRESS #2 OIL PRES	X					NEW	PRESSURE TRANSDUCER	RTU0250H	IT0250PT965	7
			BELT PRESS #2 WATER PRES	X					NEW	PRESSURE TRANSDUCER	RTU0250H	IT0250PT966	7
			BELT PRESS #3 STATUS		X				EXISTING	LOCAL CONTROL PANEL	RTU0250H	XT0250YY967	7
			BELT PRESS #3 SPEED	X							RTU0250H	IT0250SI968	7
			BELT PRESS #3 E-STOP STATUS		X						RTU0250H	XT0250YA969	7
			BELT PRESS #3 OIL PRES	X					NEW	PRESSURE TRANSDUCER	RTU0250H	IT0250PT970	7
			BELT PRESS #3 WATER PRES	X					NEW	PRESSURE TRANSDUCER	RTU0250H	IT0250PT971	7

NOTES:

1. DEMOLISH EXISTING FIELD DEVICE, WIRING, & RACEWAY. DELETE SOFTWARE POINT ASSIGNMENT & ASSOCIATED SOFTWARE PROGRAMMING. DELETE POINT FROM SCADA USER INTERFACE.
2. REUSE EXISTING FIELD DEVICE, WIRING, AND RACEWAY. RECONNECT EXISTING WIRING TO NEW PLC I/O, REPROGRAM USING ASSIGNED POINT NAME, RETAIN EXISTING FUNCTIONALITY AND SCADA USER INTERFACE. TEST & COMMISSION.
3. PROVIDE NEW OR REPLACEMENT FIELD DEVICE, WIRING, AND RACEWAY AS INDICATED. CONNECT TO NEW PLC I/O, PROGRAM USING ASSIGNED POINT NAME AND INTEGRATE CONTROL AND MONITORING INTO SCADA USER INTERFACE. TEST & COMMISSION.

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	POINT NAME	
4. PROVIDE NEW FIELD DEVICE WITH GRIT SYSTEM EQUIPMENT PACKAGE, FACTORY PRE-WIRED OR FIELD WIRED WITH NEW RACEWAY. ASSIGN POINT NAME AS INDICATED AND INTEGRATE MONITORING AND CONTROL FUNCTIONALITY INTO SCADA USER INTERFACE. TEST & COMMISSION.													
5. PROVIDE NEW WIRING AND RACEWAY CONNECTION TO MFG'S REPLACEMENT CONTROL PANEL. CONNECT NEW WIRING TO NEW PLC I/O, REPROGRAM USING ASSIGNED POINT NAME, RETAIN EXISTING OR PROVIDE NEW SOFTWARE PROGRAMMING AS REQUIRED. INTEGRATE CONTROL AND MONITORING INTO SCADA USER INTERFACE. TEST & COMMISSION.													
6. REPLACE EXITING BLOWER MANUFACTURER'S CONTROL PANEL WITH MANUFACTURER'S NEW PLC CONTROL PANEL. REPLACE FIELD DEVICES (BY BLOWER MANUFACTORER) AS INDICATED. ASSIGN POINT NAME AS INDICATED AND INTEGRATE MONITORING AND CONTROL FUNCTIONALITY INTO SCADA USER INTERFACE. TEST & COMMISSION.													
7. PROVIDE NEW OR REPLACEMENT FIELD DEVICE OR REUSE EXISTING FIELD DEVICE AS INDICATED. PROVIDE NEW WIRING AND RACEWAY TO NEW PLC CONTROL CABINET. CONNECT TO NEW PLC I/O, PROGRAM USING ASSIGNED POINT NAME AND INTEGRATE CONTROL AND MONITORING INTO SCADA USER INTERFACE. TEST & COMMISSION.													

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	EXISTING POINT NAME	
LPC-300	AIR SUPPLY (NEW)	NEW SIEMENS S7-315-2NP/DP	CPU HEALTH ALARM				X		NEW	AV ALARM DEVICE	NEW 240D	NEW	3
			BLOWER #1 RUN STATUS		X				NEW	MOTOR STARTER	NEW 240D	XT0240MY801	3
			BLOWER #1 ALARM		X				NEW	MOTOR STARTER	NEW 240D	XT0240MA801	3
			BLOWER #1 FAULT		X				NEW	MOTOR STARTER	NEW 240D	XT0240MSA801	3
			BLOWER #2 RUN STATUS		X				NEW	MOTOR STARTER	NEW 240D	XT0240MY802	3
			BLOWER #2 ALARM		X				NEW	MOTOR STARTER	NEW 240D	XT0240MA802	3
			BLOWER #2 FAULT		X				NEW	MOTOR STARTER	NEW 240D	XT0240MSA802	3
			BLOWER #3 RUN STATUS		X				NEW	MOTOR STARTER	NEW 240D	XT0240MY803	3
			BLOWER #3 ALARM		X				NEW	MOTOR STARTER	NEW 240D	XT0240MA803	3
			BLOWER #3 FAULT		X				NEW	MOTOR STARTER	NEW 240D	XT0240MSA803	3
	AERATION (NEW)		AERATOR #1 VSD START				X		NEW	VARIABLE SPEED DRIVE	NEW 240D	YT0240MMH301	3
			AERATOR #1 VSD STOP				X				NEW 240D	YT0240MML301	3
			AERATOR #1 VSD BYPASS MODE STATUS		X						NEW 240D	XT0240MSY301	3
			AERATOR #1 VSD SPEED CONTROL MODE STATUS		X						NEW 240D	XT0240SCY301	3
			AERATOR #1 VSD SPEED CONTROL			X					NEW 240D	OT0240SZ301	3
			AERATOR #1 VSD MOTOR SPEED	X							NEW 240D	IT0240SI301	3
			AERATOR #1 VSD FAULT		X						NEW 240D	XT0240MA301	3
			AERATOR #1 MOTOR RUN STATUS		X				NEW	CURRENT SWITCH	NEW 240D	XT0240MY301	3
			AERATOR #1 MOTOR RUN TIME					X			NEW 240D	QT0240MQ301	5
			AERATOR #1 DO CONCENTRATION	X					NEW	DO SENSOR	NEW 240D	IT0240AI301	3
			AERATOR #1 DO SENSOR FAULT		X						NEW 240D	XT0240AA301	3
			AERATOR #1 DO SETPOINT					X			NEW 240D	QT0240AC301	5
			AERATOR #1 LOW OIL PRES		X				NEW	PRESSURE SWITCH	NEW 240D	XT0240PSL301	3
			AERATOR #2 VSD START				X		NEW	VARIABLE SPEED DRIVE	NEW 240D	YT0240MMH302	3
			AERATOR #2 VSD STOP				X				NEW 240D	YT0240MML302	3
			AERATOR #2 VSD BYPASS MODE STATUS		X						NEW 240D	XT0240MSY302	3
			AERATOR #2 VSD SPEED CONTROL MODE STATUS		X						NEW 240D	XT0240SCY302	3
			AERATOR #2 VSD SPEED CONTROL			X					NEW 240D	OT0240SZ302	3
			AERATOR #2 VSD MOTOR SPEED	X							NEW 240D	IT0240SI302	3
			AERATOR #2 VSD FAULT		X						NEW 240D	XT0240MA302	3
			AERATOR #2 MOTOR RUN STATUS		X				NEW	CURRENT SWITCH	NEW 240D	XT0240MY302	3
			AERATOR #2 MOTOR RUN TIME					X			NEW 240D	QT0240MQ302	5
			AERATOR #2 DO CONCENTRATION	X					NEW	DO SENSOR	NEW 240D	IT0240AI302	3
			AERATOR #2 DO SENSOR FAULT		X						NEW 240D	XT0240AA302	3
			AERATOR #2 DO SETPOINT					X			NEW 240D	QT0240AC302	5
			AERATOR #2 LOW OIL PRES		X				NEW	PRESSURE SWITCH	NEW 240D	XT0240PSL302	3

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	EXISTING POINT NAME	
LPC-300	AERATION (NEW)	NEW SIEMENS S7-315-2NP/DP	AERATOR #3 VSD START				X		NEW	VARIABLE SPEED DRIVE	NEW 240D	YT0240MMH303	3
			AERATOR #3 VSD STOP				X				NEW 240D	YT0240MML303	3
			AERATOR #3 VSD BYPASS MODE STATUS		X						NEW 240D	XT0240MSY303	3
			AERATOR #3 VSD SPEED CONTROL MODE STATUS		X						NEW 240D	XT0240SCY303	3
			AERATOR #3 VSD SPEED CONTROL			X					NEW 240D	OT0240SZ303	3
			AERATOR #3 VSD MOTOR SPEED	X							NEW 240D	IT0240SI303	3
			AERATOR #3 VSD FAULT		X						NEW 240D	XT0240MA303	3
			AERATOR #3 MOTOR RUN STATUS		X				NEW	CURRENT SWITCH	NEW 240D	XT0240MY303	3
			AERATOR #3 MOTOR RUN TIME					X			NEW 240D	QT0240MQ303	5
			AERATOR #3 DO CONCENTRATION	X					NEW	DO SENSOR	NEW 240D	IT0240AI303	3
			AERATOR #3 DO SENSOR FAULT		X						NEW 240D	XT0240AA303	3
			AERATOR #3 DO SETPOINT					X			NEW 240D	QT0240AC303	5
			AERATOR #3 LOW OIL PRES		X				NEW	PRESSURE SWITCH	NEW 240D	XT0240PSL303	3
			AERATOR #4 VSD START				X		NEW	VARIABLE SPEED DRIVE	NEW 240D	YT0240MMH304	3
			AERATOR #4 VSD STOP				X				NEW 240D	YT0240MML304	3
			AERATOR #4 VSD BYPASS MODE STATUS		X						NEW 240D	XT0240MSY304	3
			AERATOR #4 VSD SPEED CONTROL MODE STATUS		X						NEW 240D	XT0240SCY304	3
			AERATOR #4 VSD SPEED CONTROL			X					NEW 240D	OT0240SZ304	3
			AERATOR #4 VSD MOTOR SPEED	X							NEW 240D	IT0240SI304	3
			AERATOR #4 VSD FAULT		X						NEW 240D	XT0240MA304	3
			AERATOR #4 MOTOR RUN STATUS		X				NEW	CURRENT SWITCH	NEW 240D	XT0240MY304	3
			AERATOR #4 MOTOR RUN TIME					X			NEW 240D	QT0240MQ304	5
			AERATOR #4 DO CONCENTRATION	X					NEW	DO SENSOR	NEW 240D	IT0240AI304	3
			AERATOR #4 DO SENSOR FAULT		X						NEW 240D	XT0240AA304	3
			AERATOR #4 DO SETPOINT					X			NEW 240D	QT0240AC304	5
			AERATOR #4 LOW OIL PRES		X				NEW	PRESSURE SWITCH	NEW 240D	XT0240PSL304	3
			AERATOR #5 VSD START				X		NEW	VARIABLE SPEED DRIVE	NEW 240D	YT0240MMH305	3
			AERATOR #5 VSD STOP				X				NEW 240D	YT0240MML305	3
			AERATOR #5 VSD BYPASS MODE STATUS		X						NEW 240D	XT0240MSY305	3
			AERATOR #5 VSD SPEED CONTROL MODE STATUS		X						NEW 240D	XT0240SCY305	3
			AERATOR #5 VSD SPEED CONTROL			X					NEW 240D	OT0240SZ305	3
			AERATOR #5 VSD MOTOR SPEED	X							NEW 240D	IT0240SI305	3
			AERATOR #5 VSD FAULT		X						NEW 240D	XT0240MA305	3
			AERATOR #5 MOTOR RUN STATUS		X				NEW	CURRENT SWITCH	NEW 240D	XT0240MY305	3
			AERATOR #5 MOTOR RUN TIME					X			NEW 240D	QT0240MQ305	5
			AERATOR #5 DO CONCENTRATION	X					NEW	DO SENSOR	NEW 240D	IT0240AI305	3
			AERATOR #5 DO SENSOR FAULT		X						NEW 240D	XT0240AA305	3
			AERATOR #5 DO SETPOINT					X			NEW 240D	QT0240AC305	5
			AERATOR #5 LOW OIL PRES		X				NEW	PRESSURE SWITCH	NEW 240D	XT0240PSL305	3

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	EXISTING POINT NAME	
LPC-300	AERATION (NEW)	NEW SIEMENS S7-315-2NP/DP	AERATOR #6 VSD START				X		NEW	VARIABLE SPEED DRIVE	NEW 240D	YT0240MMH306	3
			AERATOR #6 VSD STOP				X				NEW 240D	YT0240MML306	3
			AERATOR #6 VSD BYPASS MODE STATUS		X						NEW 240D	XT0240MSY306	3
			AERATOR #6 VSD SPEED CONTROL MODE STATUS		X						NEW 240D	XT0240SCY306	3
			AERATOR #6 VSD SPEED CONTROL			X					NEW 240D	OT0240SZ306	3
			AERATOR #6 VSD MOTOR SPEED	X							NEW 240D	IT0240SI306	3
			AERATOR #6 VSD FAULT		X						NEW 240D	XT0240MA306	3
			AERATOR #6 MOTOR RUN STATUS		X				NEW	CURRENT SWITCH	NEW 240D	XT0240MY306	3
			AERATOR #6 MOTOR RUN TIME					X			NEW 240D	QT0240MQ306	5
			AERATOR #6 DO CONCENTRATION	X					NEW	DO SENSOR	NEW 240D	IT0240AI306	3
			AERATOR #6 DO SENSOR FAULT		X						NEW 240D	XT0240AA306	3
			AERATOR #6 DO SETPOINT					X			NEW 240D	QT0240AC306	5
			AERATOR #6 LOW OIL PRES		X				NEW	PRESSURE SWITCH	NEW 240D	XT0240PSL306	3
			AERATOR #7 VSD START				X		NEW	VARIABLE SPEED DRIVE	NEW 240D	YT0240MMH307	3
			AERATOR #7 VSD STOP				X				NEW 240D	YT0240MML307	3
			AERATOR #7 VSD BYPASS MODE STATUS		X						NEW 240D	XT0240MSY307	3
			AERATOR #7 VSD SPEED CONTROL MODE STATUS		X						NEW 240D	XT0240SCY307	3
			AERATOR #7 VSD SPEED CONTROL			X					NEW 240D	OT0240SZ307	3
			AERATOR #7 VSD MOTOR SPEED	X							NEW 240D	IT0240SI307	3
			AERATOR #7 VSD FAULT		X						NEW 240D	XT0240MA307	3
			AERATOR #7 MOTOR RUN STATUS		X				NEW	CURRENT SWITCH	NEW 240D	XT0240MY307	3
			AERATOR #7 MOTOR RUN TIME					X			NEW 240D	QT0240MQ307	5
			AERATOR #7 DO CONCENTRATION	X					NEW	DO SENSOR	NEW 240D	IT0240AI307	3
			AERATOR #7 DO SENSOR FAULT		X						NEW 240D	XT0240AA307	3
			AERATOR #7 DO SETPOINT					X			NEW 240D	QT0240AC307	5
			AERATOR #7 LOW OIL PRES		X				NEW	PRESSURE SWITCH	NEW 240D	XT0240PSL307	3
			AERATOR #8 VSD START				X		NEW	VARIABLE SPEED DRIVE	NEW 240D	YT0240MMH308	3
			AERATOR #8 VSD STOP				X				NEW 240D	YT0240MML308	3
			AERATOR #8 VSD BYPASS MODE STATUS		X						NEW 240D	XT0240MSY308	3
			AERATOR #8 VSD SPEED CONTROL MODE STATUS		X						NEW 240D	XT0240SCY308	3
			AERATOR #8 VSD SPEED CONTROL			X					NEW 240D	OT0240SZ308	3
			AERATOR #8 VSD MOTOR SPEED	X							NEW 240D	IT0240SI308	3
			AERATOR #8 VSD FAULT		X						NEW 240D	XT0240MA308	3
			AERATOR #8 MOTOR RUN STATUS		X				NEW	CURRENT SWITCH	NEW 240D	XT0240MY308	3
			AERATOR #8 MOTOR RUN TIME					X			NEW 240D	QT0240MQ308	5
			AERATOR #8 DO CONCENTRATION	X					NEW	DO SENSOR	NEW 240D	IT0240AI308	3
			AERATOR #8 DO SENSOR FAULT		X						NEW 240D	XT0240AA308	3
			AERATOR #8 DO SETPOINT					X			NEW 240D	QT0240AC308	5
			AERATOR #8 LOW OIL PRES		X				NEW	PRESSURE SWITCH	NEW 240D	XT0240PSL308	3

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	EXISTING POINT NAME	
LPC-300	CLARIFIERS	NEW SIEMENS S7-315	CLARIFIER #1 INLET LIFT GATE POSITION OPEN				X		NEW	VALVE ACTUATOR	NEW 240D	YT0240ZH391	3
			CLARIFIER #1 INLET LIFT GATE POSITION CLOSED				X		NEW	VALVE ACTUATOR	NEW 240D	YT0240ZL391	3
			CLARIFIER #2 INLET LIFT GATE POSITION OPEN				X		NEW	VALVE ACTUATOR	NEW 240D	YT0240ZH392	3
			CLARIFIER #2 INLET LIFT GATE POSITION CLOSED				X		NEW	VALVE ACTUATOR	NEW 240D	YT0240ZL392	3
			CLARIFIER #3 INLET LIFT GATE POSITION OPEN				X		NEW	VALVE ACTUATOR	NEW 240D	YT0240ZH393	3
			CLARIFIER #3 INLET LIFT GATE POSITION CLOSED				X		NEW	VALVE ACTUATOR	NEW 240D	YT0240ZL393	3
	SCUM SEP		SCUM SUMP HI LEVEL ALARM		X				NEW	LEVEL SWITCH	NEW 240D	XT0240LAH460	3
			SCUM PUMP #1 RUN STATUS		X				NEW	MOTOR STARTER	NEW 240D	XT0240MY461	3
			SCUM PUMP #1 FAULT ALARM		X				NEW	MOTOR STARTER	NEW 240D	XT0240MA461	3
			SCUM PUMP #2 RUN STATUS		X				NEW	MOTOR STARTER	NEW 240D	XT0240MY462	3
			SCUM PUMP #2 FAULT ALARM		X				NEW	MOTOR STARTER	NEW 240D	XT0240MA462	3
	AIR SUPPLY (EXISTING)	EXISTING SIEMENS TI 545	BLOWER #1 STATUS		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240DYN301	1
			BLOWER #1 PHASE UNBALANCE		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240EDS301	1
			BLOWER #2 STATUS		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240DYN302	1
			BLOWER #2 PHASE UNBALANCE		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240EDS302	1
			BLOWER #3 STATUS		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240DYN303	1
			BLOWER #3 PHASE UNBALANCE		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240EDS303	1
	AERATION (EXISTING)		AERATOR #1 STATUS		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240DYN331	1
			AERATOR #1 ALARM		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240UA331	1
			AERATOR #2 STATUS		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240DYN332	1
			AERATOR #2 ALARM		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240UA332	1
			AERATOR #3 STATUS		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240DYN333	1
			AERATOR #3 ALARM		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240UA333	1
			AERATOR #4 STATUS		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240DYN334	1
			AERATOR #4 ALARM		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240UA334	1
			AERATOR #5 STATUS		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240DYN335	1
			AERATOR #5 ALARM		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240UA335	1
			AERATOR #6 STATUS		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240DYN336	1
			AERATOR #6 ALARM		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240UA336	1
			AERATOR #7 STATUS		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240DYN337	1
			AERATOR #7 ALARM		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240UA337	1
			AERATOR #8 STATUS		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240DYN338	1
			AERATOR #8 ALARM		X				EXISTING	MOTOR STARTER	rtu0240A	XT0240UA338	1

LPC GROUP	PROCESS	PLC	POINT DESCRIPTION	POINT TYPE					FIELD DEVICE		POINT IDENTIFICATION		NOTES
				AI	DI	AO	DO	SW		TYPE	RTU	EXISTING POINT NAME	
LPC-500	EFFLUENT TREATMENT	EXISTING SIEMENS TI 545	PLC TIME RESET 0:00AM			X					rtu0240B	XT0240_TIME_RST	2
			BLEACH FEED #1			X					rtu0240B	OT0240DD511	2
			BLEACH FEED #2			X					rtu0240B	OT0240DD512	2
			SODIUM BISULFITE FEED #1			X			NEW	METERING PUMP	rtu0240B	OT0240DD521	4
			SODIUM BISULFITE FEED #2			X			NEW	METERING PUMP	rtu0240B	OT0240DD522	4
			SODIUM BISULFITE TANK #1 LEVEL	X					NEW	LEVEL SENSOR	rtu0240B	IT0240LT521	3
			SODIUM BISULFITE TANK #2 LEVEL	X					NEW	LEVEL SENSOR	rtu0240B	IT0240LT522	3
			PREWEIR GREENRIDGE (30 MIN. ALARM)			X					rtu0240B	XT0240AIT501A	2
			POSTWEIR	X							rtu0240B	IT0240AIT502A	2
			MIXPOINT	X							rtu0240B	IT0240AIT503A	2
			PREWEIR	X							rtu0240B	IT0240AIT501A	2
			PREWEIR (SPARE)	X							rtu0240B	IT0240AIT501Z	2
LPC-600	DISCHARGE		EFFLUENT FLOW	X							rtu0240B	IT0240FIT601A	2
			GR TP: EFF.FLOW-COUNTER(TASKCODE)10^3 GAL?					X			rtu0240B	QT0240FIT601E	2
			GR TP: EFF. FLOW-COUNTER (TASKCODE)@8AM					X			rtu0240B	QT0240FIT601F	2
			GR TP: TOTAL TEMP EFF.FLOW-COUNTER					X			rtu0240B	QT0240TEM601E	2

NOTES:

1. DISCONNECT EXISTING FIELD DEVICE. REMOVE WIRING & RACEWAYS WHERE POSSIBLE. LABEL EXISTING PLC I/O AS SPARE. DELETE SOFTWARE POINT ASSIGNMENT & ASSOCIATED SOFTWARE PROGRAMMING. DELETE POINT FROM SCADA USER INTERFACE.
2. RETAIN EXISTING FIELD DEVICE & CONTROLS "AS-IS". NOT IN CONTRACT.
3. PROVIDE NEW FIELD DEVICE, WIRING, AND RACEWAY AS INDICATED. CONNECT TO NEW PLC I/O, PROGRAM USING ASSIGNED POINT NAME AND INTEGRATE CONTROL AND MONITORING INTO SCADA USER INTERFACE. TEST & COMMISSION.
4. PROVIDE NEW FIELD DEVICE, WIRING, AND RACEWAY AS INDICATED. CONNECT TO EXISTING PLC I/O. RETAIN EXISTING POINT NAME, SOFTWARE PROGRAMMING, & SCADA USER INTERFACE. TEST & RECOMMISSION.
5. ASSIGN SOFTWARE POINT AS INDICATED, PROVIDE NEW SOFTWARE PROGRAMMING AND INTEGRATE INTO SCADA USER INTERFACE. TEST & COMMISSION.

SECTION 13310

SCADA SOFTWARE ENGINEERING SECURITY AND QUALITY REQUIREMENTS

PART 1: GENERAL

1.01 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section.
B. Include payment in lump sum bid for work of which this is a component part.

1.02 Purpose:

A. The Wastewater Operations Automation and Electrical Support Service Group maintains this document for the communication of the requirements of the SCADA software used for the control and monitoring of the wastewater facilities. These requirements are intended to address three related areas: 1) SCADA Homeland Security Requirements, 2) Texas Engineering Practice Act, 3) COH Wastewater SCADA system quality requirements:

1. According to the National Strategy for Homeland Security wastewater treatment facilities are part of the nation's critical infrastructure and the government agencies that are responsible shall take specific steps to improve SCADA security.

a. Government agencies are required to "Establish policies to minimize the likelihood that organizational personnel will inadvertently disclose sensitive information regarding SCADA system design, operations, or security controls" and "Release data related to the SCADA network only on a strict, need-to-know basis, and only to persons/entities explicitly authorized to receive such information".

b. In compliance with these Homeland Security requirements all SCADA related information is restricted to authorized personnel.

2. In compliance with Texas Engineering Practice Act (Article 3271a) and the recognition that SCADA software is an integral part of the electrical control of the wastewater facilities and is therefore within the jurisdiction of the act:

a. All SCADA software related work shall be performed by a licensed engineering firm meeting the qualifications as specified in these requirements and referred to within as the Software Engineer (SE). The software produced for the project

shall be stamped by SE in accordance with (Article 3271a §137.33 Sealing Procedures for engineering software).

3. Additionally, these requirements are to refine and perpetuate software engineering and software quality standards that will benefit the Wastewater Operation Branch in the areas of facility operations, maintenance, and facility construction projects:

   a. The requirements are intended to benefit facility operations through encouraging SCADA standards of consistency in facility functionality and operation, improved process visibility, improved efficiency and control, lower operating costs and reduced potential permit violations. The SCADA standardization also addresses improved technical support and ease of maintenance.

   b. These requirements specify SCADA related issues in construction, deliverables and qualifications that will help ensure the availability and quality of SCADA system integration.

   c. SCADA related software integration activities have been identified as a key point of quality control for construction projects. The SE shall subcontract directly to the general contractor and shall perform an independent assessment of the SCADA related work of the other subcontractors and equipment suppliers to ensure complete system and software integration within the facility per the construction specification and wastewater SCADA design guidelines.

PART 2: SCOPE

2.01 The requirements defined in this document apply to wastewater facility SCADA software including system control, monitoring and integration. The scope includes new and existing facility construction projects where new SCADA software is required or where the existing SCADA software is modified.

B. Reference Specification Section 13300 and drawings for itemized list of controls and equipment to be integrated.

C. SCADA software activities shall be performed only by the pre-approved SE and include: Coordination, verification, and analysis for identification of existing I/O signals and field device functionality, PLC programming, HMI configuration and graphics development, historical logging software application and report generation, network configuration and programming.

D. Manufactured packaged subsystems with pre-engineered software may be specifically excluded if specified in that subsystem equipment specification, that the system shall be shipped with the software as a fully functional unit. The system PLC and HMI hardware and software application shall meet the requirements for SCADA integration and software documentation. The packaged system provider shall deliver all software to SE as soon as possible for the purpose of review and integration.

E. These requirements apply to all SCADA security related activities including configuration of servers, workstations and network equipment.

PART 3: SOFTWARE ENGINEERING REQUIREMENTS

3.01 SCADA integration and user interface programming shall be accomplished using GE IFIX software, version compatible with COH existing IFIX implementations.

3.02 The SE shall perform the software engineering functions as required within the scope section meeting the requirements within.

F. The SE shall use the wastewater standards for SCADA software engineering and Homeland Security in all work performed.

1. The SE shall identify and communicate omissions and required modifications to these standards.

2. Details on these standards are restricted to authorized personnel only according to the Homeland Security requirements and are not included in these requirements. The pre-approved SE is authorized for access to these standards.

3.03 The SE shall provide the SCADA related submittals as defined in the submittals section.

The SE shall perform the work required to complete the required SCADA software submittals.

The SE shall review and report on the SCADA related submittals of the project subcontractors and equipment providers.

3.04 The SE shall assist the project team including; the engineer, the wastewater operations and equipment suppliers with the SCADA integration issues.

The SE shall attend project meetings as required by the project team.

The SE shall assist the project team with functional test of the system.

3. This may include providing project related process data from the SCADA system.

PART 4: SUBMITTALS

4.01 Within 30 days of the notice to proceed the SE shall submit a letter of SE qualifications specifically addressing each item of qualification as defined in these requirements.

Include the SE professional engineering firm licensed number and date of issuance.

Include a statement addressing the awareness of the Homeland Security concerns and intention to restrict the dissemination of security sensitive SCADA network information to those who are authorized by the COH and require the information in the support of this project.

4.02 Within 90 days of the notice to proceed the SE will submit the Software Engineering Manual (Preliminary Report).

Include report for identification and verification of existing I/O signals and field device functionality in including recommendations for replacement or demolition.

Include the software conventions for the use in the HMI development.

Include diagrams and schedules for all network devices associated with the process control and monitoring for the facility/facilities.

Include the interfaces for the City SCADA network.

Identify every network component (new and existing).

The Software Engineering Manual will be updated for the final O&M.

4.03 The SE will submit letters of software and network integration compatibility to be included in all the control related submittals.

Included but not limited to: PLCs, network devices, computers, HMI devices.

Include deviations from City standards and the construction specifications for electrical control drawings and tag naming conventions.

Include deviations from the submitted Software Engineering Preliminary Report.

Include the manufacturer supplied package systems with control panels.

The SE shall distribute monthly a Software Engineering Integration Schedule highlighting software and system integration progress and issues.

4.04 Factory demonstration test confirmation report

After the required factory demonstration test the SE shall submit a report confirming the related software and network compatibility.

4.05 Field Acceptance Functional Test

Shall be completed prior to performance and reliability testing.

Field Acceptance Functional Test Submittals shall include:

4. Field Acceptance Functional Test Plan Submittal.

5. Description of plan for testing field devices.

6. Description of plan for function test and system integration of each subsystem.

7. Field Acceptance Functional Test Schedule shall be submitted after the acceptance of the test plan submittal.

8. Field Acceptance Functional Test plan completion report shall be submitted.

4.06 Updated Software Engineering Manual (Final Version)

Update and submit a singled CD with all related SCADA software.

Control and network components.

Inventory of software components.

Network device configuration documentation.

Software Engineering documentation.

PLC and HMI software shall be documented using the product development tool.

Software shall be stamped as required in Texas Engineering Practice Act (Article 3271a §137.33 Sealing Procedures) with the date, the engineers name, the PE designation with license number.

The SE will collect and submit all software and network device configuration programs and data developed for the project.

PART 5: SOFTWARE ENGINEER (SE) QUALIFICATIONS

5.01. The Wastewater Operations Automation and Electrical Support Services group has set forth these qualifications for performing all SCADA related software activities for the wastewater facilities as defined in these requirements.

5.02. The SE shall be currently pre-approved by Automation and Electrical Support Services section for Wastewater Operations. Currently approved firms include:

1. Automation Nation, Inc., 1700 Gazin St., Houston, TX 77020 Phone: 713-675-4999

5.03. Specific qualifications for pre-approved SE:

The SE shall be a Texas Registered Professional Engineering firm with a minimum of five (5) years of licensed history with the software engineering of the control systems for advanced wastewater treatment processes.

The SE shall be experienced with the software application development packages which are used as standards for Wastewater Operations including a minimum five (5) years of software engineering experience with Wonderware Archestra and G.E. IFIX HMI application development packages and Siemens PLCs.

The SE shall demonstrate a minimum of five (5) years of continuous Cisco Advanced Security expertise. This ensures the SE has the required expertise to configure, secure and maintain the SCADA system network for applicable projects (excluding stand-alone control system at the lift stations and small plants where only a single PLC is installed).

The SE shall have errors and omissions insurance with coverage in the amount of $1,000,000.00 (aggregate).

The SE shall have an existing office, within the City of Houston, and shall maintain that office for the duration of the warranty and extended software service requirement.

To ensure effectiveness and objectivity in the review and reporting of SCADA related integration issues, the SE shall be an independent entity and provide only software engineering services for the construction projects. Additional scope of automation and electrical services may be provided as required by the owner. The services may include, but not limited to network diagram development, efficiency and optimization program and application implementation, data dictionary design guideline development.

END OF SECTION

SECTION 13315

PROCESS INSTRUMENTATION AND CONTROL - PRODUCTS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section.
B. Include payment in lump sum bid for work of which this is a component part.

1.02 SECTION INCLUDES

A. Programmable logic controllers (PLCs), remote input/output (I/O) units, network communications equipment, field sensors and devices, control panel components including switches and relays.

1.03 RELATED WORK

A. Section 13300 Process Instrumentation and Controls – General Provisions.
B. Section 13310 SCADA Software Engineering Security and Quality Requirements
C. Section 13441 Pump Station Controls
D. Section 13471 Control Cabinet Enclosures
E. Section 13500 Communications Backbone Cabling
F. Section 13510 Communications Horizontal Cabling
G. Section 13600 Control & Instrumentation Cable
H. Division 16 Electrical.

1.04 REFERENCES

A. National Electrical Manufacturers Association (NEMA).

1. NEMA ICS 1 - General Standards for Industrial Control and Systems.

2. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies.

3. NEMA ICS 3 - Industrial Systems.

4. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

5. NEMA ST 1 - Standard for Specialty Transformers (Except General

Purpose Type).

B. Instrument Society of America (ISA).

C. Underwriters Laboratories, Inc. (UL).

D. Factory Mutual (FM).

E. Institute of Electrical and Electronic Engineers (IEEE).

F. National Fire Protection Association (NFPA). ANSI/NFPA 70 - National Electrical Code (NEC).

G. Joint Industrial Council (JIC).

H. American National Standards Institute (ANSI).

I. International Electrotechnical Commission (IEC).

1.05 SUBMITTALS

A. Submit product data under provisions of Section 01330 - Submittal Procedures.

1. Submit in complete packages grouped to permit review of related items as outlined in these specifications.

2. Bind submittals in three-ring binders with complete indexing and tab dividers. Completely tag and label equipment information to correspond with Drawings.

3. Review of Submittals will be for conformance to Contract Documents and for application to specified functions.

1.06 SPARE PARTS

A. Provide at least 25% of each PLC module furnished as spare parts, excluding CPU. Minimum spare parts will include the following for each type furnished:

1. One spare of each type I/O module with channel capacity equivalent or greater to any provided module.

2. One spare PLC power supply.

3. One spare CPU.

4. One spare Communication Processor.

5. One spare Interface Module

6. Two spare Laser Printer toner cartridges

PART 2 P R O D U C T S

2.01 PROGRAMMABLE LOGIC CONTROLLER (PLC)

A. Manufacturer and Product. **Note: Product Manufacturer & Models Must Provide Seamless Compatibility With Existing Siemens SCADA System**

1. Siemens SIMTAC S7-300 Series

2. Substitute or alternate products are not acceptable unless approved in writing prior to bid.

B. Description: Modular Programmable Logic Controllers including the following modular components:

1. Central Processing Unit (CPU) Modules

2. Communications and Interface Modules

3. Input/Output Signal Modules

4. Power Supply Modules

5. Mounting Rails

C. General Service Conditions

1. Temperature: 32 to 140 degrees F, horizontally installed.

2. Humidity: 5 to 95 percent, non-condensing.

3. Electromagnetic Compatibility: Noise suppression to EN 50082-2, Noise emission to EN50081-2.

4. Vibration: IEC 68, Part 2-6/10 to 58 Hz.

5. Shock: IEC 68, Part 2-27/half-sine: 15 g peak, 11 milliseconds.

D. Configurations

1. Processor Rack: Include processor, power supply, micro memory card, communication modules, and input/output modules with front connectors.

2. Expansion Unit: Include interface module, power supply, communication module, input/output modules, front connectors and necessary connection cables.

3. Mounting Rail: Provide passive mounting rail for processor, power supply, communication, and input/output modules.

E. Central Processor Unit Modules

1. Integrated Memory: Internal 384 KB minimum, 128 KB retentive

2. CPU Blocks: 1,024 minimum, 64 KB each

3. Digital Input/Output Channel Capacity: 16,384 minimum.

4. Analog Input/Output Channel Capacity: 1,024 minimum.

5. I/O Address Memory: 2,048 bytes.

6. Typical Execution Times:
   a. Bit & Word Operations: <0.1 microsecond
   b. Fixed Point Arithmetic: <0.2 microsencond
   c. Floating Point Arithmetic: <0.5 microseconds

7. Integral Real Time Clock with Backup Battery

8. Storage Memory: Micro Memory Card, 2 MB minimum capacity.

9. Communications Ports

F. Communications

1. PROFINET Industrial Ethernet

   a. Industrial Ethernet IEE 802.3
   b. PROFINET IEC 61158/IEC 61784 Compatible
   c. 10BASE-T, 100 BASE-T Support
   d. IEC 60603-7 Isolated RJ45 Interface
   e. Integral 2-Port Autosensing Switch
   f. TCP/IP, ISO over TCP/IP, UDP, Web Server

g. Integral Isochronous Mode Support

2. PROFIBUS

a. PROFIBUS IEC 61158/EN 50170 Distributed I/O Mode (DP) support as master or slave
b. Multi-Point Interface (MPI) compatible
c. EIA Isolated RS-485 Interface
d. 12 Mbit/Second Minimum transmission rate

G. Input/Output Signal Modules

1. General Requirements
a. Hot swapable design
b. Provide dedicated function modules only with not less than 4 or not more 16 channels per module.
c. Provide expansion I/O modules with dedicated communications interface and power supply modules.

2. Digital Input Characteristics

a. 24 V DC Load Voltage
b. Optically Isolated
c. Input Characteristic Curve compliant with IEC 61131 Type 1
d. < 5.0 ms response time
e. LED channel status indicator

3. Digital Output Characteristics

a. 24 V DC Load Voltage
b. Optically Isolated
c. Input Characteristic Curve compliant with IEC 61131 Type 1
d. < 5.0 ms response time

4. Analog Input Characteristics

a. Selectable for 1 to 5V, 0 to 10V -10 to +10V, 0 to 20mA, -20 to +20mA, or 4 to 20mA voltage/current span.
b. Optional Thermocouple or Resistance Thermal Device (RTD) selectable input with parametric characteristic linearization.
c. 100 k ohm minimum input impedance (voltage input)
d. 100 ohm maximum input resistance (current input)
e. 12 bit minimum resolution, 60 ms minimum sampling rate with selectable integration span
f. 0.5% maximum A/D error
g. 500 VDC minimum channel-to-channel isolation

5. Analog Output Characteristics

   a. Selectable for 1 to 5V, 0 to 10V -10 to +10V, 0 to 20mA, -20 to +20mA, or 4 to 20mA voltage/current span.
   b. Provided with internal short circuit protection.
   c. 1 k ohm minimum, 1 micro-farad maximum voltage load drive impedance.
   d. 500 ohm maximum, 10 mH minimum current load drive impedance.
   e. 12 bit minimum resolution, 0.8 ms minimum conversion time.
   f. < 0.5 ms settling time (non-inductive loads)
   g. 0.5% maximum A/D error
   h. 500 VDC minimum channel-to-channel isolation
   i. With configurable diagnostics and integrated load fault alarm

H. Power Supply

1. Input:
   a. 85-132 VAC
   b. 47-63 HZ
   c. 20 ms mains buffering.

2. Output:
   a. 24 VDC
   b. 5 amp nominal
   c. +/- 3% voltage regulation
   d. 40 mV nominal ripple
   e. -30 db maximum hash noise to 20 mHz, EN 55011 Class A and EN 61000-6-2 compliant

3. Closed Loop Control:
   a. 0.3% Dynamic mains compensation
   b. 3% Dynamic load smoothing
   c. 5 ms settling time

4. Protection & Monitoring

   a. Independent output overvoltage protection with auto restart
   b. Output current inrush limited with over-current protection
   c. UL 508 Listed
   d. Class 1 primary/secondary separation
   e. EN 60529 IP20

5. Mounting: On PLC Mounting Rail

6. Front Panel: Green status LED, On/Off Switch

7. Output Terminations: Screw terminations with connector to PLC CPU, plus additional terminations for wiring to other control system 24 VDC needs.

2.02 WORKSTATION & LOCAL AREA NETWORK (LAN) EQUIPMENT

A. Managed Network Switches

1. Manufacturer and Product: Siemens SCALANCE X-200 Series Network Switches **Note: Product Manufacturer & Models Must Provide Seamless Compatibility With Existing Siemens Managed System. Substitute or alternate products not allowed without engineering approval prior to bid.**
2. Description: Managed, fault-tolerant, industrial Ethernet switches with two (2)100Mbit/s multi-mode fiber optical ports, four (4) to eight (8) 10/100Base-T ports, redundant power supply, resettable error signaling contacts, integrated PROFINET support & network management interface.

B. Operator Workstations

1. Case: Tower Style, multiple fan cooling, with front mounted integral USB 2.0 & 3.0 jacks
2. Power Supply: 900 watt minimum
3. Motherboard: ATX style supporting Intel Core i7 and up to 32GB DDR3 memory, with on-board dual SATA III 6GB/s controllers, RAID version 0/1/10, USB 2.0/3.0, 10/100/1000 Mbsp LAN,
4. Intel Quad Core i7, minimum performance version 4790K or better.
5. Memory: 16 GB dual channel PC3-12800 or faster.
6. Hard Disk Drives: Dual 4TB 7,200 RPM SATA III 6.0 GB/s drives configured in RAID 1
7. Optical Disk Drive: CD/DVD
8. Video Card: Standard performance supporting dual monitors at 1920 x 1080 minimum resolution, PCIe interface with dual DVI ports, 2048 MB memory
9. Monitors: Dual 24" LED widescreen with 1920 x 1080 minimum resolution.
10. Operating System Software: Microsoft Windows 7 or 8 Professional, including software license to City of Houston.
11. Accessories: USB Keyboard & mouse, UPS, Surge Protector
12. Warranty & Support: 12 months

C. Application Software

1. Provide GE IFIX user interface software for two (2) user workstation seats licensed to City of Houston.

2. Reference Section 13310 for additional requirements.

D. Network Printers

1. HP Laserjet Pro 400 Series or equal
2. 1200 DPI
3. 30 pages per minute nominal print speed

2.03 FIELD DEVICES

E. Tank Level Sensors – Magnetic Level Gage

1. Manufacturers: Emerson Rosemount, Penberthy Inc., or equal.

2. Chamber: 2" CPVC with fiberglass armored or 300 series stainless steel shield and fiberglass flanged tank connections

3. Internal magnetic float: select for specific gravity of sodium bisulfate

4. External magnetic indicator: hermetically sealed and mounted outside of float chamber, photo-etched stainless steel scale calibrated in one foot increments.

5. Magnetostrictive Level Transmitter
   a. Non-wetted, double sealed construction
   b. 316 SS NEMA 4X housing
   c. 2-wire, loop powered, 24 VDC
   d. 4-20 mA scalable output,
   e. 0.01% accuracy
   f. Locally configurable with LCD display
   g. Mounted within 5 ft. of grade level for service.

6. Accessories: Provide sight gauge chamber with isolation and drain valves.

F. Ultrasonic Level Sensors

1. Manufacturers: Rosemount, Flowline, Gems, or approved equal

2. Construction: Aluminum housing, Nema 4X with 2" NPT process connection and PVC mounting flange. Provide with PVDF wetted parts.

3. Range: 12" minimum, 72" to 300" maximum as selected for application

4. Electrical

a. 2-wire, loop powered, 24 VDC
b. 4-20 mA scalable output with HART communications.
c. 0.5% accuracy
d. Locally configurable
e. Integral LCD display & programming buttons.

G. Pressure Sensors

1. Manufacturers: Rosemount 2051, 2088 or approved equal

2. Housing: Nema 4X with 2" NPT process connection and 300-series SS accessory mounting flange.

3. Type & Range: Static (gage) or differential as required for application, field verify range for existing process.

4. Manifold: Provide with 300 series stainless steel manifold complete with needle valves.

5. Electrical
   a. 2-wire, loop powered, 24VDC
   b. 4-20 mA scalable output with HART communications
   c. Locally configurable
   d. Accuracy: 0.075% of span

H. Flow/Volume Totalizing Meters – Coriolis Type

1. Manufacturers: Emerson R-Series Micro-Motion or approved equal

2. Meter Housing: 2" NPT or flanged connections as required, process connection and 300-series SS accessory mounting flange.

3. Electrical Housing: Aluminum NEMA 4X remote wall mounted with factory supplied interconnecting cable. Field verify required cable length.

4. Range: Field Verify with existing process

5. Electrical
   a. 120 VAC powered
   b. 4-20 mA scalable flow rate output
   c. Auxiliary totalizing output
   d. Remote mounted transmitter with LCD display
   e. Locally configurable
   f. Field verify flow rates and fluid viscosities.

I. Flow/Volume Totalizing Meters – Magnetic Type

1. Manufacturers: Emerson, Badger, or approved equal

2. Element Housing: 2" NPT process connection (field verify) and 300-

series SS accessory mounting flange. Lining suitable for wastewater sludge applications.

3. Flow Processor Enclosure: NEMA 4X

4. Range: Field Verify with existing process

5. Electrical
   a. 2-wire, loop powered, 24VDC
   b. 4-20 mA scalable flow rate output
   c. Pulse flow volume totalizing output
   d. Local LCD display
   e. Locally configurable

2.04 CONTROL SWITCHES AND INDICATOR LIGHTS

J. Manufacturers

1. Automatic Timing and Controls Company.

2. Cutler Hammer.

3. Eagle Signal Company.

4. General Electric Company.

5. Square D Company.

6. Allen Bradley.

7. Siemens

K. Substitutions: Comply with Section 01630 - Product Substitution Procedures.

L. Control Switches

1. Contacts: NEMA ICS 2; at least two Form C contact sets.

2. Contact Ratings: NEMA ICS 2; 120V, 10 ampere inductive.

3. Selector Switch Operators: NEMA ICS 2; heavy-duty, oil-tight, NEMA 4 multi-position rotary selector switch.

4. Push-button Operator: NEMA ICS 2; heavy-duty oil-tight NEMA 4 unguarded and lockable type; black for start, red for stop.

M. Indicator Lights: Red for run, amber or yellow for alarm, green for control mode; LED, oil-tight, 100,000-hour rated life expectancy; rated voltage approximately 125 percent of nominal 120 VAC operating voltage. To be push-to-test type.

2.05 CONTROL RELAYS

A. Contacts: NEMA ICS 2; three Form C contact sets.

B. Rating: NEMA ICS 2; 120 volt, 10 ampere inductive.

C. Coil Voltage: 120 volt, 60 Hz AC.

D. Socket: Turck S3B with coding system, label and label holder (11-pin).

E. Features: 11-pin tube socket relay base, external color-coded test button, mechanical and electrical status indications, impact-resistant thermoplastic case.

F. Manufacturer: Turck, Inc., or approved equal.

G. Spare Units: In addition to units installed, furnish 2 spare units.

2.06 TIME DELAY RELAYS

A. Contacts: NEMA ICS 2; three Form C contact sets.

B. Contact Ratings: NEMA ICS 2; DPDT Class; 120 volt 10 ampere inductive.

C. Coil Voltage: 120 volt 60 Hz AC.

D. Socket: Turck S3B with coding system, label and label holder (11-pin).

E. Description: Control relay as specified above in Paragraph 2.04, with added Time Cube Module as manufactured by Turck, Inc.; series CT3, with on or off delay, as indicated.

F. Features: DIP switch-selectable timing ranges of 0.2 to 3 seconds, 0.8 to 12 seconds, 0.1 to 1.5 minutes and 0.8 to 12 minutes; externally-adjustable graduated time dial; solid-state digital timing system.

G. Spare Units: In addition to units installed, furnish 2 spare units.

2.07 UNINTERRUPTABLE POWER SUPPLY

A. Manufacturer and Model: Powerware Model 9120 with relay interface

card model #1014018, or approved equal.

B. Rating: Provide uninterrupted conditioned power to PLC and critical components for 7 minutes at a load of 1000 VA and 18 minutes at a load of 500 VA.

C. Description: Continuous-duty, online, solid state uninterruptible power system incorporating double-conversion technology. The UPS shall operate in conjunction with the existing electrical system to protect electronic equipment from power disturbances that may occur in utility power such as voltage fluctuations, brownouts, blackouts, power surges and power sags.

D. Modes of Operation: The UPS shall operate as an online, double-conversion UPS with the following modes:

1. Normal Mode: The rectifier shall derive power as needed from the commercial AC utility or generator source and supply filtered and regulated DC power to the online inverter. The inverter shall convert the DC power at its input to highly regulated and filtered AC power for the critical loads.

2. High Efficiency Mode: In the presence of favorable incoming utility conditions, the UPS shall optimize its operating state to maximize its efficiency.

3. Battery Mode: Upon complete failure of utility power, the UPS shall provide power to the critical loads through the inverter, from the UPS' internal or extended batteries. When utility power returns, the unit shall return to Normal Mode operation.

4. Bypass Mode: The automatic bypass shall transfer the critical load to the commercial AC source, bypassing the UPS' inverter/rectifier, in the case of an overload, load fault, or internal failure.

5. Standby Mode: When initially attached to a utility or other power source, the UPS shall start in Standby Mode until the user initiates power to the critical load. In this mode, the UPS shall recharge the batteries, but power shall not be supplied to the critical load.

E. TVSS Rating: Total energy rating more than 520J, 320V/130J MOV from L-N, L-G, and N-G.

F. Input Voltage: 80 to 144 VAC, User-selectable nominal voltages of 100, 110, 120 and 127 VAC: 45 to 65 Hz, automatic selection of nominal 50/60 Hz.

G. Output Voltage: User-selectable nominal voltages of 100, 110, 120 and 127 VAC; plus or minus 3 percent of selected nominal voltage, 50 or 60 Hz, auto-selectable.

H. Input Line Cord: 6-ft. attached line cord with 5-15P.

I. Output Receptacles: Four 5-1R and two 5-20R

J. Operating Temperature: 41 to 104 degrees F.

K. Serial Communication Interfaces: RS-232 port (DB9) and USB (Universal Serial Bus) for communication to vendor-supplied Power Management Software.

L. Transient Protector: RJ-45/RJ-11 universal connectors to allow attachement of data/LAN lines for surge suppression and protection.

M. Remote Emergency Power-Off (REPO) Connection: When initiated by external contact closure, the UPS shall open its output relays and disengage the battery converter to prevent power from being delivered to the attached

N. Relay Output: Include optional Relay Output Card for status reporting to the PLC.

O. External Maintenance Bypass: Input and Output to connect through Make-Before-Break Maintenance Bypass for isolation of UPS without impacting line-to-load.

P. UPS Input: 120 VAC.

Q. UPS Output: Six 120 VAC 15 amp receptacles.

PART 3 EXECUTION

3.01 CAPACITIES

A. Configure PLC controls with the following minimum capacities:

1. Provide central processor unit with sufficient memory such that the final operating configuration does not use or occupy more than 50% of total system memory.

2. Provide minimum 25% spare I/O rack space.

3. Provide minimum 25 percent spare I/O channel capacity for each type of I/O module, pre-configured, wired, terminated, and identified as such.

4. Provide low voltage power supplies not exceeding 60% of rated nominal load demand.

B. Connect PLC inputs/outputs including analog inputs through snap-on isolated fused terminal blocks.

C. Separate the AC and control signals from DC and loop signals by at least 6 inches. Provide a barrier between AC and DC within the raceways.

3.02 GENERAL REQUIREMENTS

A. Reference Section 13300 and 13325 for additional execution requirements.

END OF SECTION

Section 13325

CONTROL PANELS AND PANEL MOUNTED EQUIPMENT

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Refer to Section 13300.

B. Furnish and install control panels and panel mounted equipment as specified herein and shown on the Contract Drawings.

C. All new panels and panel components shall match existing equipment makes and models wherever possible, so that system additions can be most easily integrated with respect to operation and maintenance training, spare parts inventory, and service contracts. Even when exact matches are not possible, equipment furnished must be fully compatible with the existing system. Color, size and material of new panels should conform to that of existing panels.

D. Each panel shall be supplied with full sub-panels and side panels as required.

E. All new control panels provided under this contract and their locations are shown on the electrical drawings. Panels NEMA rating classification shall be maintained as shown on the electrical drawings.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be provided for work performed under this Section. Include the cost for this work in the lump sum base bid.

B. Refer to Section 01270 – Measurement and Payment.

1.03 RELATED WORK

A. General instrumentation and control requirements are included in Section 13300.

B. Electrical requirements are included in Division 16.

C. Specific control panel components, terminal blocks, controllers, and other general devices are specified in other Sections of Division 13.

D. Section 16195 – Electrical Identification

1.04 SUBMITTALS

A. Refer to Section 13300.

1.05 REFERENCE STANDARDS

A. Refer to Section 13300.

1.06 QUALITY ASSURANCE

A. Refer to Section 13300.

1.07 SYSTEM DESCRIPTION

A. Refer to Section 13300.

1.08 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 13300.

B. Accessories, drawings, instruction bulletins, etc., shall be packed and shipped with the panel.

1.09 PROJECT/SITE REQUIREMENTS

A. Refer to Section 13300.

1.010 MAINTENANCE

A. Refer to Section 13300.

B. Spare Parts: In addition to the spare parts listed in other instrumentation sections, provide the following:

1. Fuses: 20 percent of each size and type used, but no less than 10 of each size and type.

2. Relays: 20 percent of each type used, but no less than 10 of each type.

3. DC Power Supplies: 20 percent of each size and type used, but no less than two of each size and type.

4. Corrosion Inhibiting Vapor Capsules: Provide 100 of each type and size used.

C. The spares listed above shall be packed in a manner suitable for long term storage and shall be adequately protected against corrosion, humidity and temperature.

1.011 WARRANTY

A. Refer to Section 13300.

1.012 SYSTEM FINAL DOCUMENTATION

A. Refer to Section 13300.

PART 2: PRODUCTS

2.01 GENERAL

A. Refer to Section 13300.

2.02 LIGHTNING/SURGE PROTECTION

A. Refer to Section 13300.

2.03 CONTROL PANEL GENERAL REQUIREMENTS

A. All control panel assemblies shall be UL labeled. Ensure final enclosure sizing and panel arrangements accommodate all required equipment for a fully integrated and operational system as specified herein and in the Contract Documents.

B. All panel doors shall have a lock installed in the door handle, or a hasp and staple for padlocking. Locks for all panels provided under this Contract shall be keyed alike.

C. The instruments designated for rear of panel mounting shall be arranged within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment.

D. The panels shall be shop fabricated with preinstalled instruments and wiring other than field terminations.

E. All components shall be mounted in a manner that shall permit servicing, adjustment, testing and removal without disconnecting, moving or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the

enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Internal components shall be identified with suitable plastic or metal engraved tags attached with drive pins adjacent to (not on) each component identifying the component.

F. All exterior panel mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.

G. Nameplates

1. All panels and panel devices shall be supplied with suitable nameplates which identify the panel and individual devices as required. Each device nameplate shall include up to three lines with the first line containing the device tag number as shown on the Contract Drawings, the second line containing a functional description (e.g., Recirculation Pump No. 1), and the third line containing a functional control description (e.g., Start).

2. Unless escutcheon plates are specified or unless otherwise noted on the Contract Drawings, nameplates shall be 3/32 inch thick, black and white, Lamacoid with engraved inscriptions. The letters shall be black against a white background. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable. Nameplates shall be affixed to the panels using 4-40 thread stainless steel button head hex screws.

H. Mounting Elevations

1. ISA Recommended Practice RP60.3 shall be used as a guide in layout and arrangement of panels and panel mounted components. Dimensions shall account for all housekeeping pads that panels will be placed on when installed.

2. Centerline of indicators and controllers shall be located no lower than 48 inches or higher than 66 inches above the floor on a panel face.

3. Centerline of lights, selector switches and pushbuttons shall be located no lower than 32 inches or higher than 70 inches above the floor on a panel face.

4. Tops of annunciators shall be located no higher than 86 inches above the floor on a panel face.

5. Installation of panel components shall conform with component manufacturers' guidelines.

2.04 PANEL MATERIALS AND CONSTRUCTION

A. Structure and Enclosure

1. Panels shall be of continuous welded steel construction. Provide steel angle stiffeners as required on the back of the panel face to prevent panel deflection under instrument loading or operation. Internally the panels shall be supplied with a structural steel framework for instrument support purposes and panel bracing. The internal framework shall permit panel lifting without racking or distortion. Provide removable lifting rings designed to facilitate simple, safe rigging, and lifting of the control panels during installation. Plugs shall be provided and shall unobtrusively fill the panel lifting ring holes when substituted for the lifting rings after installation is complete. Plugs shall not compromise the overall NEMA rating of the panel.

2. Each panel shall be provided with full height, fully gasketed access doors where shown. Doors shall be provided with a three point stainless steel latch and heavy duty stainless steel locking handle. Rear access doors shall be conveniently arranged and sized such that they extend no further than 24 inches beyond the panel when opened to the 90 degree position. Front and side access doors shall be as shown. Panel access doors shall be provided with full length, continuous, piano type, 316 stainless steel hinges with 316 stainless steel pins. Front access doors with mounted instruments or control devices shall be of sufficient width to permit door opening without interference from flush mounted instruments. Doors shall swing to the right or left, NOT from the top or bottom.

3. The panels, including component parts, shall be constructed and assembled in a thoroughly workmanlike manner and shall be free from sharp edges and welding flaws. Wiring shall be free from kinks and sharp bends and shall be routed for easy access to other components for maintenance and inspection purposes.

4. The panel shall be suitable for top or bottom conduit entry as required by the Electrical Drawings. For top mounted conduit entry the panel top shall be provided with nominal one foot square removable access plates which may be drilled to accommodate conduit and cable penetrations. All conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts,

or other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.

5. All panels in indoor, dry, non-corrosive environments shall be NEMA 12 unless otherwise noted. All panels in outdoor, wet or chemically corrosive environments shall be NEMA 4X unless otherwise noted. All panels located in a hazardous location (e.g., Class 1, Division 1) shall be rated NEMA 7.

B. Freestanding Vertical Panels

1. Freestanding vertical panels shall meet the NEMA classification as shown on the Contract Drawings or specified herein. The panels shall be constructed of 12 gauge sheet steel, suitably braced internally for structural rigidity and strength. Front panels or panels containing instruments shall be not less than 10 gauge stretcher leveled sheet steel, reinforced to prevent warping or distortion.

C. Wall or Unistrut Mounted Panels

1. All wall mounted panels shall meet the NEMA classification as shown on the Contract Drawings or specified herein. The panels shall be constructed of not less than USS 14 gauge steel, suitably braced internally for structural rigidity and strength. All NEMA 4X rated wall mounted panels shall be constructed of 316 stainless steel, unless FRP is specifically indicated to be provided. All FRP panels located in direct sunlight shall be provided with a protective coating and sun shield to prevent discoloration and cracking.

D. Finish Requirements

1. All sections shall be descaled, degreased, filled, ground and finished. When fabricated of steel, the enclosure shall be finished with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which shall be applied by either hot air spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel, and FRP panels will not require a paint finish.

2. The panels shall have edges ground smooth and shall be sandblasted and then cleaned with a solvent. Surface voids shall be filled and ground smooth.

3. Immediately after cleaning, one coat of a rust inhibiting primer shall be applied inside and outside, followed by an exterior intermediate and top coat of a two component type epoxy enamel. A final

sand¬ing shall be applied to the intermediate exterior coat before top coating.

4. Apply a minimum of two (2) coats of flat white lacquer on the panel interior after priming.

5. Unless otherwise noted, the finish exterior colors shall be ANSI 61 gray with a textured finish.

2.05 ENVIRONMENTAL CONTROL

A. All panels shall be provided with louvers, sun shields, heat sinks, forced air ventilation, or air conditioning units as required preventing temperature buildup inside of panel. The internal temperature of all panels shall be regulated to a range of 45 Deg F to 104 Deg F under all conditions. Under no circumstances shall the panel cooling or heating equipment compromise the NEMA rating of the panel.

B. Submit heat dissipation calculations for every new control panel.

C. Except for panels mounted with their backs directly adjacent to a wall, louvers shall be in the rear of the panels, top and bottom, and shall be stamped sheet metal construction. If louvers cannot be installed to maintain the required panel NEMA rating, other means must be provided to maintain temperature limits as specified.

D. For panels mounted with their backs directly adjacent to a wall, louvers shall be on the sides.

E. Forced air ventilation fans, where used, shall provide a positive internal pressure within the panel and shall be provided with washable or replaceable filters. Fan motors shall operate on 120 volt, 60 Hz power.

F. An air conditioner shall be provided for panels with internal heat that cannot be adequately dissipated with natural convection and heat sinks, or forced air ventilation.

G. The air conditioner shall have fully gasketed flanges on all four mounting edges for a watertight seal that maintain the NEMA rating of the enclosure. The air conditioner shall have a thermostatic low temperature control to provide energy efficient operation and prevent over cooling. The AC shall also have EMI/RFI suppressor to minimize transient spikes during compressor on/off cycling and it shall be short cycle protected. The AC enclosure shall be Stainless Steel and UL certified.

H. Provide custom fabricated sun shields for all outdoor panels in accordance

with the following requirements:

1. Sun shields shall be fabricated from minimum 12 gage Type 316 Stainless Steel. Units shall be designed, fabricated, installed and supported to fully cover and shade the top, sides and back of the enclosure, and to partially shade the front panel of the enclosure from direct exposure to sunlight from sunrise to sunset.

2. Depending on overall size, sun shields may be fabricated in single or multiple segments for attachment to the enclosure support framing or to separate free standing framing around the enclosure.

3. Sun shields shall not be attached directly to the enclosure by drilling holes through, or welding studs to, the enclosure surfaces, and shall be designed and mounted to provide a minimum 3 inch air gap all around the enclosure for air circulation and heat dissipation.

4. The top section of all sun shields shall be sloped at a minimum angle of 5 degrees from horizontal. For wall mounted enclosures, the top section shall slope downward away from the wall and towards the front of the enclosure. For free standing, floor mounted and frame mounted enclosures, the top section shall slope downward towards the back side of the enclosure.

5. The front edge of the top section of all sun shields shall incorporate a narrow and more steeply sloped drip shield segment which sheds water away from the front of the enclosure and prevents it from dripping and/or running directly onto the front panel of the enclosure.

6. All seam welds used in sun shield fabrication shall be continuous and ground smooth.

7. All exposed corners, edges and projections shall be smooth rounded or chamfered to prevent injury.

I. All enclosures shall be provided with a thermostatically controlled strip heater to reduce condensation and maintain the minimum internal panel temperature. Strip heaters shall be mounted close to the bottom of the panel on a vertical plane.

2.06 CORROSION CONTROL

A. Panels shall be protected from internal corrosion by the use of corrosion

inhibiting vapor capsules as manufactured by Northern Instruments Model Zerust VC; Hoffman Model A HCI; or equal.

2.07 CONTROL PANEL INTERNAL CONSTRUCTION

A. Internal Electrical Wiring

1. All interconnecting wiring shall be stranded, type MTW, and shall have 600 volt insulation and be rated for not less than 90 degrees Celsius. Wiring for systems operating at voltages in excess of 120 VAC shall be segregated from other panel wiring either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier. Panel layout shall be developed such that technicians shall have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.

2. Power distribution wiring on the line side of fuses or breakers shall be 12 AWG minimum. Control wiring on the secondary side of fuses shall be 16 AWG minimum. Electronic analog circuits shall utilize 18 AWG shielded, twisted pair, cable insulated for not less than 600 volts.

3. Power and low voltage DC wiring systems shall be routed in separate wireways. Crossing of different system wires shall be at right angles. Different system wires routed parallel to each other shall be separated by at least 6 inches. Different wiring systems shall terminate on separate terminal blocks. Wiring troughs shall not be filled to more than 60 percent visible fill.

4. Signal wires shall be tinned copper type. All wiring shall terminate onto a single tier master terminal board, where each terminal is uniquely and sequentially numbered. Direct interlock wiring between equipment will not be allowed. Multi-level terminal blocks or strips are not acceptable. The master terminal board shall have a minimum of 25 percent spares. Terminal blocks shall be arranged in vertical rows and separated into groups (power, AC control, DC signal). Terminal blocks shall be the compression type, fused, unfused, or switched as shown on the Contract Drawings or specified elsewhere in Division 13.

   a. Discrete inputs and outputs (DI and DO) shall have two terminals per point with adjacent terminal assignments. All active and spare points shall be wired to terminal blocks.
   b. Analog inputs/outputs (AI and AO) shall have three terminals per shielded pair connection with adjacent terminal assignments for each point. The third terminal is for

shielded ground connection for cable pairs. Ground the shielded signal cable at the PLC cabinet. All active and spare points shall be wired to terminal blocks.

c. Wire and tube markers shall be the sleeve type with heat impressed letters and numbers.

d. Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal block shall not be within 6 inches of the side panel or adjacent terminal, 8-inches of the bottom of free standing panels, or 3-inches of stanchion mounted panels.

5. All wiring to hand switches, etc., which are live circuits independent of the panel's normal circuit breaker protection shall be clearly identified as such.

6. All wiring shall be clearly tagged and color coded. All tag numbers and color coding shall correspond to the panel wiring diagrams and loop drawings prepared by the PCSI.

7. All power wiring, control wiring, grounding and DC wiring shall utilize different color insulation for each wiring system used. The color coding scheme shall be:

   a. Incoming 120 VAC Hot - Black

   b. 120 VAC Hot wiring downstream of panel circuit breaker – Red

   c. 120 VAC Hot wiring derived from a UPS system – Red with Black stripe

   d. 240, 208 or 480 VAC wiring – as specified in Division 16

   e. 120 VAC neutral - White

   f. Ground - Green

   g. DC wiring – Blue and Blue/White

   h. Foreign voltage - Yellow

8. Provide surge protectors on all incoming power supply lines at each panel per the requirements of Section 13300.

9. Each field instrument furnished under Division 13 and shown on the Contract Drawings as deriving input power from the control panel(s) shall have a separate power distribution circuit with a circuit breaker

or fuse and blown fuse indication. Provide 24 VDC power supplies as required to power field instruments and panel devices.

10. Wiring trough for supporting internal wiring shall be plastic type with snap on covers. The side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the subpanel by stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives.

11. Each panel shall have a single tube, fluorescent light fixture, 20 Watt in size, mounted internally to the ceiling of the panel. Light fixture shall be switched and shall be complete with the lamp.

12. Each panel shall have a specification grade duplex convenience receptacle mounted internally within a stamped steel device box with appropriate cover.

13. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.

14. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.

15. Each panel shall have control, signal and communication line surge suppression in accordance with Section 13300.

16. All microprocessor-based electronic devices in the panel that are powered by 120VAC shall be powered by the UPS (refer to Section 13310).

17. Each panel shall be provided with a circuit breaker to interrupt incoming power. Provide a minimum of two (2) spare 20-amp breakers.

18. Additional electrical components including transformers, motor starters, switches, circuit breakers, etc. shall be in compliance with the requirements of Division 16.

PART 3: EXECUTION

3.01 INSTALLATION

A. The panels shall be installed at locations as shown on the Contract Drawings.

B. Refer to Section 13300.

3.02 TESTS

A. All panels shall be tested as part of the complete system factory and site testing procedures as specified in Section 13300.

END OF SECTION

Section 13441

PUMP STATION CONTROL SYSTEM (LEVEL I)

PART 1 G E N E R A L

1.01 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section.
B. Include payment in lump sum bid for work of which this is a component part

1.02 SCOPE OF WORK

A. Greenridge WWTP: Provide new replacement control panel for clarifier scum sump pumps including, but not limited to control switches, relays, transformers, alarm panels, terminal blocks, power supplies, and accessories.

1.03 RELATED WORK

A. Section 13300 Process Instrumentation and Controls – General Provisions
B. Section 13310 SCADA Software Engineering Security and Quality Requirements
C. Section 13315 Process Instrumentation and Controls – Products
D. Section 13471 Control Cabinet Enclosures
E. Section 13500 Communication Backbone Cabling
F. Section 13510 Communication Horizontal Cabling
G. Section 13600 Control and Instrumentation Cable

1.04 REFERENCES

A. National Electrical Manufacturers Association (NEMA).

1. NEMA ICS 1 - General Standards for Industrial Control and Systems.

2. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies.

3. NEMA ICS 3 - Industrial Systems.

4. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

5. NEMA ST 1 - Standard for Specialty Transformers (Except General Purpose Type).

B. Instrument Society of America (ISA).

C. Underwriters Laboratories, Inc. (UL).

D. Factory Mutual (FM).

E. Institute of Electrical and Electronic Engineers (IEEE).

F. National Fire Protection Association (NFPA). ANSI/NFPA 70 - National Electrical Code (NEC).

G. Joint Industrial Council (JIC).

H. American National Standards Institute (ANSI).

1.03 SUBMITTALS

A. Submit product data, shop drawings and samples (if samples are requested by the City Engineer) under provisions of Section 01330 - Submittal Procedures.

1. Submit in complete packages grouped to permit review of related items as outlined in these specifications.

2. Bind submittals in three-ring binders with complete indexing and tab dividers. Completely tag and label equipment information to correspond with Drawings.

3. Review of submittals will be for conformance to Contract Documents and for application to specified functions.

B. Product Data. Submit descriptive product literature including manufacturer's specifications for each component specified.

C. Shop Drawings. Indicate layout and mounting of completed assemblies and systems, interconnecting piping and cabling, dimensions, weights, external power and communications connections.

1. Panel, Console, and Cabinet Information
   a. Layout drawings, including the following:
      1) Front, rear, end, and plan views to scale.
      2) Dimensional information.
      3) Tag numbers and functional names of components mounted in and on panels, consoles, or cabinets.
      4) Product information on panel components.
      5) Nameplate locations and legends, including text, letter sizes and colors to be used.

6) Location of anchoring connections and holes.
7) Location of external wiring and piping connections.
8) Mounting and installation details.
9) Proposed layouts and sizes of graphic display panels.

b Wiring and piping diagrams, including 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 for each wire and color coding legend.
6) Functional name and manufacturer's designation of components to which wiring and piping are connected.

c. Electrical control schematics in accordance with JIC standards.

d. Plan showing equipment layout in each area.

2. Field Wiring and Piping/Tubing Diagrams
a. Wiring and piping/tubing sizes and types.
b. Terminal strip, device terminal and wire numbers.
c. Color coding.
d. Designation of conduits in which wiring is to be located.
e. Location, functional name and manufacturer's designation of items to which wiring or piping are connected.
f. Point-to-point wiring diagrams identifying every termination point and connection.

3. Instrumentation Diagrams
a. Prepare instrument loop diagrams for analog and digital displays, and control and I/O loop diagrams, using ISA standard symbols in accordance with ISA Standard S5.4. Drawing shall include the following:
1) Instrument tag numbers.
2) Functional name, manufacturer's name, product name and model or catalog number of each item.
3) Location of each item.

b. Submit loop diagrams, wiring diagrams, and control schematics on 3.5-inch, 1.44-Mb diskettes, formatted as AutoCAD.DWG files using the latest release of AutoCAD current and available on bid date, or any subsequent version. Identify diagrams, schematics and other files with computer-printed labels affixed to each diskette. Leave at least 200,000 bytes free space available on each diskette.

c. In addition, submit such diagrams and schematics laser-printed on 8.5-inch x 11-inch paper. Use lettering and numerals of at least 1/16-inch nominal height.

D. Quality Control Submittals

1. Factory Test Reports. If specified, submit 6 copies.

2. Testing Procedures. Submit testing procedures proposed to verify operations of the system logic. Test and verify system with external devices required to simulate field connections connected simultaneously for a full system test. Reconnecting external devices to verify portions of the systems at a time is not acceptable.

3. Certificates. Under provisions of Section 01450 - Contractor's Quality Control, submit manufacturers' certificates that equipment and systems meet or exceed specified requirements.

4. Instructions. Submit manufacturer's installation instructions for each component specified.

5. Field Reports. Submit 6 copies of manufacturer's installation inspection, field calibration and field testing reports.

E. Operation and Maintenance (O&M) Data.

1. Submit operation and maintenance data in accordance with of Section 01782 - Operation and Maintenance Data.

2. Information and drawings submitted must reflect the final installed condition. Revise documents requiring updates following testing and start-up.

3. In addition to the content specified in Section 01782 - Operations and Maintenance Data, provide the following information:
   a. Name, address and telephone number of the control system supplier's local service representative.
   b. Complete list of supplied system hardware parts with full model numbers referred to system part designations, including spare parts and test equipment provided.
   c. Copy of approved submittal information and system shop drawings as specified in Paragraph 1.03, Submittals, with corrections made to reflect actual system as tested, delivered and installed at the site. Provide half-size blackline reproductions of all shop drawings larger than 11 inches x 17 inches.
   d. Original copies of manufacturer's hardware, installation, assembly, and operations manuals for control system components.
   e. Control system description and system operation sequence instructions.

f. In separate binders, submit control and loop diagrams, electrical drawings, system description, operation instructions, and files on 3.5-inch, 1.44-Mb diskette.

F. Project Record Documents

1. Submit record documents under provisions of Section 01785 - Project Record Documents.

2. Revise system shop drawings and other submittals to reflect system as installed. Accurately record locations of controller cabinets and input and output devices connected to system. Include interconnection wiring and cabling information and terminal block layouts in a suitable drawing pocket installed inside the controller cabinet door.

3. Insert half-size blackline prints of wiring diagrams applicable to each control panel in a clear plastic envelope and store in a suitable print pocket or holder inside each control panel.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications. Manufacturer shall be a company specializing in manufacturing products specified in this Section, having proven compatibility with the City's existing facilities and at least 3 years of documented experience. The company shall maintain service facilities within 100 miles of the City of Houston.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site in factory-sealed containers. Store and protect products under provisions of Section 01610 - Basic Product Requirements.

B. Check for damage upon receiving products on site.

C. Store products in a clean, dry area; maintain temperature in accordance with NEMA ICS 1.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature above 32 degrees F and below 104 degrees 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.

1.07 MAINTENANCE SERVICE

A. Provide manufacturer's maintenance services for hardware products for one year from Date of Substantial Completion without additional cost to the City.

PART 2 P R O D U C T S

2.01 CONTROL SWITCHES AND INDICATOR LIGHTS

A. Manufacturers

1. Automatic Timing and Controls Company.

2. Cutler Hammer.

3. Eagle Signal Company.

4. General Electric Company.

5. Square D Company.

6. Allen Bradley.

B. Substitutions. Comply with Section 01630 - Product Substitution Procedures.

C. Control Switches

1. Contacts: NEMA ICS 2; at least two Form C contact sets.

2. Contact Ratings: NEMA ICS 120 VAC, 10 ampere inductive.

3. Selector Switch Operators: NEMA ICS 2; heavy-duty oil-tight NEMA 4 multi-position rotary selector switch.

4. Push-button Operator: NEMA ICS 2; heavy-duty oil-tight NEMA 4 unguarded and lockable type; black for start, red for stop.

D. Indicator Lights: Red for run, amber or yellow for alarm, green for control mode.

1. Indoor: LED, oil-tight, 120 VAC, 100,000-hour rated life expectancy.

2. Outdoor: Incandescent, oil-tight, rated voltage approximately 125 percent of nominal operating voltage.

2.02 CONTROL RELAYS

A. Contacts: NEMA ICS 2; three Form C contact sets.

B. Rating: NEMA ICS 2; 120 VAC, 10 ampere inductive.

C. Coil Voltage: 120 VAC, 60 Hz.

D. Socket: Turck S3B with coding system, label and label holder (11 pin).

E. Features. 11-pin socket relay base, external color-coded test button, mechanical and electrical status indications, impact-resistant thermoplastic case.

F. Manufacturer: Turck, Inc., or approved equal.

2.03 TIME DELAY RELAYS

A. Contacts: NEMA ICS 2; three Form C contact sets.

B. Contact Ratings: NEMA ICS 2; DPDT Class; 120 VAC 10 ampere inductive.

C. Coil Voltage: 120 VAC, 60 Hz..

D. Socket: Turck S3B with coding system, label and label holder (11-pin).

E. Description. Control relay as specified above in Paragraph 2.03, with added Time Cube Module as manufactured by Turck, Inc.; series CT3, with on or off delay, as indicated.

F. Features. DIP switch-selectable timing ranges of 0.2 to 3 seconds, 0.8 to 12 seconds, 0.1 to 1.5 minutes and 0.8 to 12 minutes; externally-adjustable graduated time dial; solid-state digital timing system.

2.04 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: 480/240 volt primary, 120 volt secondary, single phase.

2.05 PHASE/VOLTAGE MONITOR RELAY

A. Manufacturer, Product: Diversified Electronics Inc.; Model SLM Series.

B. Description. All three phases monitored individually for preselected under and over voltage limit phase loss, phase unbalance, phase reversal, frequency shift and phase shift. Automatic reset after adjustable release delay when line conditions return to normal.

C. Indicators: LED indicators for under and over voltage limit.

D. Output Rating: DPDT, 3 amps resistive at 600 VAC.

E. Phase Sequence: ABC.

F. Sampling Time: 2 seconds.

G. Spare Unit. In addition to the unit installed, furnish one spare phase/voltage monitor relay.

2.06 TERMINAL BLOCKS

A. Manufacturers

1. Bussmann.

2. Entrelec, Inc.

3. General Electric Company.

4. Phoenix Contact.

5. Weidmuller.

6. Allen Bradley.

B. Substitutions. Comply with Section 01630 - Product Options and Substitutions.

C. Terminal Blocks. Provide isolated fused snap-on type terminal blocks.

D. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.

E. Signal and Control Terminals: Modular construction type suitable for channel mounting with tubular pressure screw connectors; 300 volt rating.

F. Provide color-coded (green/yellow) ground bus terminal block, with each connector bonded to enclosure.

2.07 LEVEL RECORDER

A. Not required

2.08 ACCESSORIES

A. Plastic Raceway: Plastic slotted wireway with snap-on locking covers.

B. Manufacturer

1. Anixter Bros., Inc.

2. Delaware Industries, Inc.

3. Panduit Corp.

PART 3 E X E C U T I O N

3.01 SYSTEM DESCRIPTION

A. Level Measurement System. Equip pump station with two independent well level measurement systems, each system consisting of an air cell with associated air piping and tubing to provide a pneumatic signal proportional to well level, and associated transmitters, recorders and pressure switches as specified, and as indicated on the Drawings.

B. Air Cells. Fabricate and install each air cell assembly to provide an airtight pneumatic system. Lower air cells into pump wells through access manholes provided and arrange to allow removal after initial installation. Air cell assemblies shall consist of:

1. Support Piping: 1-1/4-inch diameter stainless steel pipe coupled as shown in maximum 10-foot sections. Drill a 1/4-inch diameter hole in each section horizontally 18 inches below the threaded fitting to provide support during removal and disassembly. Brace support piping every 15 feet.

2. Air Tubing: 1/4-inch diameter soft copper tubing with PVC outer jacket. Install air tubing continuous without couplings from control cabinet to air cell suspension rod top. Weld or braze copper tubing to air cell to assure leak-free operations.

3. Air Cell: 18-inch long, 3-inch diameter stainless steel pipe with threaded cap. Drill and tap cap to accept a brass pneumatic fitting for attachment of air tubing. Wrap fitting with PVC tape after testing.

4. Blowdown Valves: Provide a schrader valve and isolation valves for each air cell to pressurize the pneumatic devices (calibration) or purge the air line using a hand pump.

C. Primary Level Measurement System: An air cell assembly with independent dual setpoint latching pressure switches for each pump, and a pneumatic 7-day chart recorder.

D. Secondary Level Measurement System: An air cell assembly with high-level pressure switch.

E. Primary Pump Control

1. Accomplish via independent latching pressure switches set to start and stop each pump at preselected levels. Provide alternator relay to sequence pumps.

2. Provide hardware timer to stagger pump starts (add time cube modules to pump start relays).

3. Provide hardware interlocks to stop pumps when overload, high temperature or phase failure occurs.

F. Secondary Pump Control. When high level switch is energized, both pumps shall be activated to run and alarm must be initiated.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and 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 on Drawings.

3.04 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Section 01755 - Starting Systems.

3.05 DEMONSTRATION

A. Provide systems demonstration under provisions of Section 01770 - Closeout Procedures.

B. Demonstrate operation of control system. Provide 2 sessions of 1 hour of instruction each for 2 persons, to be conducted at project site with manufacturer's representative.

C. System demonstration shall include complete verification of field wiring and control system.

END OF SECTION

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

****

A. Coordinate this specification with other specifications including the following related Sections:

Section 01450 - Contractor's Quality Control
Section 01610 - Basic Product Requirements
Section 01630 - Product Substitution Procedures
Section 01755 - Starting Systems
Section 01770 - Closeout Procedures
Section 01782 - Operations and Maintenance Data
Section 01785 - Project Record Documents
Section 13446 - Primary Instrumentation Devices
Section 13471 - Control Cabinet Enclosures
Section 16195 - Wiring and Conduit Identification
Section 16902 - Electric Controls and Relays

****

END OF NOTES

SECTION 13471

CONTROL CABINET ENCLOSURES

PART 1 - G E N E R A L

1.01 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include payment in lump sum bid for work of which this is a component part.

1.02 SECTION INCLUDES

A. Control cabinet enclosures for Control and Instrumentation Systems.

1.03 RELATED WORK

A. Section 13300 Process Instrumentation and Controls – General Provisions
B. Section 13310 SCADA Software Engineering Security and Quality Requirements
C. Section 13315 Process Instrumentation and Controls – Products
D. Section 13441 Pump Station Controls
E. Section 13500 Communication Backbone Cabling
F. Section 13510 Communication Horizontal Cabling
G. Section 13600 Control and Instrumentation Cable

1.04 REFERENCES

A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

B. ANSI/NFPA 70 - National Electrical Code (NEC).

C. Underwriters Laboratories, Inc. (UL).

D. Factory Mutual (FM).

E. Occupational Safety and Health Administration (OSHA).

F. American National Standards Institute (ANSI).

1.05 SUBMITTALS

A. Conform to Section 01330 - Submittal Procedures.

B. Product Data: Provide manufacturer's product literature and specifications.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Paragraph 1.04, Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.06 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70 (NEC).

B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and shown; install in accordance with UL requirements.

C. All control cabinets, regardless of who manufactures these, shall have applicable NEMA rating and all the wiring within shall be UL approved, before shipping from the Plant to Project Site. All the wires shall be marked with pre-printed, tubular heat shrink wire and cable markers per Section 16195.

1.07 EXTRA MATERIALS

A. Provide two keys for each cabinet; key locks as directed by City Engineer to operate in current City of Houston master keying system.

B. Insert half-size blackline prints on rite in the rain all weather writing paper model 8511 of the complete wiring diagrams, schematics, and loop diagrams applicable to each control panel in a clear plastic envelope and store in a suitable print pocket or holder inside each control panel.

PART 2 - P R O D U C T S

2.01 MANUFACTURERS

A. Acceptable Manufacturers
   1. Rittal,
   2. Hennessey Products, Inc.
   3. Hoffman Engineering.
   4. Hammond Manufacturing
   5. The EMF Company.
   6. Rose Enclosure.
   7. Weigman Company.
   8. N.E.M.A. Enclosure Mfg. Co.

B. Substitutions: Comply with Section 01630 - Product Substitutions and Procedures.

2.02 INDOOR CONTROL CABINETS

A. Enclosure: NEMA 250, Type 12; if requested by City Engineer, obtain Underwriters Laboratory, Inc. approval after completion.

B. Enclosure Size: As indicated on Drawings; or, if not indicated, at least 72 inches high by 20 inches deep by 48 inches wide, or larger, as required to mount equipment indicated to U.L. Standards.

C. Backboard for mounting terminal blocks and components: 12 gauge steel, finished in white enamel.

D. Fronts: Steel pan-type doors with concealed stainless steel hinges, held closed by stainless steel 3-point latch operable by pistol-grip handle.

E. Provide solid metal barriers to separate compartments containing control wiring operating at less than 50 volts from power wiring.

F. 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.

G. Panel Construction: Provide panel stiffeners and bracing. Fully gasket doors. Weld seams and grind smooth.

H. Conduit Entrances: Bottom entry unless otherwise indicated on Drawings.

I. Material: Minimum 12 gauge steel.

J. Finish: Enamel; gray outside, white inside.

K. Provide convenience outlets and internal fluorescent lighting, as shown on Drawings.

L. 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. Provide nameplates for all devices within panel.

M. Install wiring in open-slot plastic wiring duct.

N. 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.

2.03 OUTDOOR CONTROL CABINETS

A. Enclosures: NEMA 4X series 300 stainless steel 0.125 inch thickness. If requested by City Engineer, obtain inspection and approval by Underwriters Laboratory, Inc., after installation of control system in cabinet.

B. Enclosure Size: As indicated on Drawings, or if not indicated, at least 72 inches high by 48 inches wide by 36 inches deep, or larger, as required to accommodate equipment and as indicated in UL standards.

C. Material: Exterior and interior enclosure doors, shelves and component enclosures: Fabricate of 14 gauge type 316 stainless steel.

D. Doors: Stainless steel pan-type construction, with full-length stainless steel piano hinge (for stainless steel or aluminum). Equip exterior door with padlock, heavy-duty locking pistol-grip handles 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.

E. Provide rain shield with 1 inch drip lip for outdoor cabinets to protect against direct sun radiation and rainfall. Design shield to provide 3-1/2 feet of cover front and back and 6 inches of cover on the sides. Design shield shall have a 1-inch open panel door clearance. Shielding material: Type 316 stainless steel.

F. 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. Provide nameplates for all devices within panel.

G. In each cabinet section, provide a 120V convenience outlet and a switched 40 watt minimum fluorescent light fixture, with 0 degrees F ballast in each section.

H. Inside and outside of cabinet shall be smooth and free from burrs.

I. Hinges shall be .090 inch thick minimum, aluminum, and shall have .250 inch diameter stainless steel hinge pin. Hinge leaves shall not be exposed externally when door is closed.

J. NEMA 4X enclosures shall have all bolt holes gasketed.

K. 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.

PART 3 - E X E C U T I O N

3.01 EXAMINATION

A. Verify that surface and job conditions are ready for construction; report unsatisfactory conditions to the City Engineer. Do not proceed with work until unsatisfactory conditions have been corrected.

3.01 INSTALLATION

A. Transport, handle and install products in accordance with manufacturer's instructions.

B. Install on prepared pads. Anchor securely at each corner. Shim and grout as required to form a watertight seal.

C. Install cabinet fronts plumb.

D. Field-cut bottom conduit entrance openings for outdoor cabinets. Seal removable plates with silicone sealant.

E. Install ground rod and equipment ground conductor.

F. Install separate instrument ground lug and ground conductor; connect to common station ground grid.

G. Mount devices to allow removal and reinstallation without backboard removal. Use stainless steel mounting hardware.

H. Except for nameplate fasteners, mounting or other hardware shall not penetrate panel exterior.

I. Exterior panels: Mount with stainless steel anchor bolts and ground to the station ground field. Install and test ground field to provide maximum 5 ohm resistance to ground in accordance with Section 16170 - Grounding and Bonding.

J. Provide door restraints for outer and inner doors to positive lock and hold doors open at 115 degrees minimum.

K. Label all wires with heat shrink markers per Section 16195.

END OF SECTION

SECTION 13500 - COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1

1.2 MEASUREMENT AND PAYMENT

A. Include payment in unit prices for Fiber optic cable described within this Section. Fiber optic cable will be paid based on actual installed quantities per unit price. Refer to Section 01270 – Measurement and Payment for unit price procedures.

B. Include payment in lump sum bid for all work described within this Section other than fiber optic cable.

1.3 SUMMARY

A. This Section includes the following:

1.
2. Fiber and Copper Cables
3. Splice Cases
4. Terminal Blocks and Cross-Connect Systems
5. Fiber Termination Equipment
6. Building Entrance Terminals
7. Maintenance Hole Racking and Duct Plug Equipment
8. Identification Products

1.4 RELATED WORK

Section 13300 Process Instrumentation and Controls – General Provisions
Section 13310 SCADA Software Engineering Security and Quality Requirements
Section 13315 Process Instrumentation and Controls – Products
Section 13441 Pump Station Controls
Section 13471 Control Cabinet Enclosures
Section 13510 Communication Horizontal Cabling
Section 13600 Control and Instrumentation Cable

1.5 REFERENCES

A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts:
1. Between referenced requirements: Comply with the one establishing the more stringent requirements.
2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements.

D. References:
1. ANSI/TIA/EIA-526-7 – Measurement of Optical power Loss of Installed Single-mode Fiber Cable Plant (Method A)
2. ANSI/TIA/EIA-526-14-A - Measurement of Optical power Loss of Installed Multi-mode Fiber Cable Plant
3. ANSI/TIA/EIA-568-B Commercial Building Telecommunications Cabling Standard
4. ANSI/TIA/EIA-568-B.3.1 – Additional Transmission Performance Specifications for 50/125μm Optical fiber Cables
5. ANSI/TIA/EIA-569-B - Commercial Building standard for Telecommunications Pathways and Spaces
6. ANSI/TIA/EIA-606-A Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
7. ANSI/TIA/EIA-758 Customer Owned Outside Plant Telecommunications Cabling Standard
8. International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) DIS11801, January 6, 1994
9. National Electrical Manufacturers Association (NEMA)
10. American Society for Testing Materials International (ASTM)
11. National Electrical Code (NFPA-70)
12. National Electrical Safety Code (NESC)
13. Underwriters Laboratories Inc. (UL 497)
14. BICSI Telecommunications Distribution Methods Manual (TDMM)
15. BICSI Customer Owned Outside Design Manual
16. Local, county, state and federal regulations and codes in effect as of date of purchase.
17. Equipment of foreign manufacture must meet U.S. codes and standards. It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.

1.6 SUBMITTALS

A. The Contractor shall perform no portion of the work requiring submittal and review of record drawings, shop drawings, product data, or samples until the

respective submittal has been approved by the Owner. Such work shall be in accordance with approved submittals.

B. Qualifications: The Contractor shall submit qualification data sheets for firms and persons as specified in the "Quality Assurance" article of this specification to demonstrate their capabilities and experience.

C. Proposed product data sheets: The Contractor shall submit catalog cut-sheets that include manufacturer, trade name, and complete model number for each product specified. Model number shall be handwritten and/or highlighted to indicate exact selection. Identify applicable specification section reference for each product.

D. Product data for cable test equipment

E. Cable test reports, in accordance with the "Field Quality Control" article of this specification.

F. Record Drawings: Furnish AutoCAD drawings of completed work including cable ID numbers following the Owner's labeling standards. Submit in hardcopy and electronic formats. Record drawings shall include room numbers and equipment rack numbers labeled per TAMU labeling standards.

1.7 QUALITY ASSURANCE

A. Contractor Qualifications:

1.
2. The Contractor shall submit references and other related evidence of installation experience for a period of three years prior to the issue date of this Specification.
3. The contractor shall be certified by the manufacturer of the products, adhere to the engineering, installation and testing procedures and utilize the authorized manufacturer components and distribution channels in provisioning this Project.
4. Work shall be supervised on-site by a BICSI RCDD. Must demonstrate knowledge and compliance with all BICSI, TIA/EIA, UL, and NEC methods, standards and codes.
5. All members of the installation team shall be certified by the manufacturer as having completed the necessary training to complete their part of the installation. Resumes of the entire team shall be provided along with documentation of completed training courses.
6. All Data contractor installation personnel must be BICSI Certified Installer Level 1 or higher. The onsite supervisor of the data contractor must be a BICSI Certified Technician. The data contractor must have on staff a BICSI Certified RCDD. All certifications must be current. Proof of certification must be presented at the pre-installation meeting.

B. Standard Products

1.
2. Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of telecommunications cabling products and shall be the manufacturer's latest standard design in satisfactory use for at least one year prior to bid opening.

3. Provided products shall meet the following requirements: Items of the same classification shall be identical. This requirement includes equipment, assemblies, parts, and components.

C. Assure that the "as installed" system is correctly and completely documented including engineering drawings, manuals, and operational procedures in such a manner as to support maintenance and future expansion of the system.

D. Materials and equipment: Equipment shall be rated for continuous operation under the ambient environmental temperature, humidity, and vibration conditions encountered at the installed location. The equipment shall meet the following requirements:

1.
2. Interior controlled environment: 60 to 100 degrees F dry bulb and 20 to 90 percent relative humidity, non-condensing.
3. Interior uncontrolled environment: 0 to 130 degrees F dry bulb and 10 to 95 percent relative humidity, non-condensing.
4. Exterior environments: Minus 30 degrees to 130 degrees F dry bulb, and 10 to 100 percent relative humidity, condensing.
5. Hazardous environment: All system components located in areas where fire or explosion hazards may exist because of flammable gas or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings, shall be rated and installed according to Chapter 5 of the NFPA 70 and as shown.

1.8 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating units without field measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

1.10 DELIVERY AND STORAGE

A. Equipment shall be delivered in original packages with labels intact and identification clearly marked.

B. Equipment shall not be damaged in any way and shall comply with manufacturer's operating specifications.

C. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants. Equipment damaged prior to system acceptance shall be replaced at no cost to the Owner.

1.11 COORDINATION

A. Field coordinate installation of conduit and cable with other trades to ensure clearance requirements are met.

B. Coordinate with all contractors providing equipment outside the scope of this contract.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Backbone Optical Fiber Cable, Patch Cables and Connecting Hardware

1.
2. Panduit
3. Corning
4. Commscope

B. Splice Cases

1.
2. Preformed
3. 3M
4. Corning

C. Building Entrance Terminals

1.
2. Protectors: Circa
3. Modules: Oneac

2.2 OPTICAL FIBER CABLE

A. General Requirements

1.
2. Optical Fiber shall be certified to meet all parts of TIA/EIA-455 and comply with TIA/EIA-492, ISO/IEC 11801, ANSI/ICEA S-83-596 and ANSI/ICEA S-83-640 and the NEC.
3. Fibers shall have D-LUX coating or approved equivalent to ensure color retention, minimize microbending losses and improve handling. The coating shall be mechanically strippable.
4. Cable installed in plenums or air-handling spaces shall meet UL 910 and shall be marked OFNP (optical fiber non-conductive plenum) in accordance with the NEC. Plenum Fiber rated cable consisting of multiple fibers shall have a Plenum PVC outer jacket. Each group of fibers shall have a color-coded Low Smoke PVC buffer. The buffered fibers are

organized in subunits of fibers, reinforced with aramid yarn for extra strength and surrounded with a color-coded low smoke tube.

5. Riser cable shall meet UL 1666 and be marked OFNR (optical fiber non-conductive riser) in accordance with the NEC. Non-plenum, riser rated cable consisting of multiple fibers, shall have an orange, Polyvinyl Chloride (PVC) outer jacket.
6. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B. Jacket shall be imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).
7. Breakout kits and splice trays for terminations shall be provided by the same manufacturer as cable.
8. Fiber cable shall be riser rated indoor/outdoor interlocking armored central cable, and meet or exceed the transmission performance specifications listed in ANSI/TIA/EIA-568-B.3 and ANSI/TIA/EIA-758(A).
9. Optical fibers conductors shall follow standard color code schemes. Fiber numbers and binders shall correspond to the color codes as follows:
    a.
    b. Fiber/Binder No. 1 – blue
    c. Fiber/Binder No. 2 – orange
    d. Fiber/Binder No. 3 – green
    e. Fiber/Binder No. 4 – brown
    f. Fiber/Binder No. 5 – slate
    g. Fiber/Binder No. 6 – white
    h. Fiber/Binder No. 7 – Red
    i. Fiber/Binder No. 8 – Black
    j. Fiber/Binder No. 9 – Yellow
    k. Fiber/Binder No. 10 – Violet
    l. Fiber/Binder No. 11 – Rose
    m. Fiber/Binder No. 12 – Aqua
10. The fiber optic cable shall be shipped on reels in lengths as specified.
    a.
    b. The cable shall be wound on the reel so that unwinding can be done without kinking the cable.
    c. Two meters of cable at both ends of the cable shall be accessible for testing.
    d. Marking: Each reel shall have a permanent label attached showing length, cable identification number, cable size, cable type, attenuation, bandwidth, and date of manufacture. Labels shall be water resistant and the writing on the labels shall be indelible.
11. Cable Minimum Bending Radius
    a.
    b. During Installation: 20 times cable diameter
    c. After Installation: 10 times cable diameter
12.
13. Operating Temperature Range: -76°F to 185°F (-60°C to 85°C)
14. Storage Temperature Range: -40°F to 149°F (-40°C to 65°C)
15. All optical fiber cables shall be installed in innerduct.

2.3 OPTICAL FIBER TERMINATION HARDWARE

A. Modular Fiber Optic Patch Panels

1.
2. Fiber patch panels shall have black all metal solid surfaces, padlock hasps on front and rear doors, legends to be installed inside.
3. Fiber patch panels shall support modular six or eight duplex LC connector bulkhead panels.
4. SM connector/coupler covers shall be yellow in color.
5. Side cable entry, side jumper entry
6. All coupler panels shall have ceramic sleeves/ferrules.
7. 19-inch rack-mountable
8. Accept 12, 24, or 48-strand terminations, as shown on Drawings.

B. Fiber Optic Cable Connectors

1.
2. Fiber optic cable connector shall be duplex LC.
3. Connector shall be properly sized for fiber type.
4. All termination methods shall be as specified as acceptable to the fiber cable manufacturer to maintain full cable manufacturer's warranty and industry standard expected life cycle. Construction shall be applicable for the intended installation environment.

2.4 OPTICAL FIBER PATCH CABLES

A. Buffered, graded-index fiber with a 50 micron core and a 125 micron cladding for multimode.

B. The fiber cladding shall be covered by aramid yarn and a jacket of flame-retardant PVC.

C. Provide factory assembled patch cords with LC style connectors with ceramic ferrules.

D. ISO 9001 Certified Manufacturer

E. Operating temperature: -4° to 158° F (-20 to 70° C)

F. Cable Retention: 50 lb. (220 N) minimum

G. Single mode patch cables shall be yellow.

H. Provide one duplex patch cord for each Fiber Optic Patch Panel termination pair.

I. Provide patch cables sized to routing requirements.

2.5 SPLICE CASES

A. Description: Fiber and Copper Splice Casing for use in underground and building entrance applications with two cable entrance ports on each end to facilitate butt or inline splices.

B. Case shall be water proof with encapsulation for underground use. Entrance splice cases shall be re-enterable with splicing modules capable of 50 percent growth.

C. Outdoor NEMA-rated enclosure, or splice case suitable for the site environmental conditions shall be provided for outside plant tube distribution and routing.

2.6 IDENTIFICATION (LABELING) SYSTEM

A. Labeling system shall consist of a hand-held portable printer and labels appropriate to the application. Handwritten labels are not acceptable.

B. Fiber termination hardware (designation strip): Thermal transfer printable label with a permanent acrylic adhesive, preferably .75" X .25".

C. 110 Copper termination hardware: Laser printable, non-adhesive label designed for 110 terminal block marking.

D. Patch cords, inside copper and low count (12 strands or less) fiber optic cable: Permanent acrylic adhesive, self-laminating vinyl wire and cable identification, 1.00" X 1.50" X .50".

E. Outside plant copper cable: Permanent acrylic adhesive, self-laminating vinyl wire and cable identification 1.50" X 6.00" X 1.50".

F. Outside and outside plant fiber cables: Permanent acrylic adhesive, self-laminating vinyl wire and cable identification 1.50" X 4.00" X 1.00".

G. All labels shall be permanent, i.e. will not fade, peel, or deteriorate due to environment or time and comply with TAMU labeling standards.

PART 3 - EXECUTION

3.1 PREPARATION

A. Contractor's on-site RCDD supervisor shall review, approve and stamp all shop drawings, coordination drawings and record drawings.

B. Verify all cable and materials have been tested prior to and after installation.

C. Verify all cable splices have been identified and adequate equipment is on hand to perform splicing.

D. Verify all equipment is certified and tested before being used to test cables.

3.2 INSTALLATION

A. Install work following drawings, manufacturer's instructions and approved submittal data. The number of cables per run, outlet configuration and other pertinent data are included on the drawings.

B. All installation shall be done in conformance with ANSI/TIA/EIA-568-B standards, BICSI methods and industry standards. The Contractor shall ensure

that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities. Failure to follow the appropriate guidelines shall require the Contractor to provide in a timely fashion the additional material and labor necessary to properly rectify the situation. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.

C. The contractor shall provide service loops (slack) for cables terminating in the telecommunications rooms. A 6-foot service loop shall be provided above the access ceiling or cable trays unless specified otherwise. This allows for future changes or expansion without installing new cables.

D. Backbone cable shall be installed in cable tray and/or conduit as shown in the Drawings. Backbone fiber shall be installed in innerduct within the cable tray or conduit. Cable hangers shall not be used to distribute backbone cable.

E. Identification: Label cable and terminations in accordance with Owner's labeling standards.

3.3 FIELD QUALITY CONTROL

A. Post Installation Testing

1.
2. Contractor shall test each fiber strand of every optical fiber cable prior to acceptance.
3. Contractor shall provide sufficient skilled labor to complete testing within a reasonable test period.
4. Contractor shall supply all of the required test equipment used to conduct acceptance tests.
5. Contractor shall submit acceptance documentation as defined in below. No cabling installation is considered complete until test results have been completed, submitted and approved as defined below.

B. Standards Compliance and Test Requirements

1.
2. Fiber Optic Cable shall meet the indicated performance specifications: ANSI/TIA/EIA 568-B.3 Optical Fiber Cabling Components Standard
3. All test equipment used shall meet the performance specifications defined below.

C. Cable Test Documentation

1.
2. Cable test documentation shall be submitted in hard copy in three-ring binders and electronic (CD-ROM) formats. If proprietary software is used, CD shall contain any necessary software application required to view test results. If the results are delivered in a standard format like Excel, Access, CSV files, etc., software to read these files is not required. Electronic reports shall be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate shall reference traceable circuit numbers that match the electronic record.
3. The following reports shall be submitted. Any individual test that fails the relevant performance specification shall be marked as FAILED.

a.
b. Certification test report for Fiber Optic cable.
c. OTDR and power meter test report for Fiber Optic cable.

4. Test reports shall include the following information for each cabling element tested:
   a.
   b. Wiremap results that indicate that 100% of the cabling has been tested for shorts, opens, miswires, splits, polarity reversals, transpositions, presence of AC voltage and end-to-end connectivity.
   c. Length (in meters), propagation delay, and delay skew relative to the relevant limit. Any individual test that fails the relevant performance specification shall be marked as a FAIL.
   d. Cable manufacturer, cable model number/type and nomical velocity of propagation (NVP)
   e. Tester manufacturer, model, serial number, hardware version, and software version
   f. Circuit ID number and project name
   g. Origination and destination locations.
   h. Autotest specification used
   i. Overall pass/fail indication
   j. Date of test
   k. Test reports shall be submitted within seven (7) business days of completion of testing.

D. Fiber Cable Testing

1.
2. Perform bi-directional end to end Optical Time Domain Reflectometer (OTDR) testing on each fiber optic conductor per TIA/EIA 455-61. The system loss measurements shall be provided at 850 and 1300 nanometers for multimode fibers and 1310 and 1550 for singlemode fibers. Measured results shall be plus/minus 1 dB of submitted loss budget calculations.
3. For cable length less than 1000 feet, initially test optical cable with a light source and power meter utilizing procedures as stated in ANSI/TIA/EIA-526-14A: OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable.
   a.
   b. Measured results shall be plus/minus 1 dB of submitted loss budget calculations.
   c. If loss figures are outside this range, test cable with optical time domain reflectometer to determine cause of variation. Correct improper splices and replace damaged cables at no charge to the owner.
4.
5. Fiber links shall have a maximum loss of: (allowable cable loss per km)(km of fiber in link) + (.4dB)(number of connectors) = maximum allowable loss
6. Loss numbers for the installed link shall be calculated by taking the sum of the bi-directional measurements and dividing that sum by two.
7. Any link not meeting the requirements of the standard shall be brought into compliance by the contractor, at no charge to the Owner.
8. Submit OTDR and/or Power Loss test results and include the following:

a.
b. Fiber Type
c. Wavelength
d. Fiber and cable number
e. End point locations
f. Test direction
g. Reference power measurement (when not using a power meter with a Relative Power Measurement Mode)
h. Measured attenuation of the link segment
i. Acceptable link attenuation
j. Test equipment model and serial numbers
k. Date
l. Reference setup
m. Operator (crew members)

9. Acceptable Attenuation Values
   a.
   b. The general attenuation equation for any link segment is as follows; Acceptable Link Attn. = Cable Attn. + Connection Attn. + Splice Attn. + Coupled Power Ration (CPR) Adjustment.
   c. Note: A connection is defined as the joint made by mating two fibers terminated with re-mateable connectors (e.g. SC, LC).

E. Cable Test Equipment

1.
2. Test equipment used under this contract shall be from manufacturers that have a minimum of 5 years experience in producing field test equipment. Manufacturers shall be ISO 9001 certified.
3. Test equipment for multimode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-14-A. The light source shall meet the launch requirements of ANSI/TIA/EIA-455-50B, Method A. The cable installers shall have a copy of these references in their possession and be familiar with the contents.
4. The test instrument shall be within the calibration period recommended by the manufacturer.
5. Test instruments shall have the latest software and firmware installed.
6. All test tools of a given type shall be from the same manufacturer, and have compatible electronic results output.
7. Test adapter cables shall be approved by the manufacturer of the test equipment. Adapters from other sources are not acceptable.

F. No cable shall be put into service until it is fully tested and accepted by the Designer and Owner.

3.4 CLEANING

A. Remove all unnecessary tools and equipment, unused materials, packing materials, and debris from each area where Work has been completed unless designated for storage.

3.5 ACCEPTANCE

A. Once all work has been completed, test documentation has been submitted and approved, and the Owner is satisfied that all work has been completed in accordance with contract documents, the Owner will notify Contractor in writing of formal acceptance of the system.

B. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100 percent PASS rating, and submittal and approval of full documentation as described above.

C. Owner reserves the right to conduct, using Contractor equipment and labor, a random re-test of up to five percent of the cable plant to confirm documented results. Random re-testing, if performed, shall be at the expense of the Owner, using standard labor rates. Any failing cabling shall be re-tested and restored to a passing condition at no cost to the Owner. In the event more than two percent of the cable plant fails during re-test, the entire cable plant shall be re-tested and restored to a passing condition at no additional cost to the Owner.

D. Owner may agree to allow certain cabling runs to exceed standardized performance criteria (e.g. length). In this event, such runs shall be explicitly identified and excluded from requirements to pass standardized tests.

END OF SECTION

SECTION 13510

COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include payment in lump sum bid for work of which this is a component part.

1.2 SUMMARY

A. This Section includes horizontal cable, patch panels, connectors, patch cables, outlets, terminal blocks, etc. as required to provide a complete system. This section specifies the following types of control and signal transmission media:

1. UTP Copper: Category 6
2. Serial Data Cable

1.3 RELATED WORK

A. Section 13300 Process Instrumentation and Controls – General Provisions

B. Section 13310 SCADA Software Engineering Security and Quality Requirements

C. Section 13315 Process Instrumentation and Controls – Products

D. Section 13441 Pump Station Controls

E. Section 13471 Control Cabinet Enclosures

F. Section 13500 Communication Backbone Cabling

G. Section 13600 Control and Instrumentation Cable

1.1 REFERENCES

A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts:

1. Between referenced requirements: Comply with the one establishing the more stringent requirements.
2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements.

D. References:

1. ANSI/TIA/EIA-568-B Commercial Building Telecommunications Cabling Standard
2. ANSI/TIA/EIA-569-B - Commercial Building standard for Telecommunications Pathways and Spaces
3. ANSI/TIA/EIA-606-A Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
4. International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) DIS11801, January 6, 1994
5. National Electrical Manufacturers Association (NEMA)
6. American Society for Testing Materials International (ASTM)
7. National Electrical Code (NFPA-70)
8. National Electrical Safety Code (NESC)
9. Underwriters Laboratories, Inc. (UL 497)
10. BICSI Telecommunications Distribution Methods Manual (TDMM)
11. BICSI Customer Owned Outside Design Manual
12. Local, county, state and federal regulations and codes in effect as of date purchase.
13. Equipment of foreign manufacture must meet U.S. codes and standards. It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.

1.2 SUBMITTALS

A. The Contractor shall perform no portion of the work requiring submittal and review of record drawings, shop drawings, product data, or samples until the respective submittal has been approved by the Owner. Such work shall be in accordance with approved submittals.

B. Qualifications: The Contractor shall submit qualification data sheets for firms and persons as specified in the "Quality Assurance" article of this specification to demonstrate their capabilities and experience.

C. Proposed product data sheets: The Contractor shall submit catalog cut-sheets that include manufacturer, trade name, and complete model number for each product specified. Model number shall be handwritten and/or highlighted to indicate exact selection. Identify applicable specification section reference for each product.

D. Product data for test equipment

E. Cable test reports in accordance with the "Field Quality Control" article of this specification.

F. Record Drawings: Furnish CAD drawings of completed work including cable ID numbers following the Owner's labeling standards. Submit in hardcopy (two full size and two half size) and electronic formats. Record drawings shall include room numbers and equipment rack numbers labeled per TAMU labeling standards.

G. Commissioning Functional Tests:

1. In the event project specific functional test reports/checklists are not provided by the Owner or Commissioning Consultant, the Subcontractor shall develop and submit project specific functional test report/checklist for each system, subsystem, or equipment including interfaces and interlocks, and include a separate entry, with space for comments, for each item to be tested.
2. CONTENT

   a. The functional test report/checklists shall include operating the system and components through each of the written sequences of operation, for all modes of operation for each identified sequence, including but not limited to: startup, shutdown, unoccupied mode, manual mode, staging, miscellaneous alarms, power failure, CO2 purge, CO purge, economizer, security alarm when impacted, and interlocks with other systems or equipment, as applicable.

3. FORMAT

   a. The test report/checklist shall be formatted in an action-response format with a Yes/No checkbox to allow for clearly marking whether or not the identified anticipated response for each applicable control device and monitored point was achieved.
   b. The format of each report/checklist shall be tabular including step-by-step procedures so that the test is clear, sequential, and repeatable with a single line entry for each specific action and a single line entry for each applicable response (both hardware/device related as well as soft responses, e.g. alarms, trends, set-point changes, etc.).

4. The requirements stipulated in this section are in accordance with Section 01 91 00 – General Commissioning Requirements, and provide requirements for the Contractor

1.3 QUALITY ASSURANCE

A. Contractor Qualifications:

1. The Contractor shall submit references and other related evidence of installation experience for a period of three years prior to the issue date of this Specification.

2. The contractor shall be certified by the manufacturer of the products, adhere to the engineering, installation and testing procedures and utilize the authoriz manufacturer components and distribution channels in provisioning this Project.
3. Work shall be supervised on-site by a BICSI RCDD. Must demonstrate knowledge and compliance with all BICSI, TIA/EIA, UL, and NEC methods, standards and codes.
4. All members of the installation team shall be certified by the manufacturer as having completed the necessary training to complete their part of the installation. Resumes of the entire team shall be provided along with documentation of completed training courses.

B. Standard Products

1. Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of telecommunications cabling products and shall be the manufacturer's latest standard design in satisfactory use for at least one year prior to bid opening.
2. Provided products shall meet the following requirements: Items of the same classification shall be identical. This requirement includes equipment, assemblies, parts, and components.
3. Single Point of Contact Responsibility: All cable and components of each kind shall be covered by a single warranty program with a single point of contact. For fiber optic and Category 6 UTP cable, cable and connecting hardware shall be manufactured by the same company or be part of the same cabling system, i. warranted by the manufacturer(s) as one cabling system.

C. Assure that the "as installed" system is correctly and completely documented including engineering drawings, manuals, and operational procedures in such a manner as to support maintenance and future expansion of the system.

D. Materials and equipment: Equipment shall be rated for continuous operation under the ambient environmental temperature, humidity, and vibration conditions encountered at the installed location. The equipment shall meet the following requirements:

1. Interior controlled environment: 60 to 100 degrees F dry bulb and 20 to 90 percent relative humidity, non-condensing.
2. Interior uncontrolled environment: 0 to 130 degrees F dry bulb and 10 to 95 percent relative humidity, non-condensing.
3. Exterior environments: Minus 30 degrees to 130 degrees F dry bulb, and 10 to 100 percent relative humidity, condensing.
4. Hazardous environment: All system components located in areas where fire or explosion hazards may exist because of flammable gas or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings, shall be rated and installed according to Chapter 5 of the NFPA 70 and as shown.

1.4 WARRANTY

A. The Contractor shall provide a joint written warranty of the manufacturer(s) and the installer(s), on a single document. The document shall warrant complete installation of the equipment, system, and software to be free from defects in materials and workmanship for a period of no less than 20 years for horizontal copper and 25 years for fiber, starting with the date of Final System Acceptance.

B. Contractor shall warrant that all approved cabling components meet or exceed the specifications provided in the product data submittal and exceed ANSI/TIA/EIA-568-B and ISO/IEC 11801 for the warranty period. The warranty shall apply to all passive SCS components.

C. Copper horizontal distribution media components, including cabling, jacks and connecting hardware, shall carry warranty to meet applicable Category 6 performance standards as defined in ANSI/TIA/EIA-568-B series of standards and addenda and in manufacturer specifications.

D. Fiber optic multimode horizontal distribution media components, including cabling, connectors, splices, and jacks, shall carry warranty to meet applicable transmission performance requirements of the ANSI/TIA/EIA-568-B series of standards and addenda and in manufacturer specifications.

E. The Contractor shall warrant that the proposed merchandise will conform to its description and any applicable specifications, and shall be of good quality for the known purpose for which it is intended.

F. The product warranty shall cover the replacement or repair of defective products and labor for the replacement or repair of such defective products.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating units without field measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

1.6 DELIVERY AND STORAGE

A. Equipment shall be delivered in original packages with labels intact and identification clearly marked.

B. Equipment shall not be damaged in any way and shall comply with manufacturer's operating specifications.

C. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants. Equipment damaged prior system acceptance shall be replaced at no cost to the Owner.

1.7 COORDINATION

A. Field coordinate installation of conduit and cable with other trades to ensure clearance requirements are met.

B. Coordinate cable routing to avoid interference with other work disciplines.

C. Coordinate installation with other trades and furniture installers.

D. Coordinate with all contractors providing equipment outside the scope of this contract.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Horizontal Copper Cable and Connecting Hardware:

1. Berk-Tek
2. NextLAN (Leviton connecting hardware/Superior Essex cable)
3. Mohawk

2.2 HORIZONTAL COPPER UTP CABLE

A. Cable shall be four pair, 23 or 24 AWG, Category 6 cable: the cable shall have cable length markers minimum every two feet and relevant UL markings. Cable type to be above base level category 6 cable, equivalent or better than Berk-Tek Lanmark 1000.

B. Category 6 four-pair UTP with continuous blue jacket.

C. Cable jacket shall comply with NEC Article 800 for use as a plenum cable and shall be UL and c (UL) Listed Type CMP (communications multipurpose plenum).

D. Cable shall terminate on an eight-pin modular jack at each outlet. All horizontal cabling shall meet or exceed the ANSI/EIA/TIA-568-B.2 Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components.

E. Cables shall be marked as UL verified with a minimum of Category 6 rating.

F. The cable shall support Voice, Analog Baseband Video/Audio, Fax, Modem, Switched 56, T-1, ISDN, RS-232, RS-422, RS-485, 10BASE-T Ethernet, Token Ring, 100Mbps TP-PMD, 100BASE-T Ethernet, 155 Mbps ATM, AES/EBU Digital Audio, 270 Mbps

Digital Video, 622 Mbps 64-CAP ATM and emerging high-bandwidth applications, including 1 Gbps Ethernet, gigabit ATM, as well as all 77 channels (550 MHz) of analog broadband video.

G. The maximum horizontal cable length for horizontal copper UTP cable from the termination of the cable in the communications room to the outlet is 295 feet.

H. Cable shall meet or exceed the following electrical characteristics:

1. Mutual capacitance: 47.8 nF/m
2. Characteristic impedance: (± 3%) of 100 Ohms 1-550 MHz
3. DC resistance maximum: 9.83 Ohms/100m
4. Positive ACR: Out to 395 MHz-km

2.3 COPPER TERMINATION HARDWARE

A. Copper Patch Panels

1. Component certified to meet or exceed Category 6 standards.
2. Configuration: Modular RJ-45 non-keyed 8-position jack port to 110 printed circuit board, factory pre-wired, Category 6 standards, EIA/TIA T568B, active pins: 1 through 8, connection hardware: IDC PCB (printed circuit board) mounted connector for 22-26 AWG.
3. Individual patch panel size not to exceed 48 ports, black finish.
4. Basis of Design: Leviton
5. The termination block on the patch panel shall support the appropriate Category 6 applications, including 100 Base-T, 52/155 Mbps ATM, and 1000 BASE-T Gigabit Ethernet, and facilitate cross connection and inter connection using modular patch cords.
6. All modular cross connect panels shall be UL listed.

B. Work Area Outlets

1. 8P8C non-keyed modular outlets for applications up to one Gbps and ANSI/TIA/EIA-568-B compliant for Category 6 transmission requirements
2. Part of the UL LAN Certification and Follow-up Program
3. T568B eight-position jack pin/pair assignments
4. Faceplates shall be white or ivory to match electrical outlets with four positions. Category 6 jacks shall be red in color.
5. Wall Phone Plates: Single jack wall plates shall be stainless steel, contain six conductor jacks and accept standard wall phones.

2.4 COPPER PATCH CABLES

A. Provide Category 6 Modular Patch Cord for each installed port.

B. Patch cables shall be performance and impedance matched with horizontal cables and provided by the same manufacturer of the horizontal cable.

C. All Category 6 patch cables shall conform to the requirements of TIA/EIA-568-B.2 for Category 6.

D. Cords shall be equipped with an eight-pin modular connector on each end and shall be of appropriate length for application.

E. Where applicable (only when connecting voice outlets to copper riser), provide hybrid patch cords. Cords shall be one-pair stranded D8PS (RJ45) connector on one end and 110GS on the other end and shall be of appropriate length for application.

F. All Category 6 cordage shall be round, and consist of 24 AWG minimum copper, stranded conductors, tightly twisted into individual pairs.

G. Maximum equipment cable length from the work area outlet to the device should be limited to 10 feet. Maximum cable length for jumpers and patch cords in the communications room should be limited to 20 feet.

H. Jacket color shall be Black.

I. Data Patch Cables for within MDF and IDF rooms shall be Black without boots. Provide patch cables in the following quantities:
   1. 45% - 5'-0"
   2. 50% - 7'-0"
   3. 5% - 10'-0"

J. Data Patch Cables at User end outlet shall be Black with boots. Provide patch cables in the following quantities:
   1. 90% - 10'-0"
   2. 5% - 15'-0"
   3. 5% - 20'-0"

2.5 IDENTIFICATION (LABELING) SYSTEM

A. Labeling system shall consist of a hand-held portable printer and labels appropriate to the application. Handwritten labels are not acceptable.

B. Fiber termination hardware (designation strip): Thermal transfer printable label with a permanent acrylic adhesive, preferably .75" X .25"

C. Patch panels: Gloss white film with a permanent acrylic based adhesive, .375" X .60"

D. Modular Faceplate: Highly durable, non-adhesive, polypropylene tag stock used for thermal transfer printing of faceplate designation strip, 1.938" x .375"

E. Horizontal cabling, patch cords, inside copper and low pair count (12 strands or less) fiber optic cable: Permanent acrylic adhesive, self-laminating vinyl wire and cable identification 1.00" X 1.50" X .50"

F. All labels shall be permanent, i.e. will not fade, peel, or deteriorate due to environment or time.

PART 3 - EXECUTION

3.1 PREPARATION

A. Contractor's on-site RCDD supervisor shall review, approve and stamp all shop drawings, coordination drawings and record drawings.

B. Verify all cable and materials have been tested prior to and after installation.

C. Verify all equipment is certified and tested before being used to test cables.

D. Verify that no horizontal copper cable run is greater than 295 feet from the outlet, through the provided pathway, to the communications room termination panel, including slack and service loops.

3.2 INSTALLATION

A. Install work following drawings, manufacturer's instructions and approved submittal data.

B. All installation shall be done in conformance with ANSI/TIA/EIA-568-B standards, BICSI methods and industry standards. The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities. Failure to follow the appropriate guidelines shall require the Contractor to provide in a timely fashion the additional material and labor necessary to properly rectify the situation. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.

C. The contractor shall provide service loops (slack) for cables terminating in the telecommunications rooms. A 6-foot service loop shall be provided above the access ceiling unless specified otherwise. This allows for future changes or expansion without installing new cables.

D. Horizontal cable shall be installed in conduit from work area outlet to ceiling. From conduit, cable shall be distributed by cable hangers to the nearest junction box. Cable shall be run parallel and perpendicular to building structure. Refer to 27 05 28 Pathways for Communications for additional pathway requirements.

E. Identification: Label cable and terminations in accordance with Owner's labeling standards.

3.3 FIELD QUALITY CONTROL

A. Post-Installation Testing

1. Contractor shall test each Category 6 cable prior to acceptance.
2. Contractor shall supply all of the required test equipment used to conduct acceptance tests.
3. Contractor shall submit acceptance documentation as defined below. No cabling installation is considered complete until test results have been completed, submitted and approved.

B. Test Procedure

1. Owner reserves the right to be present or to assign a representative to be present during any or all testing.
2. All Category 6 cable installed shall be tested to the complete category 6 test standards for permanent link using a Level IV test unit such as a Fluke DTX-1800. The unit must have been calibrated within the last year. Proof of calibration shall be provided at the pre-testing meeting.
3. All cabling not tested strictly in accordance with these procedures shall be re-tested at no additional cost to the Owner.
4. Testing of all copper wiring shall be performed prior to system(s) cutover.
5. 100% of the installed cabling shall be tested. All tests shall pass test criteria defined below.
6. Test equipment shall be fully charged prior to each day's testing.
7. Any pairs not meeting the requirements of the standard shall be brought into compliance by the contractor at no charge to the Owner. Complete end-to-end test results shall be submitted to the Owner.

C. Cable Test Documentation

1. Cable test documentation shall be submitted in hard copy in three-ring binders and electronic (CD-ROM) formats. If proprietary software is used, CD shall contain any necessary software application required to view test results. If the results are delivered in a standard format like Excel, Access, CSV files, etc., software to read these files is not required. Electronic reports shall be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate shall reference traceable circuit numbers that match the electronic record.
2. The following reports shall be submitted. Any individual test that fails the relevant performance specification shall be marked as FAILED.

   a. Certification test report for Category 6 cable

3. Test reports shall include the following information for each cabling element tested:

    a. Wiremap results that indicate that 100% of the cabling has been tested for shorts, opens, miswires, splits, polarity reversals, transpositions, presence of AC voltage and end-to-end connectivity.
    b. Length (in meters), propagation delay, and delay skew relative to the relevant limit. Any individual test that fails the relevant performance specification shall be marked as a FAIL.
    c. Cable manufacturer, cable model number/type and nomical velocity of propagation (NVP)
    d. Tester manufacturer, model, serial number, hardware version, and software version
    e. Circuit ID number and project name
    f. Origination and destination locations
    g. Autotest specification used
    h. Overall pass/fail indication
    i. Date of test

4. Test reports shall be submitted within seven (7) business days of completion of testing.

D. Cable Test Equipment

1. Test equipment used under this contract shall be from manufacturers that have a minimum of 5 years experience in producing field test equipment. Manufacturers shall be ISO 9001 certified.
2. Test equipment for Category 6 UTP shall be UL verified to meet Level III accuracy as specified in ANSI/TIA/EIA-568-B.2-1. The cable installers shall have a copy of this reference in their possession and be familiar with the contents.
3. The test instrument shall be within the calibration period recommended by the manufacturer.
4. Test instruments shall have the latest software and firmware installed.
5. All test tools of a given type shall be from the same manufacturer, and have compatible electronic results output.
6. Test adapter cables shall be approved by the manufacturer of the test equipment. Adapters from other sources are not acceptable.

E. No cable shall be put into service until it is fully tested and accepted by the Designer and Owner.

3.4 CLEANING

A. Remove all unnecessary tools and equipment, unused materials, packing materials, and debris from each area where Work has been completed unless designated for storage.

3.5 ACCEPTANCE

A. Once all work has been completed, test documentation has been submitted and approved, and the Owner is satisfied that all work has been completed in accordance with contract documents, the Owner will notify Contractor in writing of formal acceptance of the system.

B. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100 percent PASS rating, and submittal and approval of full documentation as described above.

C. Owner reserves the right to conduct, using Contractor equipment and labor, a random re-test of up to five percent of the cable plant to confirm documented results. Random re-testing, if performed, shall be at the expense of the Owner, using standard labor rates. Any failing cabling shall be re-tested and restored to a passing condition at no cost to the Owner. In the event more than two percent of the cable plant fails during re-test, the entire cable plant shall be re-tested and restored to a passing condition at no additional cost to the Owner.

D. Owner may agree to allow certain cabling runs to exceed standardized performance criteria (e.g. length). In this event, such runs shall be explicitly identified and excluded from requirements to pass standardized tests.

END OF SECTION

Section 13600

CONTROL & INSTRUMENTATION CABLE

PART 1 - G E N E R A L

1.01 MEASUREMENT AND PAYMENT

A. Include payment in base bid unit prices for cabling described within this Section. Payment will be based on actual installed quantities per unit price. Refer to Section 01270 – Measurement and Payment for unit price procedures.

1.02 SECTION INCLUDES

A. Control and Instrumentation Cabling other than Communications Cabling

1.03 RELATED WORK

A. Section 13300 Process Instrumentation and Controls – General Provisions
B. Section 13310 SCADA Software Engineering Security and Quality Requirements
C. Section 13315 Process Instrumentation and Controls – Products
D. Section 13441 Pump Station Controls
E. Section 13471 Control Cabinet Enclosures
F. Section 13500 Communication Backbone Cabling
G. Section 13510 Communication Horizontal Cabling

1.04 REFERENCES

A. 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.

3. ASTM B 33 - Tinned Soft or Annealed Copper Wire for Electrical Purposes.

4. ASTM B 174 - Bunch-stranded Copper Conductors for Electrical Conductors.

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), 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.

1.04 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. Conformance certificate.

1.05 QUALITY ASSURANCE

A. Tests.

1. Cable shall be tested at the factory to confirm that the cable complies with requirements of Part 6 of ICEA S-61-402, S-66-524 or S-68-516. Refer to data sheet for additional test requirements.

1.06 DELIVERY STORAGE AND HANDLING

A. 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 ACCEPTABLE MANUFACTURERS

A. Alpha Wire Corporation

B. Belden Division, Cooper Industries, Inc.

C. Cablec Continental Cables Company

D. General Cable Company

E. Manhattan Electric Cable Corporation

F. 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 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 be as follows:

a. Single Phase 120 VAC Control Circuits: Two (2) #12 stranded conductors in a jacketed cable assembly.

b. 24 VDC Control Circuits: Two (2) #18 stranded conductors in a shielded and jacketed cable assembly.

B. Conductors. Provide conductors which are concentric or bunch-stranded, annealed tinned copper with physical and electrical properties conforming to ASTM B 3, ASTM B 8 or ASTM B 33 or ASTM B 174 and Part 3 of ICEA S-61-402, S-66-524, or S-68-516 unless otherwise specified on the 600-Volt Control Cable Data Sheets.

C. Insulation. Each conductor shall be insulated as specified on the 600-Volt Control Cable Data Sheets complying to 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 Section 3.2, Table 3-1 of ICEA S-61-402, S-66-524 or S-68-516 for 600 volt insulation. The minimum insulation thickness shall not be less than 90 percent of the nominal value.

D. Drain Wire. For shielded applications, provide drain wire Class B, seven-stranded, tin-coated copper in accordance with ASTM B 3, ASTM B 8, or ASTM B 33.

E. Shielding. Cable shielding shall consist of laminated, nonburning, mylar-backed aluminum tape applied helically around conductors with the aluminum side in continuous contact with the drain wire. The tape shall be wrapped around the conductors with a 25 percent minimum overlap.

F. Jacket.

1. When control cables are to be enclosed in conduit, ducts or in other raceway systems, the cables shall be of the non-metallic type and shall be covered by an overall nonmetallic jacket which complies with the requirements of Section 4.4 of ICEA S-66-524 or S-68-516, Section 4.3 of ICEA S-61-402, or Table 21-5 of Part 21 of UL 83.

2. Multi-conductor cables shall have a jacket thickness which complies with Table 4-7 of Part 4 of ICEA S-66-524, Table 4-5 of Part 4 of ICEA S-68-524, or Table 4-6 of Part 4 of ICEA S-61-402.

G. Armor. Where control cables are to be exposed, as in cable tray, cable channel or other cable support systems, the cables shall be protected by an interlocked metal tape armor made of galvanized steel which meets the requirements of paragraph 4.5 of ICEA S-68-516 or S-66-524.

H. Conductor Identification. Identify individual conductors in conformance with Appendix L of ICEA S-66-524, Part 5 of ICEA S-68-516, or Appendix I of ICEA S-61-402.

I. Cable Marking. Print cable marking information on the jacket of each cable at 2-foot intervals. Use a permanent printing method with a color sharply contrasting the jacket color.

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 F.

E. Clean conduits of all foreign matter before cables are pulled in.

F. Provide at least 30 percent spare conductors.

3.02 INSTALLATION

A. Cable in Conduit and Ductbank.

1. Install cables in accordance with the manufacturer's instructions and the National Electrical Code (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 wire pulling compounds approved by cable manufacturers to reduce friction. Lubricants must not be harmful to the conductor insulation or cable jacket. Mixtures containing soap or detergent shall not be used.

B. Cable in Tray

1. Install armored cable in cable tray.

2. 600-Volt Control Cable may be installed in cable tray with 600-volt power cables.

3. Install cables in trays in a neat and orderly manner. Tie cables to the rungs at approximate 15-foot intervals by use of cable ties.

C. Termination

1. Do not splice conductors unless approved by the Project Manager. For termination use crimp-on type, ring tongue, non-insulated, tin-plated copper lugs.

2. 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-on base of the terminal.

D. Tests

1. Test insulation integrity and conductor continuity before connecting the cables.

2. Use a 500 VDC megohmmeter and perform the cable insulation test in accordance with the operating instructions.

E. Termination. After the 600-volt control cable has been tested with satisfactory results, terminate the cable at both ends to designated terminal points.

END OF SECTION

Section 15010

BASIC MECHANICAL AND PLUMBING REQUIREMENTS

PART 1 GENERAL

1.01 GENERAL

A. Plans and Specifications, including general conditions, special conditions, supplements or addenda thereto, information to bidders, and other pertinent documents issued by Engineer of Record, are a part of these specifications and accompanying Mechanical, and Plumbing drawings. The above is included herewith, and shall be examined by all bidders. Failure to comply shall NOT relieve Contractor of responsibility or be used as basis for additional compensation due to omission of Engineer of Record and/or Structural details from Mechanical and Plumbing drawings.

1.02 SCOPE

A. Refer to Section 01110 and Plans for the scope of the Project.

B. Scope of work under the Mechanical and Plumbing Sections of specifications shall include complete systems as shown on drawings and as specified herein. Contractors shall provide supervision, labor, materials, equipment, machinery, plant, and items necessary to complete Mechanical and Plumbing systems. Items of equipment may be specified in singular; however, contractors shall provide number of items of equipment as indicated on drawings, and as required for complete systems. Work shall include all attendant accessories, etc. necessary to deliver complete and satisfactory operating systems acceptable to the Engineer of Records.

C. These specifications define the scope of work of the Mechanical and Plumbing Subcontractors for the guidance of the Prime Contractor to coordinate and be responsible for the work of all Subcontractors on the project, to furnish to the Owner a complete project.

D. If additional details or special conditions are required, it is the responsibility of Contractor to furnish same, as well as provide material and equipment usually furnished with such systems or required to complete installation, whether mentioned or not.

E. Indication on the drawings or mention in the Construction Documents of articles, materials, tests, operations or methods require that the Contractor or his Subcontractors provide each item indicated or mentioned of the quality or subject to the qualifications noted; perform according to conditions stated for each operation, and provide, therefore, all necessary labor,

equipment, services and designate the quality and type of materials or equipment to be furnished.

1.03 UNIT PRICES

A. No separate payment will be made for mechanical, plumbing, and other work performed under this Section. Include cost in lump sum price bid for work of which this is a component part.

1.04 DEFINITIONS

A. "As Directed": Wherever phrase "as directed" is used, it means "as directed by Engineer of Record or his authorized representative.

B. "Bidder": The bidder shall mean the same as "Contractor" for these specifications.

C. "By G.C.": Wherever word "General Contractor" or "G.C." is used, it means the Prime Contractor for the project. Any special feature or knowledge should be coordinated with him.

D. "Contractor": Wherever word "Contractor" is used, it means respective Plumbing, Heating, Ventilating and Air Conditioning, Systems or Fire Protection Contractor.

E. "Not in Contract": Items indicated on Drawings as "NIC" or noted "Not in Contract", are shown for convenience only and are not part of the Contractor's work unless specifically indicated.

F. "Owner": The term "Owner" herein refers to the individual or organization entering into a written contract for construction of the project and execution of the work defined by the plans and specifications.

G. "Provide": Wherever the word "provide" is used, it means "furnish and install, complete and ready for use.

H. "Subcontractor": See "Contractor".

I. Approval - written authority to proceed from the Engineer of Record

1.05 CONTRACTORS QUALIFICATIONS

A. The Contractor and his Subcontractors shall be experienced and qualified Contractors, in the field of heating, ventilating, air conditioning, and plumbing systems.

B. The owner specifically reserves the right to reject any Contractor who has previously failed to perform properly, or complete in a reasonable time, a contract of similar nature, or who has not paid his bills, or otherwise disregarded his obligations to subcontractors, material, supplier and/or employees.

C. The Contractor shall have had for a minimum of 5 consecutive years just prior to bid date, the following:

1. The contractor and subcontractors shall have a minimum of 5 years of experience in their fields and must present a list of minimum 5 similar projects completed by their company.

2. A permanent place of business.

3. Adequate personnel and equipment to do the work properly and expeditiously.

4. A suitable financial status to meet the obligations incident to the work.

5. Competent technical experience in plumbing and ventilating installation and service.

6. The Contractor shall note in his quotation any and all exceptions to this Specification; failure to do so on any point will be interpreted as being in full compliance herewith.

7. The owner reserves the right to reject any or all bids or to accept any bid considered advantageous. The owner also reserves the right to waive any or all bid formalities.

1.06 SITE VISIT AND FAMILIARIZATION

A. The Contractor shall be familiar with the plans and specifications and shall have examined the premises and understand the conditions under which he will be obligated to operate in performing the contract.

1.07 GUARANTEE AND MAINTENANCE

A. Guarantee: The Contractor shall guarantee work as installed by him for a period of one (1) year after substantial completion date; said guarantee to require the Contractor to furnish all necessary materials and labor to replace any defective materials or workmanship without cost to the owner. Date of substantial completion shall be made a matter of written record by the Engineer of Record. When the manufacturer offers an extended warranty for an item or system, this warranty shall be transferred to or written in the name of the owner.

1.08 WORKMANSHIP

A. All work shall be executed by none but skilled mechanics, and be first class and complete in both effectiveness and appearance whether finally concealed or exposed.

B. Work shall conform to requirements, rules, regulations and ordinances of the local codes, Harris County, City of Houston and other authorities having jurisdiction, and with the standards promulgated pursuant to the Federal Occupational, Safety and Health Act of 1970, whether shown on drawings or not and shall be completed to the entire satisfaction of the Engineer of Record. In cases where alterations to and/or deviations from specifications and accompanying drawings are required by said authority, the Contractor shall report same to the Engineer of Record, and secure approval in writing before work is started. In cases where requirements of specifications and accompanying drawings are in excess of Code and other similar requirements, the specifications and drawings shall govern.

C. The work shall comply with the latest adopted standards of local codes, amendments, ordinances and the American Society of Mechanical Engineers, the National Board of Fire Underwriters, the latest edition of National Electrical Code, and standards of ASHRAE and SMACNA.

1.09 DISCREPANCIES

A. Clarification shall be obtained from the Engineer of Record before submitting a bid for the work under Division 15 as to discrepancies or omissions from the Contract documents, or questions as to the intent thereof.

B. Consideration will not be granted for misunderstanding of the amount of work to be performed. Tender of a proposal conveys full agreement of the items and conditions specified, shown, scheduled or required by the nature of the project.

1.10 RELATED WORK SPECIFIED IN OTHER DIVISIONS

A. Painting of Equipment, Piping and Accessories: Finish painting will be performed under another Section. Priming coat for equipment and other items and/or materials subject to rust or corrosion shall be provided under Division 15.

1.11 DRAWINGS AND SPECIFICATIONS

A. The drawings are schematic in nature and indicate approximate locations of the various items of the systems except where specific locations are noted and dimensioned on the documents. These items are shown approximately to scale and attempt to show how these items should be integrated with building construction. Locate all the various items by on-the-job measurements, conformance with Contract Documents and cooperation with other trades.

B. When Mechanical and Plumbing drawings do not give exact details as to elevation of pipe, and ducts, physically arrange the systems to fit the space available at elevations intended, with proper grades for functioning of systems involved. Piping, and exposed duct systems (unless shown otherwise) are generally intended to be installed as high as possible against structure in a neat and workmanlike manner. Work shall be concealed in finished areas.

C. Should drawings disagree in themselves or with specifications, better quality or greater quantity work or materials shall be estimated upon, unless otherwise ordered by Engineer of Record, in writing. Figures given on drawings govern small scale drawings.

D. Exact locations of fixtures and equipment items shall be determined by references to general plans and to detail drawings, equipment drawings, rough-in drawings, certified construction drawings, etc. Minor relocations necessitated by conditions at the site or directed by the Engineer of Record shall be made without additional cost to the Owner.

E. Piping interferences shall be handled by giving precedence to pipe lines that require a stated grade for proper operation. Where space requirements conflict, contact the Engineer of Record.

1.12 SPECIFICATIONS

A. Titles to Divisions, Sections and Sub-Sections in these specification Contract Documents are introduced merely for convenience and shall not be taken as a correct, complete segregation of the several units of materials and labor. No responsibility, either direct or implied, is assumed by the Architect and/or Engineer for omissions or duplications by the Contractor or his Sub-Contractor due to real alleged error in arrangement of matters in these Documents.

1.13 PREFERENCE IN AUTHORITY OF DOCUMENTS

A. In case the Specifications should not fully agree with drawings the better quality and or greater quantities of work shall be included in the bid. Figures given on Drawings govern scale measurements, and large scale details govern small scale drawings.

B. Explanatory notes in the Drawings shall be preferred to conflicting drawn out indications, if any. Where figures are lacking, scale measurements may be followed, but in all cases, the measurements are to be checked from the work in place. Should any variations be found, such must be referred to the Engineer of Record for instructions. Details or notes shown on the Drawings are typical for all similar conditions throughout the project.

C. Certified Construction Drawings of approved equipment and materials shall take precedence over catalog dimensions or sizes and shapes shown in these Documents. Certified Construction Drawings shall be the final authority in determining final installed conditions.

1.14 LAYING OUT WORK, MEASUREMENTS, LEVELS AND SURVEYS

A. Contractor shall base measurements, both horizontal and vertical, from established bench marks. Work shall agree with these established lines and levels. Verify measurements at the site and check corrections of the same as related to work, prior to fabrication of shop made items or ordering of factory-made items.

B. Before ordering any materials or doing any work, each Contractor shall verify all measurements at the building and shall be responsible for the correctness of the same. No extra charge or compensation will be allowed on account of differences between actual dimensions and the measurements indicated on the Drawings. Any differences that may be found shall be submitted to the Engineer of Record for consideration before proceeding with the work.

C. Should Contractor discover a discrepancy between actual measurements and those indicated, which prevents following good practice or intent of drawings and specifications, he shall notify the Engineer of Record and shall not proceed with work until he has received instructions from the Engineer of Record.

1.15 CODES & REFERENCES

A. Codes: All work shall be executed in accordance with the local, national and state codes, ordinances and regulations governing the particular class of work involved. Should these specifications and the accompanying

drawings conflict with code or ordinance requirements, the Contractor shall follow code or ordinance requirements only if such codes require a higher class of work than is outlined herein.

B. Contractor shall include, without extra cost to the Owner, any labor, materials, services, apparatus, or drawings, in order to comply with applicable codes, laws, ordinances, rules, and regulations whether or not shown on drawings and/or specified.

C. Materials furnished and work installed shall comply with National Fire Code of the NFPA; with requirements of local utility companies; and with requirements of governmental departments having jurisdiction.

D. Materials and equipment for electrical work shall bear approval label, or shall be listed by Underwriter's Laboratories.

E. References: In addition to state and local ordinances, the following industry standards apply, where applicable, except where requirements of the specifications are more stringent:

1. AIEE - American Institute of Electrical Engineers
2. ASA - American Standard Association
3. ASHRAE - American Society of Heating, Refrigeration and Air Conditioning Engineers
4. ASME - American Society of Mechanical Engineers
5. ASTM - American Society for Testing and Materials
6. AWWA - American Water Works Association
7. NEC - National Electrical Code
8. NEMA - National Electrical Manufacturer's Association
9. NFPA - National Fire Protection Association
10. UL - Underwriter's Laboratories
11. ANSI - American National Standards Institute
12. ARI - American Refrigeration Institute
13. MSS - Manufacturer's Standardization Society
14. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association

Where these standards have conflicting requirements, the more stringent requirement shall apply.

1.16 SUBSTITUTIONS AND DEVIATIONS

A. Intent of these specifications is to establish quality standards of material and equipment installed.

B. Substitutions: All materials, equipment, apparatus or products shall be new, unless noted otherwise, and of the quality indicated in the following specifications. Where manufacturer's names are mentioned in the body of the specifications and/or included in a list of approved equipment, the products so mentioned have proved to be satisfactory under similar conditions of service and are the products acceptable for this installation except as outlined below.

C. It is not the Engineer of Record's intention to discriminate against any manufacturer or product, and any manufacturer desiring to submit his product for approval as an equal to that specified may do so by delivering a sample, or in the case of large equipment, a sample specification to the Engineer's office at least fifteen (15) days prior to the bid opening, preferably sooner.

D. Naming of a manufacturer, brand or model number as part of the description of manufactured items shall be deemed to include any description or specifications of such item in that manufacturer's catalogs, advertisements or other representations. Should there be contradictions or variations in the manufacturer's literature currently available, the better quality or greater quantity of material or workmanship described shall be furnished under this contract.

E. Where two or more units of same type or class or equipment are required, provide units of a single manufacturer. Manufacturers' names and catalog numbers specified under sections of Divisions 15 and 16 are used to establish the minimum standard of design, performance, quality and serviceability.

F. The Engineer of Record will examine the data and samples so submitted and a written response will be issued. Only those products mentioned by name may be furnished in this project.

G. Where a substitute item alters the design or space requirements indicated on drawings, Contractor shall include items of cost for revised design and construction, including cost of allied trades involved.

H. Acceptance or rejection of proposed substitutions are subject to Engineer of Record approval. If the Engineer of Record and or Engineer so requests, Contractor shall submit samples of specified and substitute items for evaluation.

I. Where minor deviation requires a different quantity and arrangement of duct work, piping, wiring & conduit from that specified or indicated on drawings, Contractor shall provide such duct work, piping, structural supports & insulation, electrical wiring and conduit, and other additional equipment required by system at no additional cost to Owner.

1.17 MATERIALS AND EQUIPMENT

A. Materials, equipment and apparatus shall be new, unless noted otherwise, of first class quality, and shall be furnished, delivered, erected, connected, and finished in every detail, and shall be selected and arranged to fit properly into building spaces. Where no specific kind or quality is given, furnish a first-class standard article approved by the Engineer of Record.

B. Materials: Building materials, contractor's equipment, etc., may be stored on the premises but the placing of same shall be within the construction fence. When any room in the building is used as a shop, store room, etc., the one making use of such room will be held responsible for any repairs, patching, or cleaning arising from such use. Each subcontractor shall protect and be responsible for any damage to his work or material from the date of the agreement until the final payment is made, and will make good without cost to the Owner, any damage or loss that may occur during this period. The Contractor will handle all material as directed so that it may be inspected by the Engineer of Record's representative. All materials affected by the weather shall be covered and protected to keep them free from damage while they are being transported to the site as well as when they are stored on the site.

C. During the execution of the work, open ends of all piping and all openings in equipment shall be closed before leaving the work at anytime as to prevent the entrance of all foreign matter.

D. All drains shall be covered until placed in service to prevent the entrance of all foreign matter.

E. Each Contractor in performing his or her work shall take particular care not to damage the existing and new structure under construction. All finished floors, step treads and the Owner's equipment shall be covered to prevent any damage by workmen or their tools and equipment during the construction of the building. In addition, each Contractor shall protect any

materials on the job site, whether a part of his contract or the property of another Contractor or the Owner.

F. Each Contractor shall be responsible for any damage done to the Owner's property or any adjacent property caused by activity in connection with his portion of the work. Any and all damages done to the building, building systems, or utilities shall be repaired to owner's satisfaction at no cost.

G. Equipment: Equipment installed on project shall have local representation, local factory- authorized service, and local stock or repair parts.

H. All mechanical and plumbing equipment shall be protected during the execution of the work.

I. Size of mechanical equipment shown on drawings is based on dimensions of a particular manufacturer. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine if equipment he proposes to furnish will fit into the space. Shop drawings shall be prepared as required to indicate suitable arrangement.

J. Equipment shall be installed in a manner to permit access to all surfaces. Valves, motors, drives, lubrication devices, filters, panel boards, transformers, controller, disconnect switches and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.

K. The printed directions supplied by the manufacturer of each item of equipment shall be followed in the preparation, assembly, installation, erection, and cleaning of all manufactured equipment and/or materials, unless otherwise specified.

L. Motor starters, other than those supplied as integral parts of equipment, will be furnished under Specification Division 16.

M. Motors for driven equipment supplied under Division 15 shall be installed under Division 15.

N. Motors shall have grease lubricated ball bearings, suitable mounting base, and connection boxes. Motors shall be Reliance, U.S. Motor, Baldor, or General Electric, and shall have a minimum of 1.15 service factor, and be so labeled.

O. Motors shall be especially selected for quiet operation. Noisy operating motors shall be removed and replaced.

P. Motors shall not be delivered to the job-site until ready to be installed.

Q. All motors shall be fully protected and kept dry during storage and after installation, and prior to placing in service.

R. Contractor shall not deliver, or receive, equipment at the job-site until ready for installation unless suitable protected space is provided to prevent weather or other damage.

1.18 FOUNDATIONS, SUPPORTS AND PIERS

A. Provide necessary foundations, supports, pads, bases and piers, as required and shown on drawings for equipment furnished under this contract.

B. For equipment where foundations are indicated, provide concrete pads as shown. Extend pads 4 inches beyond machine base in all directions; chamfer top edge. Insert steel dowel rods into floors to anchor pads.

C. Securely attach equipment to building in approved manner. Attachments shall be strong and durable and if not considered so by the Engineer of Record, shall be replaced as directed at no cost.

D. When foundations or equipment supports are not detailed in these documents, Contractor shall provide equipment supports or foundation as recommended by the equipment manufacturer at no additional cost to owner.

1.19 OUTLET OPERATING AND VIBRATIONS

A. Systems shall operate under all load conditions without sound or vibration that is considered by the Engineer of Record to be objectionable. Sound or vibration exceeding universal standards either inside or outside a room where moving machine is installed, will be considered objectionable. Sound or vibration conditions shall be corrected by Contractor in an approved manner and/or by use of approved vibration eliminators, as recommended by the manufacturer, at Contractor's expense.

1.20 GENERAL AND SPECIAL CONDITIONS

A. Read and comply with all General and Special conditions for the project, of these specifications, information to Bidders, Addendum, Proposal Forms, and all other pertinent documents issued

B. Install all pipe concealed in spaces having ceilings. In unfurnished spaces where pipe must be exposed, install in a neat manner; install pipe lines to a continuous grade; install piping square to the building.

C. Place all inserts required for concrete construction in place after forms are set and before the concrete is poured.

D. Set sleeves in place in the forms before the concrete is poured and in masonry walls while they are under construction.

E. Be responsible for fitting scheduled equipment into the space assigned, or report to the Engineer of Record in writing prior to ordering of equipment. Failure to comply shall render Contractor liable for all expenses necessary to provide adequate space.

F. Provide minor details necessary for proper installation and operation as if herein specified or shown.

G. Each Contractor shall keep a competent superintendent or a foreman on the job at all times, and shall be fully responsible for the conduct and supervision of all work performed under his contract.

H. A periodic observation of the work by the Engineer of Record is only for the express purpose of verifying compliance with the contract documents. Such site visits by the Engineer of Record shall not be construed as construction supervision.

I. Each Contractor shall be solely responsible for providing a safe place for the performance of the work by his personnel and for taking safety precautions and/or providing safety appliances for his employees and for his Subcontractors.

1.21 COMPLETION SCHEDULE

A. The completion of this project and the acceptance and occupancy by the Owner within the time limits stipulated is an absolute necessity. Therefore, the Contractor shall carefully determine that all work, including delivery of materials and equipment to the job site, will permit compliance with the contractual deadline of completion.

B. Accessibility: Contractor is responsible for sufficiency of size of shafts and chases and adequate clearance in double partitions and hung ceilings, for proper installation of his work. Contractor shall cooperate with other Contractors working in the same space. Advise General Contractor of requirements and keep spaces and clearances to minimum sizes required.

C. Locate equipment that must be serviced, operated or maintained, in fully accessible positions. Equipment includes, but is not limited to, valves, clean outs, motors, controllers, and drain points. Furnish access doors if

required. Minor deviations from drawings may be made to allow for better accessibility; however, changes must be approved by the Engineer of Record prior to installation.

D. Cooperation with Other Trades: Contractor shall give full cooperation to other trades. Where work will be installed in close proximity to, or will interfere with, work of other trades, Contractor shall assist in working out space conditions to make a satisfactory adjustment. Plan work sufficiently in advance of construction so conflicts can be ascertained and remedial procedures initiated. If adequate solutions can be reached by sleeving or casting into building members these methods shall be cleared with the Engineer of Record. If Contractor installs his work before coordinating with other trades, he or she shall make the necessary changes in his work to correct the condition without extra charge.

E. Contractor shall furnish, as required, necessary templates, patterns, setting plans, and shop details for proper installation of work and for purpose of coordinating adjacent work.

PART 2 PRODUCTS

2.01 SHOP DRAWINGS AND PRODUCT DATA

A. Prior to commencement of installation of any equipment and within number of days allowed in project General Conditions, the Contractor shall submit copies of shop drawings and published engineering data. The copies shall be assembled in individual sets with the item being submitted indicated by the item number shown on drawings and/or specifications. Included shall be drawings and descriptive literature providing required dimensional, ratings and operational data on items tabulated below and all corrections in submission and resubmit if requested.

B. The Contractor shall be responsible for and bear any expense of alterations to the building or is appurtenances resulting from the substitution of equipment to that specified in the Contract Documents.

C. Obtain, check, certify and submit complete shop drawings and brochures from Contractors, manufacturers, Suppliers, Vendors, etc., for all materials and equipment specified herein.

D. All shop drawings shall be checked by contractors for full compliance of plans and specifications. They shall be properly sealed, signed and dated by contractors before submitted to the Engineer of Record.

E. Shop drawings shall be submitted for the following items:

1. Insulation for Piping and Duct work
2. Plumbing Pipe, Fittings, and hangers
3. Plumbing Fixtures and Trim

F. Any one group of similar equipment as described in the listings above must be the product of one manufacturer.

G. Approval of shop drawings does not release the Contractor from fully complying with all requirements of plans and specifications and providing satisfactorily operating mechanical and plumbing systems. Material and equipment shall be approved for final acceptance when construction is completed and all units and systems have been operated, tested, adjusted and balanced to the satisfaction of the Engineer. Should proposed approved alternate equipment involve rearrangement of designed equipment, a complete layout of the area involved shall be submitted by the Contractor, and shall be approved in writing before installation of any such items of equipment. Any additional expenses involved shall be a Contractor borne expense.

2.02 AS-BUILT DRAWINGS

A. The Contractor shall maintain a record set of blue line prints at the project site which is dedicated to marking in "red" any variation in the work as compared to the general design drawings. This record set is to be carefully maintained and kept neat and clean and used for no other purpose.

B. The Contractor shall secure from the Engineer of Record a complete set of mylar sepias of all heating, ventilating and air conditioning, and plumbing drawings, the cost of which shall be paid by the Contractor. At the conclusion of the work transfer all corrections on to the mylar sepias using the marked in "red" record blue line set and "cloud" all revisions so they are easily identified.

C. The Contractor shall deliver the corrected reproducible drawings to the Engineer of Record upon completion of work. Final approval will not be given by the Engineer of Records until prints have been received by the Engineer of Records with all corrections made.

PART 3 EXECUTION

3.01 CUTTING AND PATCHING

A. Place all equipment in a timely manner to avoid cutting new construction.

B. If holes or sleeves are not properly installed and cutting and patching becomes necessary, it shall be done at no expense to the Owner.

3.02 IDENTIFICATION OF EQUIPMENT

A. Provide equipment nameplates on all items of heating, ventilating, air conditioning, and plumbing equipment. Nameplates shall include:

1. Manufacturer's name, serial and model number.

2. General engineering information.

3. Electrical requirements.

B. The nameplates shall be attached to the equipment in conspicuous places with self-tapping stainless steel screws or contact adhesive where screws cannot be used. Prevent painting of name plates.

3.03 LUBRICATION, REFRIGERATION, AND OIL

A. On completion of the job, and before any ventilating and plumbing equipment is put into operation, Contractor for this Section shall check and lubricate, but not over-lubricate, all bearings with high-grade oil or grease of type recommended by the equipment manufacturer.

3.04 OWNER'S MANUAL, SERVICE TOOLS

A. Prepare, in bound form and identified with lettering imprinted on the face of binder. Owner's Manual which shall consist of the following:

1. Complete description of each item of equipment and apparatus furnished and installed under Division 15, including ratings, capacities and characteristics.

2. Fully detailed, applicable parts lists, including all numbered parts, of each item of equipment and apparatus furnished and installed under Divisions 15 and 16.

3. Manufacturers printed instructions describing operation, servicing and maintenance, and repair of each item of equipment and apparatus.

4. Typewritten record of all tests made of materials, equipment and systems included under Division 15. Such records shall state the dates the tests were conducted, names of person(s) making and witnessing the tests, and citing unusual conditions relevant to the tests.

B. Owner's Manual shall be approved for content and format prior to final preparation. Submit (3) copies of Owner's Manual.

C. All tests shall have been made and approved and Owner's Manuals shall be complete, approved and delivered to the Owner's authorized representative prior to completion of the work.

D. Provide and deliver to the owner any special tools required for maintenance of equipment and apparatus installed under Division 15.

3.05 FINAL REVIEW

A. Upon completion of the work, there shall be a final review of the entire system.

B. The system shall be operating properly.

C. Certificates and Documents required herein shall be in order and presented at least two weeks prior to the review.

D. After the review, any changes or corrections noted as necessary for the work to comply with these specifications and the drawings shall be accomplished without delay in order to secure final acceptance of the work.

E. The date for the final review shall be sufficiently in advance of the Contract completion date to permit the execution before the expiration of the contract of any adjustments and/or alterations which the final acceptance tests indicate as necessary for the proper functioning of all equipment. Any such modification shall be completed within the number of days allotted for completion of the contract. Retests shall be conducted as directed and shall be of such time duration as necessary to assure proper functioning of adjusted and altered items. Retests shall not relieve the Contractor of completion date responsibility.

F. A qualified person must be present at this final inspection to demonstrate the system and prove the performance of the equipment.

G. Upon completion of work, and at time designated by the Engineer of Record provide services of competent representative of the Contractors for a period

of at least 8 hours or as specified in the individual component specifications to instruct the owner's representative in the operations and maintenance of the entire mechanical, electrical, and systems.

END OF SECTION

Section 15050

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Basic mechanical requirements specifically applicable to Division 15 Sections, in addition to Division 1 – General Requirements.

1.02 UNIT PRICES

A. No separate payment will be made for mechanical materials, methods, and other work performed under this Section. Include cost in lump sum price bid for work of which this is a component part.

1.03 REFERENCES

A. ANSI: American National Standards Institute.

B. ARI: American Refrigeration Institute.

C. ASHRAE: American Society of Heating Refrigeration and Air Conditioning Engineers.

D. ASME: American Society for Mechanical Engineers.

E. ASTM: American Society for Testing and Materials.

F. AWWA: American Water Works Association.

G. MSS: Manufacturer's Standardization Society of the Valve and Fitting Industry.

H. NEMA: National Electrical Manufacturers' Association.

I. NFPA: National Fire Protection Association.

J. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

K. UL: Underwriters' Laboratories, Inc.

1.04 SUBMITTALS

A. Submit under provisions of Section 01330 – Submittal Procedures.

B. Submittals as specified in individual sections.

C. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.

D. Mark dimensions and values in units to match those specified.

1.05 REGULATORY REQUIREMENTS

A. Conform to applicable City of Houston Building Code for the Pump Station Control Building.

B. Fire Protection: Conform to national Fire Prevention Association Code.

C. Plumbing: Conform to National Plumbing Code.

D. Obtain permits, and request inspections from authority having jurisdiction on this Project.

1.06 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions.

B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of City Engineer before proceeding.

1.07 SEQUENCING AND SCHEDULING

A. Construct Work in sequence under provisions of Section 01325 – Construction Schedule.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 15052

BURIED PIPING INSTALLATION

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to install and test all buried piping, fittings, and specials. The Work includes the following:

   a. All types and sizes of buried piping, except where buried piping installations are specified under other Sections.

   b. Unless otherwise shown or specified, this Section includes all buried piping Work required, beginning at the outside face of structures or structure foundations, including piping beneath structures, and extending away from structures.

   c. Work on or affecting existing buried piping.

   d. Installation of all jointing and gasket materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, and other Work required for a complete, buried piping installation.

   e. Supports, restraints, and thrust blocks.

   t. Pipe encasements, with the exception of piping embedded in concrete within a structure or foundation specified under Section 15053, Exposed Piping Installation.

   g. Field quality control, including testing.

   h. Cleaning and disinfecting.

i. Incorporation of valves, meters, and special items shown or specified into piping systems in accordance with the Contract Documents and as required.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before buried piping Work.

2. Coordinate with appropriate piping Sections of Division 2, Site Work and Division 15, Mechanical.

C. Related Sections:

1. Division 2, Site Work

2. Division 3, Concrete.

3. Section 09901, Protective Coatings.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices

1. No separate payment will be made under this section. Include payment in Lump Sum with price breakdown included in the Schedule of Values.

2. Refer to Section 01270 - Measurement and Payment, and Section 01292 - Schedule of Values.

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

1.3 REFERENCES

A. Standards referenced in this Section are:

1. ASME Boiler and Pressure Vessel Code.

2. ASME 831.3, Process Piping.

3. American Society for Non-Destructive Testing (ASNT), ASNT-TC-1A, Recommended Practice, Personnel Qualification, and Certification in Non-destructive Testing.

4. ASTM 832, Specification for Solder Metal.

5. ASTM D2321, Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity-Flow Applications.

6. ASTM D2774, Practice for Underground Installation of Thermoplastic Pressure Piping.

7. ASTM F1417, Test Method for Installation Acceptance of Plastic Gravity Sewer Lines using Low-Pressure Air.

8. ANSI/AWWA C105, Polyethylene Encasement for Ductile-Iron Pipe Systems.

9. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

10. ANSI/AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.

11. ANSI/AWWA C651, Disinfecting Water Mains.

12. AWWA M23, PVC Pipe - Design and Installation.

13. AWWA M41, Ductile-Iron Pipe and Fittings.

14. ASCE 37, Design and Construction of Sanitary and Storm Sewers.

15. Chlorine Institute, Inc., Piping Systems for Dry Chlorine, Pamphlet No. 6.

16. NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements and recommendations of authorities having jurisdiction over the Work, including.

a. City of Houston

b. Texas Commission on Environmental Quality

2. Obtain required permits for Work in roads, rights-of-way, railroads, and other areas of the Work.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Details of piping, specials, joints, harnessing and thrust blocks, and connections to piping, structures, equipment, and appurtenances.

2. Product Data:

a. Manufacturer's literature and specifications, as applicable, for products specified in this Section.

3. Testing Procedures:

a. Submit proposed testing procedures, methods, apparatus, and sequencing. Obtain City's approval prior to commencing testing.

B. Informational Submittals: Submit the following:

1. Certificates:

a. Certificate signed by manufacturer of each product certifying that product conforms to applicable referenced standards.

2. Field Quality Control Submittals:

   a. Results of each specified field quality control test.

C. Closeout Submittals: Submit the following:

1. Record Documentation:

   a. Maintain accurate and up-to-date record documents showing modifications made in the field, in accordance with approved submittals, and other Contract modifications relative to buried piping Work. Submittal shall show actual location of all piping Work and appurtenances at same scale as the Drawings.

   b. Show piping with elevations referenced to Project datum and dimensions from permanent structures. For each horizontal bend in piping, include dimensions to at least three permanent structures, when possible. For straight runs of piping provide offset dimensions as required to document piping location.

   c. Include profile drawings with buried piping record documents when the Contract Documents include piping profile drawings.

   d. Conform to Section 01785, Project Record Documents.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery:

1. Deliver materials to the Site to ensure uninterrupted progress of the Work.

2. Upon delivery inspect pipe and appurtenances for cracking, gouging, chipping, denting, and other damage and immediately remove from Site and replace with acceptable material.

B. Storage:

1. Store materials to allow convenient access for inspection and identification. Store material off ground using pallets, platforms, or other supports. Protect packaged materials from corrosion and deterioration.

2. Pipe and fittings other than PVC and CPVC may be stored outdoors without cover. Cover PVC and CPVC pipe and fittings stored outdoors.

C. Handling:

1. Handle pipe, fittings, specials, and accessories carefully in accordance with pipe manufacturer's recommendations. Do not drop or roll material off trucks. Do not drop, roll or skid piping.

2. Avoid unnecessary handling of pipe.

3. Keep pipe interiors free from dirt and foreign matter.

4. Protect interior linings and exterior coatings of pipe and fittings from damage. Replace pipe and fittings with damaged lining regardless of cause of damage.

PART 2 PRODUCTS

2.1 MATERIALS

A. Piping materials shall conform to Specifications for each type of pipe and piping appurtenances in applicable Sections of Division 2, Site Work and Division 15, Mechanical.

B. General:

1. Pipe Markings:

a. Manufacturer shall cast or paint on each length of pipe and each fitting pipe material, diameter, and pressure or thickness class.

2.2 BURIED PIPING IDENTIFICATION

A. Polyethylene Underground Warning Tape for Metallic Pipelines:

1. Tracer tape shall be of inert, acid- and alkali-resistant, polyethylene, four mils thick, six inches wide, suitable for direct burial. Tape shall be capable of stretching to twice its original length.

2. Message shall read, "CAUTION [insert customized name of pipe service, i.e., "POTABLE WATER", "SANITARY SEWER", "CHLORINE GAS", or other service as appropriate,] PIPE BURIED BELOW", with bold letters approximately two inches high. Messages shall be printed at maximum intervals of two feet. Tape shall be custom colored the same as pipeline colors specified for associated pipe service in Section 09901, Protective Coatings.

3. Manufacturer: Provide products of one of the following:

   a. Brady Corporation

   b. Seton Identification Products

   c. Marking Services, Inc.

   d. Or approved equal.

B. Detectable Underground Warning Tape for Non-Metallic Pipelines:

1. Tape shall be of inert, acid- and alkali-resistant, polyethylene, five mils thick, six inches wide, with aluminum backing, and have 15,000 psi tensile strength and 80 percent elongation capability. Tape shall be suitable for direct burial.

2. Message shall read, "CAUTION [insert customized name of pipe service, i.e., "POTABLE WATER", "SANITARY SEWER", "CHLORINE GAS", or other appropriate service] PIPE BURIED BELOW" with bold letters approximately two inches high. Messages shall be printed at maximum intervals of two feet. Tape shall be custom colored the same as the pipeline colors as specified for the associated pipe service in Section 09901, Protective Coatings.

3. Manufacturer: Provide products of one of the following:

   a. Brady Corporation

   b. Seton Identification Products

   c. Marking Services, Inc.

   d. Or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Install piping as shown, specified, and as recommended by pipe and fittings manufacturer.

2. In event of conflict between manufacturer's recommendations and the Contract Documents, request interpretation from City before proceeding.

3. City will observe excavations and bedding prior to laying pipe by Contractor. Notify City in advance of excavating, bedding, pipe laying, and backfilling operations.

4. Minimum cover over buried piping shall be four feet, unless otherwise shown or approved by City.

5. Earthwork is specified in Section 02317, Excavation and Backfill for Utilities.

6. Excavation in excess of that required or shown, and that is not authorized by City shall be filled at Contractor's expense with granular material furnished, placed, and compacted in accordance with Section 02317, Excavation and Backfill for Utilities.

7. Comply with NFPA 24 for "Outside Protection", where applicable to water piping systems used for fire protection.

B. Plugs:

1. Temporarily plug installed pipe at end of each day of work or other interruption of pipe installation to prevent entry of animals, liquids, and persons into pipe, and entrance or insertion of deleterious materials into pipe.

2. Install standard plugs in bells at dead ends, tees, and crosses. Cap spigot and plain ends.

3. Fully secure and block plugs, caps, and bulkheads installed for testing to withstand specified test pressure.

4. Where plugging is required for phasing of the Work or subsequent connection of piping, install watertight, permanent type plugs, caps, or bulkhead acceptable to City.

C. Bedding Pipe: Bed pipe as specified and in accordance with details on the Drawings.

1. Trench excavation and backfill, and bedding materials shall conform to Section 02317, Excavation and Backfill for Utilities, as applicable.

2. Where City deems existing bedding material unsuitable, remove and replace existing bedding with approved granular material furnished, placed, and compacted in accordance with 02317, Excavation and Backfill for Utilities. Payment for additional excavation and providing granular material will be made under the unit price payment items in the Contract.

3. Excavate trenches below bottom of pipe by amount shown and indicated in the Contract Documents. Remove loose and unsuitable material from bottom of trench.

4. Carefully and thoroughly compact pipe bedding with hand held pneumatic compactors.

5. Do not lay pipe until City approves bedding condition.

6. Do not bring pipe into position until preceding length of pipe has been bedded and secured in its final position.

D. Laying Pipe:

1. Conform to manufacturer's instructions and requirements of standards and manuals listed below, as applicable:

   a. Ductile Iron Pipe: ANSI/AWWA C600, ANSI/AWWA C105, AWWAM41.

   b. Thermoplastic Pipe: ASTM D2321, ASTM D2774, ANSI/AWWA C605, AWWA M23, AWWA M45, AWWA, M55.

   c. Sanitary and Storm Sewers: ASCE 37.

2. Install pipe accurately to line and grade shown and indicated in the Contract Documents, unless otherwise approved by City. Remove and reinstall pipes that are not installed correctly.

3. Slope piping uniformly between elevations shown.

4. Keep groundwater level in trench at least 24 inches below bottom of pipe before laying pipe. Do not lay pipe in water. Maintain dry trench conditions until jointing and backfilling are complete. Keep clean and protect interiors of pipe, fittings, valves, and appurtenances.

5. Start laying pipe at lowest point and proceed towards higher elevations, unless otherwise approved by City.

6. Place bell and spigot-type pipe so that bells face the direction of laying, unless otherwise approved by City.

7. Excavate around joints in bedding and lay pipe so that pipe barrel bears uniformly on trench bottom.

8. Deflections at joints shall not exceed 75 percent of amount allowed by pipe manufacturer, unless otherwise approved by City.

9. For PVC and CPVC piping with solvent welded joints, 2.5-inch diameter and smaller, and copper tubing, snake piping in trench to compensate for thermal expansion and contraction.

10. Carefully examine pipe, fittings, valves, and specials for cracks, damage, and other defects while suspended above trench before installation. Immediately remove defective materials from the Site and replace with acceptable products.

11. Inspect interior of all pipe, fittings, valves, and specials and completely remove all dirt, gravel, sand, debris, and other foreign material from pipe interior and joint recesses before pipe and appurtenances are moved into excavation. Bell and spigot-type mating surfaces shall be thoroughly wire brushed, and wiped clean and dry immediately before pipe is laid.

12. Field cut pipe, where required, with machine specially designed for cutting the type of pipe being installed. Make cuts carefully, without damage to pipe, coating or lining, and with smooth end at right angles to axis of pipe. Cut ends on push-on joint type pipe shall be tapered and sharp edges filed off smooth. Do not flame-cut pipe.

13. Do not place blocking under pipe, unless specifically approved by City for special conditions.

14. Touch up protective coatings in manner satisfactory to City prior to backfilling.

15. Notify City in advance of backfilling operations.

16. On steep slopes, take measures acceptable to City to prevent movement of pipe during installation.

17. Exercise care to avoid flotation when installing pipe in cast-in-place concrete, and in locations with high groundwater.

E. Polyethylene Encasement:

1. Refer to Section 02528 - Polyethylene Wrap

F. Jointing Pipe:

1. Ductile Iron Mechanical Joint Pipe:

a. Immediately before making joint, wipe clean the socket, plain end, and adjacent areas. Taper cut ends and file off sharp edges to provide smooth surface.

b. Lubricate plain ends and gasket with soapy water or manufacturer's recommended pipe lubricant, in accordance with ANSI/AWWA C111, just prior to slipping gasket onto plain end of the joint assembly.

c. Place gland on plain end with lip extension toward the plain end, followed by gasket with narrow edge of gasket toward plain end.

d. Insert plain end of pipe into socket and press gasket firmly and evenly into gasket recess. Keep joint straight during assembly.

e. Push gland toward socket and center gland around pipe with gland lip against gasket.

f. Insert bolts and hand-tighten nuts.

g. If deflection is required, make deflection after joint assembly and prior to tightening bolts. Alternately tighten bolts approximately 180 degrees apart to seat gasket evenly. Bolt torque shall be as follows:

Pipe Diameter (inches)	**Bolt Diameter (inches)**	**Range of Torque (ft-lbs)**
3	5/8	45 to 60
4to 24	3/4	75 to 90
30 to 36	1	100 to 120
42 to 48	1.25	120 to 150

h. Bolts and nuts, except those of stainless steel, shall be coated with two coats, minimum dry film thickness of eight mils each, of high build solids epoxy or bituminous coating manufactured by Tnemec, or equal.

i. Restrained mechanical joints shall be in accordance with Section 15055, Ductile Iron Process Pipe.

2. Ductile Iron Push-On Joint Pipe:

   a. Prior to assembling joints, thoroughly clean with wire brush the last eight inches of exterior surface of spigot and interior surface of bell, except where joints are lined or coated with a protective lining or coating.

   b. Wipe clean rubber gaskets and flex gaskets until resilient. Conform to manufacturer's instructions for procedures to ensure gasket resiliency when assembling joints in cold weather.

   c. Insert gasket into joint recess and smooth out entire circumference of gasket to remove bulges and to prevent interference with proper entry of spigot of entering pipe.

   d. Immediately prior to joint assembly, apply thin film of pipe manufacturer's recommended lubricant to surface of gasket that will come in contact with entering spigot end of pipe, or apply a thin film of lubricant to outside of spigot of entering pipe.

   e. For assembly, center spigot in pipe bell and push pipe forward until spigot just makes contact with rubber gasket. After gasket is compressed and before pipe is pushed or pulled in the rest of the way, carefully check gasket for proper position around the full circumference of joint. Final assembly shall be made by forcing spigot end of entering pipe past gasket until spigot makes contact with base of the bell. When more than a reasonable amount of force is required to assemble the joint, remove spigot end of pipe to verify proper positioning of gasket. Do not use gaskets that have been scored or otherwise damaged.

   f. Maintain an adequate supply of gaskets and joint lubricant at the Site when pipe jointing operations are in progress.

3. Ductile Iron Proprietary Joints:

   a. Install pipe that utilizes proprietary joints for restraint specified in Section 15055, Ductile Iron Process Pipe, or

other such joints, in accordance with manufacturer's instructions.

4. Thermoplastic Pipe Joints:

   a. Bell and Spigot Joints:

      1) Bevel pipe ends, remove all burrs, and provide a reference mark at correct distance from pipe end before making joints.

      2) Clean spigot end and bell thoroughly before making the joint. Insert 0-ring gasket while ensuring that gasket is properly oriented. Lubricate spigot with manufacturer's recommended lubricant. Do not lubricate bell and 0-ring. Insert spigot end of pipe carefully into bell until reference mark on spigot is flush with bell.

5. Mechanical Coupling Joints:

   a. Mechanical couplings include but are not limited to: sleeve-type flexible couplings, split flexible couplings, ANSI/AWWA C606 grooved or shouldered end couplings and plasticized PVC couplings.

   b. Prior to installing and assembling mechanical couplings, thoroughly clean joint ends with wire brush to remove foreign matter.

   c. For mechanical couplings that incorporate gaskets, after cleaning apply lubricant to rubber gasket or inside of coupling housing and to joint ends. After lubrication, install gasket around joint end of previously installed piece and mate joint end of subsequent piece to installed piece. Position gasket and place coupling housing around gasket and over grooved or shouldered joint ends. Insert bolts and install nuts tightly by hand. Tighten bolts uniformly to produce an equal pressure on all parts of housing. When housing clamps meet metal to metal, joint is complete and further tightening is not required.

d. For plasticized PVC couplings, loosen the stainless steel clamping bands and remove clamps from coupling. Slide coupling over plain ends of pipes to be joined without using lubricants. Place clamps over each end of coupling at grooved section and tighten with torque wrench to torque recommended by manufacturer.

G. Backfilling:

1. Conform to applicable requirements of applicable Sections in Division 2, Site Work.

2. Place backfill as Work progresses. Backfill by hand and use power tampers until pipe is covered by at least one foot of backfill.

H. Connections to Valves and Hydrants:

1. Install valves and hydrants as shown and indicated in the Contract Documents.

2. Provide suitable adapters when valves or hydrants and piping have different joint types.

3. Provide thrust restraint at all hydrants and at valves located at pipeline terminations.

I. Transitions from One Type of Pipe to Another:

1. Provide necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

J. Closures:

1. Provide closure pieces shown or required to complete the Work.

3.2 TRACER TAPE INSTALLATION

A. Polyethylene Underground Warning Tape for Metallic Pipelines:

1. Provide polyethylene tracer tape for buried metallic piping, which includes pipe that is ductile iron.

2. Provide tracer tape 12 to 18 inches below finished grade, above and parallel to buried pipe.

3. For pipelines buried eight feet or greater below finished grade, provide second line of magnetic tracer tape 2.5 feet above crown of buried pipe, aligned along pipe centerline.

4. Tape shall be spread flat with message side up before backfilling.

B. Detectable Underground Warning Tape for Non-Metallic Pipelines:

1. Provide polyethylene tracer tape with aluminum backing for buried, non-metallic piping, which includes pipe that is PVC, CPVC.

2. Provide magnetic tracer tape 12 to 18 inches below finished grade, above and parallel to buried pipe.

3. For pipelines buried eight feet or greater below finished grade, provide second line of magnetic tracer tape 2.5 feet above crown of buried pipe, aligned along the pipe centerline.

4. Tape shall be spread flat with message side up before backfilling.

3.3 THRUST RESTRAINT

A. Provide thrust restraint on buried piping systems, unless noted otherwise.

B. Thrust restraint may be accomplished by using restrained pipe joints or harnessing buried pipe. Thrust restraints shall be designed for axial thrust exerted by test pressure.

C. Restrained Pipe Joints:

1. Pipe joints shall be restrained by means suitable for the type of pipe being installed.

a. Ductile Iron, Push-on Joints and Mechanical Joints: Restrain with proprietary restrained joint system as specified in Section 02501, Ductile Iron Pipe and Fittings; lugs and tie rods; or other joint restraint systems approved by City.

b. Thermoplastic Joints: Where bell and spigot-type or other non-restrained joints are utilized, provide tie rods across joint or other suitable joint restraint system, subject to the approval of City.

3.4 WORK AFFECTING EXISTING PIPING

A. Location of Existing Underground Facilities:

1. Locations of existing Underground Facilities shown on the Drawings should be considered approximate.

2. Determine the true location of existing Underground Facilities to which connections are to be made, crossed, and that could be disturbed, and determine location of Underground Facilities that could be disturbed during excavation and backfilling operations, or that may be affected by the Work.

B. Taking Existing Pipelines and Underground Facilities Out of Service:

1. Conform to requirements of City's Operations.

2. Do not take pipelines or Underground Facilities out of service unless specifically approved by City.

3. Notify City in writing prior to taking pipeline or Underground Facilities out of service. Shutdown notification shall be provided in advance of the shutdown in accordance with City's Operations.

C. Work on Existing Pipelines or Underground Facilities:

1. Cut or tap piping or Underground Facilities as shown or required with machines specifically designed for cutting or tapping pipelines or Underground Facilities, as applicable.

2. Install temporary plugs to prevent entry of mud, dirt, water, and debris into pipe.

3. Provide necessary adapters, sleeves, fittings, pipe, and appurtenances required to complete the Work.

4. Conform to applicable requirements of City's Operations.

3.5 FIELD QUALITY CONTROL

A. General:

1. When authorities having jurisdiction are to witness tests, notify City and authorities having jurisdiction in writing at least 72 hours in advance of testing.

2. Conduct all tests in presence of City representative.

3. Remove or protect pipeline-mounted devices that could be damaged by testing.

4. Provide all apparatus and services required for testing, including:

   a. Test pumps, compressors, hoses, calibrated gages, meters, test containers, valves, fittings, and temporary pumping systems required to maintain City's operations.

   b. Temporary bulkheads, bracing, blocking, and thrust restraints.

5. Provide air if an air test is required, power if pumping is required, and gases if gases are required.

6. Unless otherwise specified, City will provide fluid required for hydrostatic testing. Contractor shall provide means to convey fluid for hydrostatic testing into piping being tested. Contractor shall provide fluid for other types of testing required.

7. Repair observed leaks and repair pipe that fails to meet acceptance criteria. Retest after repair.

8. Unless otherwise specified, testing shall include existing piping systems that connect with new piping system. Test existing pipe to nearest valve. Piping not installed by Contractor and that fails the test shall be repaired upon authorization of City. Unless otherwise included in the Work, repair of existing piping or Underground Facilities will be paid as extra Work.

9. Refer to Section 02532, Sanitary Sewer Forcemains, for testing requirements for forcemains.

10. Refer to Section 02533, Acceptance Testing of Sanitary Sewers and drains, for testing requirements for gravity sewers.

11. Refer to Section 02515, Hydrostatic Testing of Pipelines for testing requirements for waterlines.

B. Test Schedule:

1. Unless otherwise specified, required test pressures are at lowest elevation of pipeline segment being tested.

   a. Hydrostatically test pipe that will convey liquid at a pressure greater than five psig. Provide process air pipe test for pipe that will convey air or gas under pressure or vacuum, except chlorine gas, which requires separate test.

   b. Use exfiltration testing, low-pressure air testing, or vacuum testing for other piping.

   c. Disinfect for bacteriological testing piping that conveys potable water.

2. Test Pressure: pressure will be determined by City based on maximum anticipated sustained operating pressure and methods described in applicable ANSI/AWWA manual or standard that applies to the piping system.

C. Hydrostatic Testing:

1. Preparation for Testing:

   a. For thermoplastic pipe not covered in Sections 02515, 02532, and 02533, follow procedures described in Section 7 of ANSI/AWWA Standard C605.

   b. For other piping follow procedures described in ANSI/AWWA Manual M9. Wetting period is not required for pipe that is not cement mortar-lined.

   c. Prior to testing, ensure that adequate thrust protection is in place and joints are properly installed.

2. Test Procedure:

   a. Fill pipeline slowly to minimize air entrapment and surge pressures. Fill rate shall not exceed one foot of pipe length per second in pipe being tested.

   b. Expel air from pipe as required. Obtain approval of City prior to tapping pipe for expelling air.

   c. Examine exposed joints and valves, and make repairs to eliminate visible leakage.

   d. After specified wetting period, add fluid as required to pressurize line to required test pressure. Maintain test pressure for a stabilization period of ten minutes before beginning test.

   e. Timed test period shall not begin until after pipe has been filled, exposed to required wetting period, air has been expelled, and pressure stabilized.

f. Timed Test Period: After stabilization period, maintain test pressure for at least two hours. During timed testing period, add fluid as required to maintain pressure within five psig of required test pressure. Test pressure shall then remain steady for one hour, indicating no leakage.

g. Pump from test container to maintain test pressure. Measure volume of fluid pumped from test container and record on test report. Record pressure at test pump at 15 minute intervals for duration of test.

3. Allowable Leakage Rates: Leakage is defined as the quantity of fluid supplied to pipe segment being tested to maintain pressure within five psi of test pressure during timed test period. Allowable leakage rates for piping are:

a. No Leakage: Pipe with flanged, welded, fused, threaded, soldered, or brazed joints.

b. Rates based on formula or table in ANSI/AWWA Manual M41:

1) Metal pipe joined with rubber gaskets as sealing members, including the following joint types:

a) Bell and spigot and push-on joints.

b) Mechanical joints.

c) Bolted sleeve type couplings.

d) Grooved and shouldered couplings.

c. Rates based on formula or table in ANSI/AWWA C605:

1) Plastic pipe joined with 0-ring gasket sealing members.

D. Exfiltration Testing:

1. Conduct in accordance with Sections 02515, 02532, and 02533.

E. Vacuum Testing:

1. Conduct in accordance with Sections 02515, 02532, and 02533.

F. Vertical Deflection Test for Thermoplastic,Pipe not covered in Sections 02515, 02532, and 02533:

1. Conduct vertical deflection test at least thirty days after backfill has been placed.

2. Use rigid ball or mandrel for deflection test, which shall have diameter of at least 95 percent of base inside diameter or average inside diameter of piping, depending on which is specified in applicable ASTM standard, including appendix, to which pipe is manufactured. Perform test without mechanical pulling devices. Re-install and retest pipe segments that exceed deflection of five percent.

G. Televised Inspection:

1. Televise lines in accordance with Sections 02515, 02532, and 02533.

H. Process Air Pipe Testing:

1. General:

a. Test pipe before backfilling pipe trench.

b. Maintain groundwater level below bottom of trench until test is successfully completed.

c. Required test pressure is listed in Buried Piping Schedule.

2. Preparation for Testing:

a. Provide temporary tie rods at expansion joints as required.

b. Verify that pipe supports, where present, are secure.

c. Test one pipe segment at a time. Use temporary blind flanges and isolators as required.

d. Install corporation cocks for filling and relieving air. Provide temporary automatic pressure relief valve and pressure gauge with range suitable for test pressure.

3. Test Procedure:

a. Pressurize pipe segment being tested with air to required test pressure. Maintain pressure for at least two hours.

b. Apply soapy water solution to all joints to check for leakage, indicated by presence of bubbles, while test pressure is maintained.

c. Allowable Leakage: Zero

4. Repair and retest pipelines that fail test.

5. After testing is complete remove temporary measures provided for testing and provide Type 304 stainless steel threaded plugs at taps used for testing.

I. Examination of Welds:

1. Personnel performing examination of welds shall be qualified to at least Level II in accordance with ASNT SNT-TC-1A.

2. Conform to ASME Boiler and Pressure Vessel Code Section V and applicable articles for examination of welds.

3. Visually examine all welds, Category D Fluid Service, in conformance with ASME 831.3.

4. Examine at least ten percent of welds using liquid penetrant examination.

5. If defect is detected, all welds shall be examined by liquid penetrant examination.

6. At conclusion of liquid penetrant examination, remove penetrant test materials by flushing, washing, or wiping clean with applicable solvents.

J. Bacteriological Testing:

1. Refer to Section 02514, Disinfection of Water Lines.

3.6 CLEANING AND DISINFECTION

A. Cleaning, General: Clean pipe systems as follows:

1. Thoroughly clean all piping, including flushing with water, dry air, or inert gas as required, in manner approved by City, prior to placing in service. Flush chlorine solution and sodium hypochlorite piping with water.

2. Piping 24-inch diameter and larger shall be inspected from inside and debris, dirt and foreign matter removed.

3. For piping that requires disinfection and has not been kept clean during storage or installation, swab each section individually before installation with five percent sodium hypochlorite solution.

B. Cleaning of Gas and Air Piping:

1. Unless otherwise specified, non-chlorine gas and air system piping six-inch diameter and smaller shall be blown out, using air or testing medium specified. Piping larger than six-inch diameter shall be cleaned by having a swab or "pig" drawn through each pipe reach.

2. After connecting to equipment, blow out pipe using the equipment.

3. Upon completion of cleaning, piping shall be drained and dried with blown air.

C. Disinfection:

1. Disinfect all potable and finished water piping in accordance with Section 02514, Disinfection of Water Lines.

END OF SECTION

SECTION 15053

EXPOSED PIPING INSTALLATION

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified, and required to install and test all exposed piping, fittings, and specials. The Work includes the following:

   a. All types and sizes of exposed piping, except where exposed piping installations are specified under other Sections.

   b. Unless otherwise shown or specified, this Section includes all piping beginning at the outside face of structures or structure foundations and extending into the structure. Piping embedded in concrete within a structure or foundation shall be considered as exposed and is included herein. Piping that is permanently or intermittently submerged, or installed in sub-aqueous environments, is considered as exposed and is included in this Section.

   c. Work on or affecting existing exposed piping.

   d. Installation of all jointing and gasket materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, and all Work required for a complete exposed piping installation.

   e. Supports, restraints, and other anchors.

   f. Field quality control, including testing.

   g. Cleaning and disinfecting.

   h. Incorporation of valves, meters, and special items shown or specified into the piping systems per the Contract Documents and as required

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before exposed piping Work.

2. Coordinate with appropriate Sections of Division 2, Site Work and Division 15, Mechanical.

C. Related Sections:

1. Section 09901, Protective Coatings.

2. Section 15055, Ductile Iron Process Pipe.

3. Section 15110, Wall Pipes, Floor Pipes and Pipe Sleeves.

4. Section 15140, Pipe Hangers, Supports and Restraints.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices

1. No separate payment will be made for exposed piping under this section. Include payment in Lump Sum with price breakdown included in the Schedule of Values.

2. Refer to Section 01270 - Measurement and Payment, and Section 01292 - Schedule of Values.

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

1.3 REFERENCES

A. Standards referenced in this Section are:

1. ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings

2. ASME Boiler and Pressure Vessel Code.

3. ASME 831.3, Process Piping.

4. American Society for Non-Destructive Testing (ASNT), ASNT-TC-1A, Recommended Practice, Personnel Qualification, and Certification in Non-destructive Testing.

5. ASTM A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems

6. ASTM 832, Specification for Solder Metal.

7. ASTM D4161, Standard Specification for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals

8. ASTM F2164, Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure

9. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

10. ANSI/AWWA C600, Installation of Ductile Iron Water Mains and Their Appurtenances.

11. ANSI/AWWA C606, Grooved and Shouldered Joints.

12. ANSI/AWWA C651, Disinfecting Water Mains.

13. AWWA M23, PVC Piping - Design and Installation.

14. AWWA M41, Ductile-Iron Pipe and Fittings.

15. AWWA M45, Fiberglass Pipe Design.

16. SAE J1227, Method for Assessing the Cleanliness Level of New Hydraulic Fluid.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements and recommendations of authorities having jurisdiction over the Work, including:

   a. City of Houston

   b. Texas Commission on Environmental Quality

1.5 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Details of piping, valves, supports, accessories, specials, joints, harnessing, and main anchor supports, and connections to existing piping, structures, equipment, and appurtenances.

2. Testing Plans, Procedures, and Testing Limitations

a. Submit description of proposed testing methods, procedures, and apparatus, and obtain City's approval prior to testing.

B. Informational Submittals: Submit the following:

1. Certificates:

a. Submit a certificate signed by manufacturer of each product certifying product conforms to applicable referenced standards.

b. Welder's Certificate to comply with Paragraph 3.1.E.7.c.

2. Source Quality Control Submittals:

a. Submit copies of testing report for each test.

3. Site Quality Control Reports:

a. Submit copies of testing report for each test.

C. Closeout Submittals: Submit the following:

1. Record Documentation:

a. Maintain accurate and up-to-date record documents showing field and Shop Drawing modifications. Record documents for exposed piping Work shall show actual location of all piping and appurtenances on a copy of the Drawings, unless otherwise approved by City.

b. Record documents shall show piping with elevations referenced to the project datum and dimensions from permanent structures.

For straight runs of pipe provide offset dimensions as required to document pipe location.

c. Include section drawings with exposed piping record documents when the Contract Documents include section Drawings.

d. Conform to Section 01785, Project Record Documents.

1.06 DELIVERY, STORAGE AND HANDLING

A. Delivery:

1. Deliver products to Site to ensure uninterrupted progress of the Work.

2. Upon delivery, inspect pipe and appurtenances for cracked, gouged, chipped, dented, and other damage and immediately remove damaged products from Site.

3. Conform to requirements of Section 01610, Basic Product Requirements.

B. Storage:

1. Store products for convenient access for inspection and identification. Store products off the ground using pallets, platforms, or other supports. Protect packaged products from corrosion and deterioration.

2. Pipe and fittings other than thermoplastic materials may be stored outdoors without cover. Thermoplastic pipe and fittings stored outdoors shall be covered.

3. Conform to requirements of Section 01610, Basic Product Requirements.

C. Handling:

1. Handle pipe, fittings, specials, and accessories carefully with approved handling devices. Do not drop or roll material of delivery vehicles. Do not otherwise drop, roll, or skid piping.

2. Avoid unnecessary handling of pipe.

3. Keep pipe interiors free of dirt and foreign matter.

4. Protect interior linings and exterior coatings of pipe and fittings from damage. Replace pipe and fittings with damaged lining regardless of

cause of damage. Repair damaged coatings.

5. Conform to requirements of Section 01610, Basic Product Requirements.

PART 2 PRODUCTS

2.01 MATERIALS

A. Piping materials shall conform to the Specification for each type of pipe and piping appurtenances.

B. Markings and Identification:

1. Pipe Markings:

a. Clearly mark each piece of pipe or fitting with a designation conforming to that shown on the approved Shop Drawings.

b. Manufacturer shall cast or paint on each length of pipe and each fitting the pipe material, diameter, and pressure or thickness class.

2. Pipe Identification Markers and Arrows:

a. 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.

b. Locate at each valve, each branch take-off, and at each side of floor or wall through which pipe passes.

c. Locate at each valve, each branch take-off, and at each side of floor or wall through which pipe passes.

d. Not more than one label is required every 12 feet if adjacent label is visible.

e. Place labels on all lines.

B. Appurtenances: Provide products that comply with:

1. Section 15110, Wall Pipes, Floor Pipes and Pipe Sleeves.

2. Section 15140, Pipe Hangers, Supports and Restraints.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work is to be installed and notify City in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Install piping as shown, specified and as recommended by the pipe and fittings manufacturer.

2. If there is a conflict between manufacturer's recommendations and the Contract Documents, request in writing instructions from City before proceeding.

3. Provide pipe manufacturer's installation specialist at Site as specified on this Section.

B. Temporary Blind Flanges, Plugs, Caps, and Bulkheads:

1. Temporarily plug installed pipe at the end of each day of work or other interruption of pipe installation to prevent entry of animals, liquids, and persons into pipe, and entrance or insertion of deleterious materials into pipe.

2. Install standard plugs in all bells at dead ends, tees, and crosses. Cap all spigot and plain ends.

3. Fully secure and block blind flanges, plugs, caps, and bulkheads installed for testing, designed to withstand specified test pressure.

4. Where plugging is required for phasing of Work or subsequent connection of piping, install watertight, permanent type blind flanges, plugs, caps, or bulkhead acceptable to City.

C. Piping Installation:

1. Conform to manufacturer's instructions and requirements of standards and manuals listed in this Section, as applicable:

   a. Ductile Iron Pipe: ANSI/AWWA C600, AWWA M41.

   b. Thermoplastic Pipe: AWWA M23

   c. Fiberglass Reinforced Plastic Pipe: AWWA M45

2. Install straight runs true to line and elevation.

3. Install vertical pipe truly plumb in all directions.

4. Install piping parallel or perpendicular to walls of structures. Piping at angles and 45 degree runs across corners of structures will not be accepted unless specifically shown on the Contract Documents or approved by the City.

5. Install small diameter piping generally as shown when specific locations and elevations are not indicated. Locate such piping as required to avoid ducts, equipment, beams, and other obstructions.

6. Install piping to leave all corridors, walkways, work areas, and similar spaces unobstructed. Unless otherwise approved by City provide a minimum headroom clearance under piping and pipe supports of 7.5 feet. Clearances beneath piping shall be measured from the outermost edge of piping, flanges or other type of joint that extends beyond the nominal outside diameter of piping.

7. Protect and keep clean interiors, fittings, and valves of pipe that will convey potable water, chemicals, and other pipe designated by City.

8. Cutting: Cut pipe from measurements verified at Site. Field cut pipe, where required, with a machine specially designed for cutting type of pipe being installed. Make cuts carefully without damage to pipe, coating, or lining, and with a smooth end at right angles to axis of pipe. Cut ends of push-on joint type pipe shall be tapered and sharp edges filed off smooth. Do not flame-cut pipe.

9. Deflections at joints shall not exceed 75 percent of amount allowed by pipe manufacturer, unless otherwise approved by the City.

10. Additional General Requirements for FRP and Thermoplastic Piping:

a. Utilize wide band supports as recommended by pipe manufacturer and approved by City to minimize localized stresses.

b. Provide piping passing through walls with a sleeve of wearing material to prevent abrasion damage to piping.

c. Provide anchored supports at elbows, valves, bends in piping, and at connections to equipment and tanks.

d. Spacing of supports shall be in accordance with the manufacturer's published recommendations at maximum design operating temperature of pipe.

e. Provide U-clamps with wide band circumferential contact.

f. Provide guides on long runs of piping to maintain alignment and reduce chance of elastic failure of pipe. Space guides as recommended by pipe manufacturer.

g. Provide anchored supports to restrain joints that allow expansion. Minimize use of bellows style joints. Where required and approved by the City provide bellows style joints with low axial force to take up pipe expansion. Flexible connectors may be used to absorb thermal movement when approved in writing by City.

h. Provide devices that will reduce hydraulic pulsation in piping, together with shut-off and drain valve on all discharge lines of positive displacement pumps to reduce hydraulic hammer, and provide flexible connectors to absorb vibration. Submit details for City to review.

D.J Jointing Pipe:

1. General:

a. Make joints in accordance with pipe manufacturer's recommendations and Contract Documents.

b. Cut piping accurately and squarely and install without forcing or springing.

c. Ream out pipes and tubing to full inside diameter after cutting. Remove all sharp edges on end cuts.

d. Remove all cuttings and foreign matter from inside of pipe and tubing before installation. Thoroughly clean all pipe, fittings, *valves,* specials, and accessories before installing.

2. Ductile Iron Flanged Joints:

a. Assemble flanged joints using ring-type gaskets, with thickness as recommended by pipe manufacturer but not less than 1/8- inch thick, for raised-face flanges. Use full-face gaskets for flat- face flanges, unless otherwise approved by City or recommended by pipe manufacturer. Gaskets shall be suitable for the service intended in accordance with the manufacturer's ratings and instructions. Gaskets shall be properly centered.

b. Tighten bolts in a sequence that provides equal distribution of bolt loads.

c. Length of bolts shall be uniform. Bolts shall not project beyond the nut more than 1/4-inch or fall short of the nut when fully taken up. Machine-cut ends of bolts to be neatly rounded. Do not use washers.

d. Prior to assembly of flanged joints, lubricate bolt threads and gasket faces.

e. Alternately tighten bolts 180 degrees apart to compress the gasket evenly.

f. After assembly, coat all bolts and nuts, except stainless steel bolts and nuts, with same coating specified in Section 09901, Protective Coatings, for material of pipe and fittings being joined.

3. Thermoplastic Pipe Joints:

a. Solvent Cement Welded Joints:

1) Bevel pipe ends and *remove* all burrs before making joint. Clean pipe and fittings thoroughly. Do not make solvent cement joints if temperature is below 40 degrees F. Do not make solvent cement welded joints in wet conditions.

2) Use solvent cement supplied or recommended by pipe manufacturer.

3) Apply joint primer and solvent cement and assemble joints in accordance with recommendations and instructions of manufacturer of joint materials and pipe manufacturer.

4) Implement appropriate safety precautions when using joint primers and solvent cements. Allow air to circulate freely through pipelines to allow solvent vapors to escape. Slowly admit fluid when flushing or filling pipelines to prevent compression of gases within pipes.

4. FRP Pipe Joints:

a. All joints shall meet the laboratory performance requirements of Section 7 of ASTM 04161.

b. Flanged Joints:

1) Provide flanged connections to expansion joints, valves, tanks, and other equipment, except where flexible connectors such as bellows type expansion joints or rubber hose are required to prevent transmission of vibration, shock loads, and undue strain to adjoining piping. Flanges shall be hand laid up to PS 15 thickness, except that minimum thickness shall be 3/4-inch.

2) Each flange face shall be machined flat, and a new corrosion barrier applied. Flange face shall be textured for use with full-face gaskets.

3) Flange drilling shall be per ANSI B16.1, 125 pounds. Bolt holes shall be back spot faced for a washer seat.

4) Flange bolts shall be torqued only to manufacturer's recommended values.

c. Tapered Butt and Strap Joints:

1) For pipe 14-inch diameter and larger, provide tapered butt and strap joints with a laminated overlay.

5. Mechanical Coupling Joints:

a. Mechanical couplings include: sleeve-type flexible couplings, split flexible couplings, flanged adapters, and other mechanical couplings used.

b. Prior to installing and assembling mechanical couplings, thoroughly clean joint ends with a wire brush to remove foreign matter.

c. For mechanical couplings that incorporate gaskets, after cleaning apply lubricant to rubber gasket or inside of coupling housing and to joint ends. After lubrication, install gasket around joint end of previously installed piece and mate joint end of subsequent piece to installed piece. Position gasket and place coupling housing around gasket and over grooved or shouldered joint ends. Insert bolts and install nuts tightly by hand. Tighten bolts uniformly to produce an equal pressure on all parts of housing. When housing clamps meet metal to metal, joint is complete and further tightening is not required.

d. For plasticized PVC couplings, loosen the stainless steel clamping bands and remove the clamps from the coupling. Slide the coupling over the plain ends of the pipes to be joined without using lubricants. Place clamps over each end of coupling at grooved section and tighten with a torque wrench to torque recommended by manufacturer.

E. Installing Valves and Accessories:

1. Provide supports for large valves, flow meters, and other heavy items as shown or required to prevent strain on adjoining piping.

2. Position flow measuring devices in pipe lines so that they have the amount of straight upstream and downstream runs recommended by the flow measuring device manufacturer, unless specific location dimensions are shown.

F. Unions:

1. Provide a union downstream of each valve with screwed connections.

2. Provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.

G. Transitions from One Type of Pipe to Another:

1. Provide all necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

H. Closures:

1. Provide closure pieces, such as blind flanges and caps, shown or required to complete the Work.

3.3 WORK AFFECTING EXISTING PIPING

A. Location of Existing Piping:

1. Locations of existing piping shown on Drawings is approximate.

2. Determine the true location of existing piping to which connections are to be made, crossed, and that could be disturbed, and determine location of other facilities that could be affected by the Work.

B. Taking Existing Pipelines Out of Service:

1. Comply with City requirements.

C. Work on Existing Pipelines:

1. Cut or tap pipes as shown or required with machines and tools specifically designed for cutting or tapping pipelines.

2. Install temporary plugs to prevent entry of mud, dirt, water, and debris into pipe.

3. Provide necessary adapters, sleeves, fittings, pipe, and appurtenances required to complete the Work.

4. Conform to applicable requirements of the City.

3.4 PAINTING

A. Field painting shall conform to Section 09901, Protective Coatings

3.5 FIELD QUALITY CONTROL

A. Testing, General:

1. Test all piping, except as exempted in the Exposed Piping Schedule.

2. Notification:

   a. Notify City at least 72 hours prior to testing.

   b. When authorities having jurisdiction are to witness tests, notify City and authorities having jurisdiction in writing at least 48 hours in advance of testing.

3. Conduct all tests in presence of City.

4. Remove or protect pipeline-mounted devices that could be damaged by testing.

5. Provide all apparatus and services required for testing, including:

   a. Test pumps, compressors, hoses, calibrated gages, meters, test containers, valves, fittings, and temporary pumping systems required to maintain City's operations.

   b. Temporary bulkheads, bracing, blocking, and thrust restraints.

6. Provide air if an air test is required, power if pumping is required, and gases if gases are required.

7. Unless otherwise specified, City will provide fluid required for hydrostatic testing. Contractor shall provide means to convey fluid for hydrostatic testing into the pipe being tested. Contractor shall provide fluid for other types of testing required.

8. Repair observed leaks and repair pipe that fails to meet acceptance criteria. Retest after repair.

9. Unless otherwise specified, testing shall include existing piping systems that connect with new piping system. Test existing pipe to nearest valve. Piping not installed by Contractor and that fails the test shall be repaired upon authorization of City. Repair of existing piping will be paid as extra work unless otherwise specified.

B. Hydrostatic Testing:

1. Preparation for Testing:

   a. For thermoplastic pipe and FRP pipe, follow procedures described in Section 7 of ANSI/AWWA Standard C605.

   b. For other piping follow procedures described in AWWA Manual M9. A wetting period is not required for pipe that is not cement mortar-lined.

   c. Prior to testing, ensure that adequate thrust protection is in place and all joints are properly installed.

2. Test Procedure:

   a. Fill pipeline slowly to minimize air entrapment and surge pressures. Fill rate shall not exceed one foot of pipe length per second in the pipe being tested.

   b. Expel air from pipe as required. Obtain approval of City prior to tapping pipe for expelling air.

   c. Examine joints and valves, and make repairs to eliminate visible leakage.

   d. After specified wetting period, add fluid as required to pressurize line to required test pressure. Maintain test pressure for a stabilization period of ten minutes before beginning test.

   e. Timed test period shall not begin until after the pipe has been filled, exposed to the required wetting period, air has been expelled, and pressure stabilized.

   f. Timed Test Period: After the stabilization period, maintain test pressure for at least two hours. During timed testing period, add fluid as required to maintain pressure within five psig of required test pressure. For HOPE pipe, after three hour expansion
   phase, reduce test pressure by ten psig and do not add liquid. The test pressure shall then remain steady for one hour,
   indicating no leakage.

g. Pump from a test container to maintain test pressure. Measure volume of fluid pumped from test container and record on test report. Record pressure at test pump at fifteen minute intervals for duration of test.

3. Allowable Leakage Rates: Leakage is defined as the quantity of fluid supplied to pipe segment being tested to maintain pressure within five psi of the test pressure during timed test period. Allowable leakage rates for piping are:

   a. No Leakage: Pipe with flanged, welded, fused, threaded, soldered, or brazed joints.

   b. Rates based on formula or table in AWWA Manual M41:

      1) Metal and fiberglass pipe joined with rubber gaskets as sealing members, including the following joint types:

         a) Mechanical joints.

   c. Rates based on formula or table in ANSI/AWWA C605:

      1) Plastic pipe joined with 0-ring gasket sealing members.

D. Exfiltration Testing:

1. Plug and bulkhead ends and lateral connections of pipe segment to be tested and admit fluid until the pipe is full. Admit fluid slowly to minimize air entrapment.
2. Before measuring leakage, allow fluid to wet pipe interior for the following period:

   a. Cement Mortar-lined Pipe: 24 hours.

   b. Other Pipe: Wetting period not required.

3. Provide a minimum hydrostatic head during test of two feet above highest point of pipe segment tested.

4. Add fluid from a test container or from a metered supply as required to maintain the test water level within three inches of the test head throughout the test.

5. Test duration shall be at least two hours.

6. Allowable Leakage Rates:

a. Leakage is defined as the quantity of fluid that must be supplied to pipe segment tested to maintain the hydrostatic head within three inches of test head during the test after pipe has been filled and exposed to required wetting period, plus the quantity required to refill to original head at end of test.

E. Process Air Pipe Testing:

1. General:

a. Required test pressure is listed in Exposed Piping Schedule.

2. Preparation for Testing:

a. Provide temporary tie rods at expansion joints as required.

b. Verify that pipe supports, where present, are secure.

c. Test one pipe segment at a time. Use temporary blind flanges ad isolators as required.

d. Install corporation cocks for filling and relieving air. Provide temporary automatic pressure relief valve and pressure gauge with range suitable for test pressure.

3. Test Procedure:

a. Pressurize pipe segment being tested with air to the required test pressure. Maintain pressure for at least two hours.

b. Apply a soapy water solution to all joints to check for leakage, indicated by presence of bubbles, while test pressure is maintained.

c. Allowable Leakage: Zero

4. Repair and retest pipelines that fail the test.

5. After testing is complete remove temporary measures provided for testing and provide Type 304 stainless steel threaded plugs at taps used for testing.

F. Examination of Welds:

1. Personnel performing examination of welds shall be qualified to at least Level II, in accordance with ASNT SNT-TC-1A.

2. Conform to ASME Boiler and Pressure Vessel Code Section V and applicable articles for examination of welds.

3. Visually examine all welds, Category D Fluid Service, in conformance with ASME B31.3.

4. Examine at least ten percent of welds using liquid penetrant examination.

5. If a defect is detected, all welds shall be examined by liquid penetrant examination.

6. At conclusion of liquid penetrant examination, remove penetrant test materials by flushing, washing, or wiping clean with applicable solvents.

3.6 CLEANING AND DISINFECTION

A. Cleaning, General: Clean pipe systems as follows:

1. Thoroughly clean all piping, including flushing with water, dry air, or inert gas as required, in a manner approved by City, prior to placing in service. Flush chlorine solution and sodium hypochlorite piping with water.

2. For piping that requires disinfection and has not been kept clean during storage or installation, swab each section individually before installation with a *five* percent hypochlorite solution.

B. Cleaning of Gas and Air Piping:

1. Unless otherwise specified, non-chlorine gas and air system piping 6-inch diameter and smaller shall be blown out, using air or the testing medium specified. Piping larger than 6-inch diameter shall be cleaned by having a swab or "pig" drawn through each pipe reach.

2. After connecting to equipment, blow out pipe using the equipment.

3. Upon completion of cleaning, piping shall be drained and dried with blown air.

C. Disinfection:

1. Disinfect all potable and finished water piping.

2. A suggested procedure for accomplishing complete and satisfactory disinfection is specified below. Other procedures may be considered

for acceptance by City.

a. Prior to disinfection, clean piping as specified and flush thoroughly.

b. Conform to procedures described in ANSI/AWWA C651. Continuous feed method of disinfecting shall be used, unless alternative method is acceptable to City.

3. Water for initial flushing, testing, and disinfection will be furnished by City. Contractor shall provide all temporary piping, hose, valves, appurtenances, and services required. Cost of water required for re-disinfection will be paid by Contractor to City at the water utility's standard rates.

4. Chlorine shall be provided by Contractor.

5. Chlorine concentration in the water entering the piping shall be between 50 and 100 ppm, such that a minimum residual concentration of 25 mg/l remains after a 24-hour retention period. Disinfect the piping and all related components. Repeat as necessary to provide complete disinfection.

6. After required retention period, the chlorinated water shall be flushed to a closed drain line, unless otherwise directed by City. Properly dispose of chlorinated water in accordance with applicable regulations. Do not discharge chlorinated water to storm sewers, ditches, or overland.

END OF SECTION

Section 15055 DUCTILE IRON PROCESS PIPE

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install exposed ductile iron pipe and fittings.

2. Extent of piping is shown on the Drawings

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before ductile iron pipe Work.

C. Related Sections:

1. Division 2, Site Work

2. Section 09901, Protective Coatings

3. Section 15050, Buried Piping Installation.

4. Section 15053, Exposed Piping Installation.

5. Section 15105, Couplings, Adapters, and Specials for Process Piping.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices

1. No separate payment will be made for centrifugal fans under this section. Include payment in Lump Sum with price breakdown included in the

Schedule of Values.

2. Refer to Section 01270 - Measurement and Payment, and Section 01292 - Schedule of Values.

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

1.3 REFERENCES

A. Standards referenced in this Section are:

1. ANSI B18.2.1, Square and Hex Bolts and Screws Inch Series.

2. ANSI B18.2.2, Square and Hex Nuts. (Inch Series).

3. ASTM A193, Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service.

4. ASTM A194, Specification for Carbon Steel and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.

5. ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

6. ASTM A354, Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners.

7. ASTM A563, Standard Specification for Carbon and Alloy Steel Nuts.

8. ASTM B117, Standard Practice for Operating Salt Spray (Fog} Apparatus.

9. ASTM C283, Standard Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid.

10. ASTM D714, Standard Test Method for Evaluating Degree of Blistering of Paints.

11. ASTM D792, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

12. ASTM D5162, Standard Practice for Discontinuity (Holiday) Testing of Non-Conductive Protective Coating on Metallic Substrates.

13. ASTM E96, Standard Test Methods for Water Vapor Transmission of Materials.

14. ASTM G14, Standard Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test).

15. ASTM G62, Standard Test Methods for Holiday Detection in Pipeline Coatings.

16. ASTM G95, Standard Test Methods for Cathodic Disbandment Test of Pipeline Coatings (Attached Cell Method).

17. ANSI/AWWA C104, Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.

18. ANSI/AWWA C110, Ductile Iron and Gray Iron Fittings for Water.

19. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.

20. ANSI/AWWA C115, Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges.

21. ANSI/AWWA C151, Ductile Iron Pipe, Centrifugally Cast, for Water.

22. ANSI/AWWA C153, Ductile Iron Compact Fittings, 3 inch through 24 inch and 54 inch through 64 inch for Water Service.

23. ANSI/AWWA C606, Grooved and Shouldered Type Joints.

24. European Standard (EN), EN 598: Ductile Iron Pipe, Fittings, Accessories and Their Joints for Sewerage Applications.

25. MSS-SP 60, Connecting Flange Joint Between Tapping Sleeves and Tapping Valves.

26. NACE RP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.

27. NAPF 500-03, Surface Preparation Standard for Ductile Iron Pipe and Fittings Receiving Special External Coatings and/or Special Internal Linings.

28. NSF/ANSI 61, Drinking Water System Components - Health Effects.

29. SSPC PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.

30. SSPC Painting Manual, Volume 1, Para. XIV.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:

a. Manufacturer shall have a minimum of five years successful experience producing ductile iron pipe and fittings and shall be able to show evidence of at least five installations in satisfactory operation in the United States that are similar applications to the specified service.

b. Lining and coating products shall be manufactured by a firm with a minimum of five years successful experience in protecting pipelines exposed to the specified service conditions , and shall be able to show evidence of at least five installations in satisfactory operation in the United States that are similar applications to the specified service.

c. When not applied by the manufacturer, lining and coating Subcontractor shall have a minimum of five years successful experience in the application of the specified linings and coatings for similar applications for the specified service, and shall be able to show evidence of at least five installations in satisfactory operation in the United States.

8. Supply and Compatibility:

1. Unless otherwise approved, obtain all pipe, fittings, and appurtenances included in this Section from a single ductile iron pipe manufacturer.

2. Ductile iron pipe manufacturer shall review and approve or prepare all Shop Drawings and other submittals for pipe, fittings, and appurtenances furnished under this Section.

3. Pipe, fittings, and appurtenances shall be suitable for the specified service and shall be integrated into overall piping system by ductile iron pipe manufacturer.

4. Ductile iron pipe manufacturer shall be responsible for all products and all factory-applied linings and coatings, whether installed at pipe manufacturer's facility or at manufacturer's Supplier's facility.

C. Regulatory Requirements:

1. Pipe and fittings, including linings and coatings, that will convey potable water or water that will be treated to become potable, shall be certified by an accredited organization in accordance with NSF/ANSI 61 as being suitable for contact with potable water, and shall comply with requirements of authorities having jurisdiction at Site.

1.5 SUBMITTALS

A. Action Submittals: Submit the following with Shop Drawings required under Section 15050, Buried Piping Installation, and Section 15053, Exposed Piping Installation:

1. Shop Drawings:

a. Detailed drawings and data for pipe, fittings, gaskets, appurtenances, linings, and coatings.

B. Informational Submittals: Submit the following:

1. Certificates:

a. Submit certificate signed by manufacturer of each product that product conforms to applicable referenced standards and the Contract Documents.

2. Source Quality Control Submittals:

a. Submit results of specified shop tests for pipe, fittings, linings, and coatings.

b. Lining and coating test coupons.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 15050, Buried Piping Installation, and Section 15053, Exposed Piping Installation.

B. Handling of Pipe and Fittings Lined with Ceramic Epoxy: Lifting devices shall

not come into contact with lined surfaces. Use hooks, forks, chains, straps, and other lifting devices only on exterior of pipe and fittings. Pipe and fittings with damaged lining shall be replaced regardless of cause of damage.

PART 2 PRODUCTS

2.01 MATERIALS

A. General:

1. Piping systems shall be suitable for their intended use.

2. Joints shall be as specified in Section 15050, Buried Piping Installation and Section 15053, Exposed Piping Installation. If not specified, provide flanged joints for exposed piping and push-on or mechanical joints for buried piping. Provide couplings on pipe with plain or grooved ends where shown or where approved by City.

B. Ductile Iron Pipe, Joints, and Fittings:

1. Refer to Section 02501, Ductile Iron Pipe and Fittings. Flanged Pipe: Fabricate in accordance with ANSI/AWWA C115.

   a. Pressure Rating: As specified in piping schedule in Section 15053, Exposed Piping Installation. If not otherwise specified, use Special Thickness Class 53 for three-inch to 54-inch diameter pipe and Pressure Class 350 for 60-inch and 64-inch diameter pipe.

2. Non-Flanged Pipe: Conform to ANSI/AWWA C151 for material, pressure, dimensions, tolerances, tests, markings, and other requirements.

   a. Pressure Class: As specified in piping schedules in Section 15050, Buried Piping Installation and Section 15053, Exposed Piping Installation. If not otherwise specified, use Pressure Class 53.

   b. Special Thickness Class: As specified in piping schedules in Section 15050, Buried Piping Installation and Section 15053, Exposed Piping Installation.

3. Pipe Joints:

   a. Flanged Joints: Conform to ANSI/AWWA C110 and ANSI/AWWA C111 capable of meeting the pressure rating or special thickness class, and test pressure specified in piping schedule in Section 15053, Exposed Piping Installation.

      1) Gaskets: Unless otherwise specified, gaskets shall be at least 1/8-inch thick, ring or full-face as required for the pipe, of synthetic rubber compound containing not less than 50 percent by volume nitrile or neoprene, and shall be free from factice, reclaimed rubber, and other deleterious substances. Gaskets shall be suitable for the service conditions specified, specifically designed for use with ductile iron pipe and fittings.

      2) Bolts: Comply with ANSI 818.2.1.

         a) Exposed: ASTM A-316 stainless steel.

         b) Refer to Section 02501

      3) Nuts: Comply with ANSI 818.2.2.

         a) Exposed: ASTM A-316 stainless steel.

         b) Refer to Section 02501

   b. Mechanical Joints: Comply with ANSI/AWWA C111 and ANSI/AWWA C151, capable of meeting pressure rating or special thickness class, and test pressure specified in piping schedules in Section 15050, Buried Piping Installation, and Section 15053, Exposed Piping Installation.

      1) Glands: Ductile iron.

      2) Gaskets: Plain tip.

      3) Bolts and Nuts: High strength, low alloy steel.

      4) Manufacturers: Provide products of one of the following:

         a) Use pre-approved manufacturers listed in City of Houston Approved Products

c. Push-On Joints: Comply with ANSI/AWWA C111 and ANSI/AWWA C151, capable of meeting pressure class or special thickness class, and test pressure specified in piping schedules in Section 15050, Buried Piping Installation, and Section 15053, Exposed Piping Installation.

1) Gaskets: Vulcanized SBR, unless otherwise specified.

2) Stripes: Each plain end shall be painted with a circular stripe to provide a guide for visual check that joint is properly assembled.

3) Products and Manufacturers: Provide one of the following:

a) Use pre-approved manufacturers listed in City of Houston Approved Products

d. Restrained Joints: Restrained push-on joints shall be capable of being deflected after full assembly. Field cuts of restrained pipe are not allowed without approval of City.

1) Products and Manufacturers: Provide restrained joints for mechanical joint piping by one of the following:

a) Use pre-approved manufacturers listed in City of Houston Approved Products

2) Products and Manufacturers: Provide restrained joints for push-on joint piping by one of the following:

a) Use pre-approved manufacturers listed in City of Houston Approved Products

4. Flanged and Push-On Joint Fittings: Comply with ANSI/AWWA C110 and ANSI/AWWA C111.

a. Material: Ductile iron.

b. Pressure rating, gaskets, bolts, and nuts shall be as specified for flanged joints. Pressure rating of fittings shall meet, but not exceed, specified pressure rating or special thickness class of the connected pipe.

5. Mechanical Joint Fittings: Comply with ANSI/AWWA C110 and ANSI/AWWA C111.

a. Material: Ductile iron.

b. Glands: Ductile iron.

c. Pressure rating, gaskets, bolts, and nuts shall be as specified for mechanical joints. Pressure rating of fittings shall meet, but not exceed, specified pressure rating or special thickness class of connected pipe.

d. Mechanical Joint Bolt Holes: Orient bolt holes to straddle vertical centerline of the fittings.

C. Lining, General:

1. Typical Service Conditions:

Property	FM
Fluid(s) Conveyed Through Pipe	Grit Slurry
Maximum Fluid Velocity (fps}	5.5
Lining Type	Refer to Section 15053

2. Surface Preparation:

a. Initial Surface Inspection: Surface to be lined shall be inspected by pipe and fitting manufacturer and applicator, if applicator is other than pipe and fitting manufacturer. Inspecting parties shall inspect surface to be coated and mutually determine recommended surface preparation method.

b. Surface Preparation: Prepare surface in accordance with recommended method.

c. Finished Surface Inspection: Lining applicator shall inspect finished surface prior to application to determine acceptability. If surface is unacceptable, repeat surface preparation as necessary.

D. Cement-mortar Lining:

1. Where specified in piping schedules included with Section 15050,

Buried Piping Installation and Section 15053, Exposed Piping Installation, pipe and fittings shall be lined with bituminous seal coated cement-mortar lining in accordance with ANSI/AWWA C104.

E. Ceramic Quartz-Filled, Amine-Cured Novalac Epoxy Lining:

1. Where specified in piping schedules included with Section 15050, Buried Piping Installation and Section 15053, Exposed Piping Installation, pipe and fittings shall be factory lined with a quartz-filled, amine-cured, novalac, epoxy containing at least twenty percent by volume of ceramic quartz pigment.

2. Ceramic epoxy lining shall have a permeability rating of zero when tested according to Method A of ASTM E96, Procedure A, with a test duration of thirty days.

3. Conduct the following tests on coupons from factory lined ductile iron pipe:

   a. ASTM B117 Salt Spray (scribed panel): Results to equal zero undercutting after two years.

   b. ASTM G95 Cathodic Disbandment 1.5 volts at 77 degrees F: Results to equal no more than 0.5 mm undercutting after thirty days.

   c. Immersion Testing rated using ASTM 0714.

      1) Twenty Percent Sulfuric Acid: No effect after two years.

      2) Twenty-five Percent Sodium Hydroxide at 140 degrees F: No effect after two years.

      3) Distilled Water at 160 degrees F: No effect after two years.

      4) Tap Water at 120 degrees F (scribed panel): Zero undercutting after two years, with no effect.

4. Ceramic epoxy lining shall have abrasion resistance of no more than four mils loss after one million cycles, in accordance with ES EN 598, Section 7.8, Abrasion Resistance.

5. Within eight hours of surface preparation, interior of pipe and fittings

shall receive 40 mils dry film thickness, utilizing method recommended by lining manufacturer that will comply with requirements of this Section. Number of coats applied shall be as recommended by lining manufacturer. Minimum substrate and ambient temperature for lining application shall be 40 degrees F.

6. Inspection and Certification:

   a. Check all ductile iron pipe and fitting linings for thickness using magnetic film thickness gage in accordance with method in SSPC PA 2 Film Thickness Rating.

   b. Test interior lining of pipe barrels and fittings for pinholes with non-destructive, 2,500-volt test. Defects found shall be repaired in accordance with lining manufacturer's recommendations prior to shipment from lining applicator's factory.

   c. Mark each pipe and fitting with date of application and its numerical sequence of application.

7. Products and Manufacturers: Provide one of the following:

   a. Protecto 401 Ceramic Epoxy.

   b. Or equal.

F. Couplings:

1. Refer to Section 15105, Couplings, Adapters, and Specials 'for Process Piping.

G. Specials:

1. Transition Pieces:

   a. Provide suitable transition pieces (adapters) for connecting to existing piping.

   b. Unless otherwise shown or indicated, expose existing piping to determine material, dimensions, and other data required for transition pieces.

2. Taps:

   a. Provide taps where shown or required for small-diameter piping or instrumentation connections.

   b. Provide corporation stops where shown or required.

   c. Where pipe wall thickness or tap diameter will not allow engagement of full threads, provide tapping saddle with outlet joints conforming to requirements of Paragraph 2.1.8.3.a of this Section for four-inch through 12-inch diameter pipe, and Paragraph 2.1.B.3.b. for 14-inch through 54-inch diameter pipe.

   d. For flanged connections on tapping saddle outlet branch, counterbore flange in accordance with MSS SP-60 dimensions. Inside diameter of outlet shall be 1/4-inch greater than nominal diameter.

3. Tangential Outlets:

   a. Provide tangential outlet fittings where shown or indicated.

   b. Flanged and grooved end joints are not allowed.

2.2 MARKING FOR IDENTIFICATION

A. In addition to identification markings specified in Section 15050, Buried Piping Installation, and Section 15053, Exposed Piping Installation, also stamp, mark, and identify push-on joint and mechanical joint pipe with:

   1. Name or trademark of manufacturer.

   2. Weight, class or nominal thickness, and casting period.

   3. Country where cast.

   4. Year the pipe was produced.

   5. Letters "DI" or "Ductile" shall be cast or metal stamped

B. In addition to identification markings specified in Section 15050, Buried Piping Installation, and Section 15053, Exposed Piping Installation, also stamp, mark, and identify flanged pipe with:

   1. Flange manufacturer's mark, size, and letters "DI" cast or stamped on the flanges.

2. Fabricator's mark if other than flange manufacturer.

3. Length and weight.

C. In addition to identification markings specified in Section 15050, Buried Piping Installation, and Section 15053, Exposed Piping Installation, also stamp, mark, and identify fittings with:

1. Manufacturer's identification.

2. Pressure rating.

3. Nominal diameters of openings.

4. Country where cast.

5. Number of degrees or fraction of the circle on bends.

6. Letters "DI" or "Ductile" cast on them.

2.3 EXTERIOR SURFACE PREPARATION AND COATINGS

A. General Coating Requirements:

1. Coating types are specified in piping schedules in Section 15050, Buried Piping Installation, and Section 15053, Exposed Piping Installation.

8. Exposed Pipe and Fittings:

1. Surface Preparation:

a. Initial Surface Inspection: Pipe and fitting manufacturer and coating applicator shall inspect surface to be coated and mutually determine recommended NAPF 500-03 surface preparation method.

b. Surface Preparation: Prepare surface in accordance with recommended NAPF 500-03 method.

c. Finished Surface Inspection: Prepared surfaces shall be inspected by coating applicator prior to application to determine acceptability of finished surface. If surface is unacceptable,

repeat surface preparation and re-application as necessary.

2. After recommended surface preparation, prime coat exterior ferrous metal surfaces of pipe and fittings in the shop in accordance with Section 09901, Protective Coatings.

3. Field painting shall comply with Section 09901, Protective Coatings.

C. Buried Pipe and Fittings:

1. Asphaltic Coating: Where specified in piping schedule in Section 15050, Buried Piping Installation, coat pipe and fittings with an asphaltic coating approximately one-mil thick, in accordance with ANSI/AWWA C151, ANSI/AWWA C115, ANSI/AWWA C110, and ANSI/AWWA C153, as applicable.

PART 3 EXECUTION

3.1 INSPECTION

A. Inspect piping to assure that piping is free from defects in material and workmanship. Verify compatibility of pipe, fittings, gaskets, linings, and coatings.

3.2 INSTALLATION AND FIELD QUALITY CONTROL

A. For buried piping installation and testing, refer to Section 15050, Buried Piping Installation.

B. For exposed piping installation and testing, refer to Section 15053, Exposed Piping Installation.

END OF SECTION

Section 15070

HOSES

PART 1 GENERAL

1.01 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.

1.02 SUBMITTALS

A. Shop Drawings and Product Data

1. Comply with the general requirements of Section 01340 - Shop Drawings, Product Data and Samples and the supplemental requirements below.

B. Operation and Maintenance Data

1. Comply with the requirements of Section 01782 - Operations and Maintenance Data.

1.03 DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements of Section 01610 - Basic Product Requirements.

PART 2 PRODUCTS

2.01 HOSE

A. Size: 1 1/2 inch inside diameter.

B. Quantity: 100 feet per hose.

C. Construction:

1. Neoprene tube

2. Rayon braiding
3. Neoprene cover

D. End Connections

1. Brass
2. Chicago standard hose threads
3. Male on one end of hose; female on the other.

2.02 NOZZLES

A. Type: Fire fighting nozzles with large handle and ball type shut off valve.

B. Quantity: One per hose.

C. Hose Connection: Female type with Chicago standard hose threads.

D. Construction: Brass

PART 3 EXECUTION

3.01 INSTALLATION

A. Install hose rack, hose and nozzle in accordance with Drawings, approved shop drawings, and the manufacturer's installation instruction.

END OF SECTION

Section 15082

INSULATION OF PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, material, equipment and incidentals as shown, specified and required to furnish and install insulation for all heating piping systems, condensate drains, refrigerant piping, process air piping and all outdoor located piping systems with all accessories, including valves and fittings.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the insulation of piping and equipment Work.

C. Related Sections:

1. Division 15, Applicable Sections on Pipe, Valves and HVAC Elements.

2. Division 16, Electrical.

D. General:

1. All existing insulation in all areas that is damaged or displaced due to Work by CONTRACTOR shall be repaired with materials and procedures identical to the existing insulation.

1.2 REFERENCE STANDARDS

Standards referenced in this Section are listed below:

1. American Society for Testing and Materials, (ASTM).

   a. ASTM C 449/C 449M, Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

   b. ASTM C 547, Specification for Mineral Fiber Pipe Insulation.

c. ASTM E 84, Test Method for Surface Burning Characteristics of Building Materials.

2. Federal Specifications, (FS).

a. FS HH 1 558B, Insulation Blocks, Boards, Blankets, Felts, Sleeving, Pipe Fitting Covering.

b. FS SS-C-160, Cement, Insulation, Thermal.

3. National Fire Protection Association, (NFPA).

a. NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Manufacturer shall have a minimum of five years' experience of producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:

1. Obtain all equipment included in this Section, regardless of the component manufacturer, from a single insulation of piping and equipment manufacturer.

2. The insulation of piping and equipment manufacturer to review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.

3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the insulation of piping and equipment manufacturer.

C. Regulatory Requirements: Comply with applicable prov1s1ons and recommendations of the following, except as otherwise shown or specified:

1. National Fire Protection Association, (NFPA}.

2. Underwriters' Laboratories, Inc., (UL). Fire hazard ratings to be verified by Underwriters' Laboratories, Inc. label or listing or a certified test report from an approved independent testing laboratory.

3. Local and State Building Codes and Ordinances:

   a. Uniform Building Code

   b. Uniform Mechanical Code.

   c. Model Energy Code.

4. Permits: CONTRACTOR shall obtain and pay for all required permits, fees, inspections and approvals by authorities having jurisdiction.

1.4 SUBMITTALS

A. Samples: Submit samples of the following:

1. Fiberglass insulation.

2. Weatherproof insulation jacket:

8. Shop Drawings: Submit the following:

1. Manufacturers' catalog literature, specifications, and illustrations with the following information:

   a. Thermal properties.

   b. Physical properties.

   c. Fire hazard ratings.

   d. Facing information.

   e. Installation instructions.

   f. Jointing recommendations for butt joints and longitudinal seam.

2. Fabrication instructions for pipe fittings and valve insulation and coatings.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
2. Material shall be packed and shipped in corrugated carton.

B. Storage and Protection:

1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

2. Store all materials in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.

3. Store material in clean, dry area, out of the weather.

4. Material shall be tightly covered to protect against dirt, water, mechanical injury or chemical damage.

5. Material shall remain in original cartons until time of installation.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

PART 2- PRODUCTS

2.01 DESIGN CRITERIA

A. Insulation systems including covering, mastics, adhesives, sealers and facings shall have the following fire hazard classifications:

1. Flame Spread: 25 maximum.

2. Fuel Contributed: 50 maximum.

3. Smoke Developed: 50 maximum.

2.2 MATERIALS

A. Fiberglass Insulation:

1. Type: Heavy-density sectional pipe insulation with vapor barrier and self-sealing lap.

2. Density: Four pounds per cubic foot.

3. R-Value Minimum: 4.0 hr.-ft2-°F/BTU.

4. Fittings: Molded fiberglass.

5. Jointing Materials: Manufacturer's recommended adhesives and tape.

6. Valve Insulation: Miter cut nesting size covering segments of same thickness as pipeline, for insulation of valves.

7. Products and Manufacturers: Provide one of the following:

a. Owens Corning Fiberglass Corporation, Fiberglass 25ASJ/SSL.

b. Certain-Teed Products Corporation, Certain Teed snap-on ASJ-SSL.

c. Or equal.

B. Process Air Piping Insulation:

1. Type: Insulation shall be 2-1/2-inch thick semi-rigid fiberglass board with a 0.016-inch thick aluminum all-weather jacket for interior and exterior piping, fittings and valves.

2. Maximum Thermal Conductivity: 0.30 BTU-in./hr.- ft2-°F at 100°F mean temperature.

3. Minimum Compressive Strength: 125 lbf/ ft2.

4. Application: Insulation shall be installed on all process air piping, fitting and valves as shown. Insulation for fittings and valves shall be mitered from the same insulation material used on process air piping.

5. Products and Manufacturers: Provide one of the following:

   a. Owens-Corning Fiberglass Pipe and Tank Insulation.

   b. Insul-Wrap 850 by Insul-Therm.

   c. Or equal.

C. Mechanical Equipment Insulation:

1. Type: Semi-rigid fiberglass board.

2. Minimum Thickness: Three-inches.

3. Insulation Jacket: All service jacket.

4. Density: Three lbs. per cubic foot.

5. Fasteners: 3/4-inch by 0.015-inch stainless steel bands.

6. Wrapping: One-inch wire mesh.

7. Finish: Two, 1/2-inch thick coats of insulating cement with open weave glass cloth.

8. Lagging Adhesive:

   a. Products and Manufacturers: Provide one of the following:

      1) Foster Products Division, Sealfast 30-36.

      2) Or equal.

   b. Type: Asbestos free, fire retardant coating.

   c. References:

      1) MIL-A-3361B, Class 1, Grade A

      2) NFPA 90A

9. Insulating Cement:

   a. Products and Manufacturers: Provide one of the following:

1) Ryder Sales: Thermokote 1.

2) Insulation Industries Inc., Smooth Kate.

3) Or equal.

b. Type: Asbestos free, hydraulic setting refractory type insulating cement, non-corrosive to ferrous metals.

c. Reference:

1) ASTM C 449/C 449M.

2) Federal Specification SS-C-160 Type III GRF.

10. Products and Manufacturers: Provide one of the following:

a. Certain-Teed Products Corporation, Snap Wrap.

b. Owens-Corning Fiberglass Corporation, Pipe Wrap.

c. Or equal.

D. Insulation for Cryogenic Service (Exposed LOX Piping):

1. Polyisocyanurate Foam Insulation:

a. Products and Manufacturers: Provide one of the following:

1) Dow Chemical Company, Trymer 2000

2) Or equal.

b. Type: Double layered system with vapor retarder.

c. Physical Properties:

PHYSICAL PROPERTIES	ASTM METHOD	ENGLISH UNITS	VALUES
Density	01622	lb/ft^3	2.05
Compressive Strength	01621	lb/inL	
Parallel to Rise (Thickness)			24
Perpendicular to Rise (Width)			13
Peroendicular to Rise (Lenoth)			24

PHYSICAL PROPERTIES	ASTM METHOD	ENGLISH UNITS	VALUES
Compressive Modulus	01621	lb/in'	
Parallel to Rise (Thickness)			550
Perpendicular to Rise (Width)			325
Perpendicular to Rise (Length)			550
Tensile Strength	01623	lb/in'	
Parallel to Rise (Thickness)			27
Perpendicular to Rise (Width)			24
Perpendicular to Rise (Length)			29
Tensile Modulus	01623	lb/in'	
Parallel to Rise (Thickness)			1500
Perpendicular to Rise (Width)			600
Perpendicular to Rise (Length)			1500
k-Factor (75EF [24EC] mean temp.)	C518	BTU-in/hr-°F	
Initial			0.141
Aqed 180 days@ 75°F (24°C)			0.190
R Value/in. (75EF [24EC] mean temp.)	C518	Hr-ft'°F/BTU	
Initial			7.1
Aqed 180 days@ 75°F (24°C)			5.3
Closed Cell Content	02856	%	92
Water Absorption (96 hr. immersion)	02842	% by Volume lb/ft^2	2 0.04
Water Absorption (24 hr. immersion)	C272	o by Volume	0.15
Water Vapor Permeability	E96	Perm-Inch	4
Dimensional Stability [1] @ -40°F (-40°C), 7 days	02126		
length		%Change	-0.2
volume		%Change	-0.5
Service Temperature		0F	-297 to +300
Surface Burning Characteristics	E84		
Flame Spread, 1" through 6" (2.5 through 15 cm)			25
Smoke Generation, up to 1.5" (3.8 cm)			50
2" throuah 6" (5 throuah 15 cm)			90
Color			Red

(1) All properties are measured at 75°F (23°C), unless otherwise indicated.
(2) Average value through foam cross section.

2. Details of Insulation System:

   a. The system shall have an inner and outer layer with staggered butt joints to reduce thermal shorts.

   b. The inner and outer layer shall be secured by filament tape.

   c. Joint sealer shall be applied on the second layer to seal joints only. The inner layer shall not be sealed to the pipe.

d. A vapor retarder shall be installed to resist the vapor drive of warm air to the surface. The vapor retarder shall be designed to meet the conditions identified in Section 1.6.A. The vapor retarder shall be completely sealed throughout the entire installation.

e. Vapor stops shall be applied as recommended by the manufacturer.

f. The insulation shall have an aluminum jacket outer cover to protect the insulation material from UV light.

g. High compressive strength rigid foam insulation shall be used at all pipe supports.

h. Install glass fiber filler expansion/contraction joints with vapor stops as recommended by the manufacturer.

i. Type: Heavy-density sectional pipe insulation with vapor barrier and self-sealing lap.

j. Density: Four pounds per cubic foot.

k. R-Value Minimum: 4.0 hr.-ft^2-°F/BTU.

l. Fittings: Molded fiberglass.

m. Valve Insulation: Miter cut nesting size covering segments of same thickness as pipeline, for insulation of valves.

n. Products and Manufacturers: Provide one of the following:

1) Owens Corning Fiberglass Corporation, Fiberglass 25ASJ/SSL.

2) Certain-Teed Products Corporation, Certain Teed snap-on ASJ-SSL.

3) Or equal.

E. Weatherproof Insulation Jacket (for insulated pipes and equipment located outdoor exposed to outside ambient conditions):

1. Type: Smooth embossed aluminum metal jacket.

2. Thickness: 0.016-inches.

3. Moisture Barrier: Polycraft.

4. Fastening: Water shed seam with 2-inch butt strap with sealant.
5. Bands: 1/2-inch aluminum bands with wing seals.
6. Fittings:
7. Type: Pre-fabricated aluminum fittings.
8. Thickness: 0.016-inches.
9. Manufacturers: Provide products of one of the following:
   a. Certain-Teed Products Corporation.
   b. Childers Products Company, Lock-On and Slip-On.
   c. Orequal.

F. Flexible-Elastomeric Thermal Insulation (for refrigerant piping):

1. Type: Expanded close cell structure elastomeric thermal insulation.
2. Thermal Conductivity: 0.25 Btu-inch/hr. - ft2-°F.
3. Density: Six lbs. per cubic feet.
4. Products and Manufacturers: Provide one of the following:
   a. Halstead Industries, Type "Insul-tube".
   b. Or equal.

2.3 SOURCE QUALITY CONTROL

A. Source Quality Control: Perform the following tests and inspections at the factory:

1. Flame spread.
2. Smoke developed.
3. Fuel contributed.

PART 3 - EXECUTION

3.1 INSPECTION

A. Ensure that surfaces of all equipment including pipes, valves, and fittings are clean and dry before applying insulation.

3.2 PREPARATION

A. Ensure that piping and equipment has been tested, inspected and released for application of insulation.

3.3 INSTALLATION

A. Pipe insulation shall be continuous through walls and floor openings, except where walls or floors are required to be firestopped or required to have a fire resisting rating.

B. Where hangers are in direct contact with piping the hanger and supporting rod shall be wrapped with foil-faced blanket insulation and vapor sealed. Hanger rod insulation and vapor barrier shall extend up to the rod a minimum distance equal to the diameter of the pipe.

C. Install insulation so as to make surfaces smooth, even, and substantially flush with adjacent insulation.

D. Follow manufacturer's application instructions for all materials used.

E. Provide insulation protection shields for insulated piping supported by pipe hangers.

F. Install and coat insulation in accordance with the manufacturer's recommendations.

G. After applying initial equipment insulation, wrap equipment and insulation with wire mesh and apply two separate coats of insulating cement. Apply one coat of insulating finish cement. When dry, apply one coat of fire retardant lagging adhesive. Embed a layer of open weave glass cloth overlapping all seams by 2-inches, and finish with a second coat of fire retardant lagging adhesive.

H. Weatherproofing for Outdoor Pipe and Equipment Insulation:

1. Piping: Apply field applied jacket with moisture barrier around pipe or equipment and position to shed water. Butt next jacket section leaving

approximately 3/8 inch gap. Place preformed 2 inch butt strap with sealant over the seam and secure with 1/2 inch aluminum band and wing seal.

2. Fittings: Apply prefabricated metal fittings identical in composition to pipe jacketing.

3.4 FIELD QUALITY CONTROL

A. Ensure that insulation is dry when installed, and before and during application of any finish.

B. Protection:

1. All material applied in one day shall have the vapor barrier applied the same day and any exposed ends shall be temporarily protected with a moisture barrier and sealed to the pipe.

3.5 SCHEDULE

A. Refer to Schedule below for a minimum thickness of pipe insulation:

Pipe Size	Minimum Insulation Thickness
½ -inches through 1-inch	1-inch
1½-inches through 4-inches	1.5-inches
5-inches and up	2-inches
Refrigerant Piping	1/2-inch thick preformed flexible elastomeric "insul-tube" pipe insulation with vapor barrier and sealing tapes with weatherproof jacket
Exterior Piping	1.5-inches thick with weatherproof jacket
Exterior Equipment	3-inches thick with cement and weatherproof jacket

B. Where part of existing piping is removed, the remaining piping shall be capped watertight and covered with insulation. Any existing piping insulation damaged shall be patched.

C. The following equipment and piping shall be insulated:
1. Exposed, non-submerged, chemical feed piping.
2. Exposed, non-submerged, plant service water piping.
3. Exposed, non-submerged, air scour piping.
4. Exposed, non-submerged, LOX piping.

D. All unions, valves and fittings shall be insulated.

END OF SECTION

Section 15101

PROCESS VALVES AND APPURTENANCES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide and process valves and appurtenances as indicated and in compliance with Contract Documents.

1. Provide sizes and capacities as indicated or specified.

1.02 UNIT PRICES

No separate payment will be made for valves and other work performed under this Section. Include cost in lump sum price bid for work of which this is a component part.

1.03 REFERENCES:

A. American Society of Mechanical Engineers (ASME):

1. B1.20.7: Hose Coupling Screw Threads.

2. B16.1: Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.

3. B16.4: Cast-Iron Threaded Fittings, Class 125 and 250.

4. B16.10: Face-to-Face and End-to-End Dimensions of Ferrous Valves.

B. American Society for Testing and Materials International (ASTM):

1. A48: Standard Specification for Gray Iron Castings.

2. A126: Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

3. A536: Standard Specification for Ductile Iron Castings.

C. American Water Works Association (AWWA):

1. C509: Resilient-Seated Gate Valves for Water and Sewage Systems

2. C550: Protective Interior Coatings for Valves and Hydrants.

3. C600: Installation of Ductile-Iron Water Mains & Their Appurtenances

4. C606: Grooved and Shouldered Joints

D. Underwriter's Laboratories:

1. UL 789: Indicator Posts for Fire-Protection Services

E. Factory Mutual:

1. FM 1110: Indicator Posts

1.04 SUBMITTALS:

A. Submit the following in accordance with Section 01330:

1. Data, regarding valve characteristics and performance including Cv.

2. Shop drawing data for accessory items.

3. Manufacturer's literature as needed to supplement certified data.

4. Operating and maintenance instructions and parts lists.

5. Listing of reference installations as specified with contact names and telephone numbers.

6. Valve shop test results.

7. Shop and Field inspections reports.

8. List of recommended spare parts other than those specified.

9. Recommendations for short and long term storage.

10. Special tools.

11. Shop and field testing procedures and equipment to be used.

12. Manufacturer's product data and specifications for shop painting.

13. Manufacturer's product data and specifications for shop painting.

14. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

1.05 QUALITY ASSURANCE:

A. Provide enclosures for the area classifications specified and indicated.

B. Perform valve leakage tests in both directions at 150 psi in the factory and field. Hydrostatic field tests of 150 psi shall be made against a dished head plug or similar arrangement.

C. Contractor responsible for verifying outside diameter of pipe to be tapped.

D. Manufacturer of valve shall have a minimum of five (5) operating installations with pumps of the size specified and in the same service as specified operating for not less than five (5) years.

E. Warranty: A five year extended warranty is required for all valves including providing 100% of all parts and labor needed to repair valves.

F. If equipment proposed is heavier, taller, different laying length or requires more operating space than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Owner.

1. If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

1.06 DELIVERY, STORAGE AND HANDLING:

Comply with all manufacturers' written instructions.

A. Shipping:

1. Ship factory fabricated assemblies in the largest sections permitted by carrier regulations, properly match-marked for ease of field erection.

2. Loose parts (couplings, nuts and bolts, gaskets, etc.) are to be packaged and shipped in crates that are clearly marked as to contents.

B. Handling and Unloading:

1. Unload and handle equipment in accordance with manufacturer's instructions. Handle unit to prevent damage during unloading and installation. Follow manufacturer's instructions on lifting and setting.

2. Transfer of stainless steel assemblies is to be accomplished utilizing nylon straps or stainless steel cables to avoid contact with carbon steel components.

C. Storage:

1. Store in an area that will avoid damage due to traffic. Store and temporarily support equipment prior to installation in strict accordance with the manufacturer's recommendations and instructions.

2. Exposure to normal weather conditions is acceptable; however, avoid contact with other materials like carbon steel, aluminum, concrete, and corrosive chemicals. Store at job site on 4"×4" blocking at 6-foot spacing. Protect from corrosion and mechanical damage.

3. Connect space heaters to a power source and keep heaters in operation. Rotate all shafts that have bearings on at least a monthly basis.

PART 2 - MATERIALS

2.01 GATE VALVES

A. Gate valves 2-1/2 inches and smaller shall be Class 125 psig, bronze construction, rising stem, solid wedge disc gate valve with screwed connections and union bonnet, as manufactured by Mueller, Clow, Kennedy, or approved equal.

B. Gate valves 3 inches and larger shall be solid wedge type, with resilient nitrile rubber (Buna-N) seating surface. Valves shall open counterclockwise. Provide valves complying with AWWA C509. Acceptable manufacturers include Clow, Crane, Mueller, or approved equal.

1. Supply gate valves rated as 200 psi water working pressure with 400 psi hydrostatic test for structural soundness.

2. Stems: Rising type (OS&Y), 300 series stainless steel or low-zinc bronze.

C. Valve bodies: Cast or ductile iron, flange bonnet and stuffing box together with ASTM A 307 Grade B bolts. Manufacturer's initials, pressure rating, and year manufactured shall be cast in body.

D. When shown on drawings, provide gate valve with post indicator valve at grade level in accordance with UL 789 and FM 1110. Post indicator valve shall be Mueller A-20806 or equal.

E. 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 D 429 Method B; seat against epoxy-coating surface in valve body.

F. Coatings: Internal and external surfaces of the valve, except those encapsulated in resilient material, shall be coated with a fusion-bonded epoxy conforming with AWWA C550.

2.02 ECCENTRIC PLUG VALVES

A. Manufacturers:

1. DeZurik
2. Milliken
3. Val-Matic.
4. Henry Pratt
5. Approved Substitute

B. Type: Non-lubricated, eccentric.

C. Body Working Pressure:

1. Cast Iron, ASTM A126 Class B or Ductile Iron, ASTM A536, Grade 64-45-12.
   a. Valves 4-inch through 12-inch: 175 psi.
   b. Valves 14-inch and larger: 150 psi.

D. Ends:

1. Grooved: ANSI/AWWA C606 for ductile iron valves.
2. Flanged: ANSI B16.1 125 pound for cast iron valves.
3. Buried Valves: Mechanical joint.

E. Valve Ports:

1. Provide rectangular ported valves, circular ports are not acceptable.

2. Valves 20-inch and smaller: Not less than 80 percent of pipe area.

3. Valves 24-inch and larger: Not less than 70 percent of pipe area.

4. All valves100% port. Port size: minimum 83 percent.

F. Valve Seats:

1. Coat plug with seat material specified. Bolted systems are not acceptable.

   a. Seat Material: Buna-N synthetic rubber

2. Provide valves with one piece coated plugs with mating seats of 90 percent, minimum, pure nickel 1/8-inch welded into the body of valves.

3. Provide valves with seats clamped to valve with mating seat of 90 percent, minimum, pure nickel welded to the valve body.

G. Upper and Lower Plug Journal Bearings:

1. Removable, permanently lubricated stainless steel bushings for valves 20-inch and smaller.

2. Bronze bearings with Type 316 stainless steel bushings for valves 24-inch and larger.

3. Provide grit seals for upper and lower plug shafts for all valves.

H. Stem Seals:

1. Adjustable multiple V-packing.

2. Replaceable and adjustable without valve disassembly.

3. Provide valves with two sets of packing rated for vacuum service for all pump suction isolation service and for services where a vacuum is specified and indicated.

I. Operators: Above-grade valves shall have worm gear handwheel operators. Operators shall clearly indicate valve position. Below-grade valves shall have operating nut extending to grade within a valve box. Operators on valves in submerged or buried service shall be lubricated and sealed to prevent entry of dirt and water into the operator.

J. Shop Testing:

1. Provide all plug valves tested and certified bubble tight in both directions at the full rated working pressure as specified herein.

K. Shop Painting:

1. Provide epoxy painting in accordance with specification 09902- Protective Coatings.

2. For valves installed in glass lined and ceramic epoxy lined piping systems provided glass lined valves with epoxy paint coating in accordance with specification 09902- Protective Coatings.

2.03 EXTENSION STEMS:

A. Provide where indicated and required for operation of all valves

B. Material:

1. Stems: Type 316L solid stainless steel bar or Schedule 40 Type 316L pipe

a. Minimum Size: 1.25 inch diameter, Slenderness ratio <200

2. Connectors, thrust relief assemblies, torque tube assemblies, universal joints and operating nuts: Type 316 or Type 316L stainless steel

3. Miter gears: Cast iron with 2 part epoxy coating

2.04 POSITION INDICATORS:

A. Manufacturer:

1. Trumbull Industries, Henry Pratt, or Equal.

B. Provide position indicators installed on all multi-turn valves and quarter turn valves with gear boxes 3 inch and larger.

C. Materials:

1. Hardware and Fasteners: Type 316 stainless steel.

D. Exposed and Submerged Valves:

1. Provide a Type 316 stainless steel extension stem connected to a 2 inch square nut on the valve and extend up through the position

indicator, terminating in a 2 inch square nut, operable by a standard waterworks tee-handle wrench.

E. Buried Valves:

1. Provide the position indicator installed in a valve box within 6 inches of grade.

F. Valves Installed Inside a Structure:

1. Where a floor is not directly over the valve and extension stem, support position indicators with a Type 316 stainless steel wall bracket mounted to a side wall.

2. When installed in a floor, provide the adapter with a bronze bushing to support and center the extension stem with the bronze bushing retained in the cast iron floor adapter by two Type 316 stainless steel screws and drilled to an inside diameter 1/16-inch larger than the outside diameter of the extension stem.

2.05 SHOP PAINTING:

A. In accordance with specification 09902- Protective Coatings.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Prior to installation, protect stored valves and appurtenances from damage due to exposure to sunlight, heat, dirt, debris, freezing and thawing, vandalism, etc.

B. Clean all debris, dirt, gravel, etc, from inside of piping before placing valves in place.

C. Erect and support valves in respective positions free from distortion and strain on appurtenances during handling and installation. Inspect material for defects in workmanship and material. Clean out debris and foreign material from valve openings and seats, test operating mechanisms to check functioning, and check nuts and bolts for tightness. Repair, valves and other equipment which do not operate easily or are otherwise defective at no additional cost to the Owner.

D. Set plumb and support valves in conformance with instructions of manufacturer. Shim valves mounted on face of concrete vertically and grout in place. Install valves in control piping for access.

E. Provide bolted split sleeve coupling or flexible type grooved coupling on downstream side of buried valves to assist in valve removal.

F. Where indicated provide Type 316 stainless steel stem extension to operating floor elevation as shown and provide the bevel gear operator with a fabricated steel floorstand and handwheel.

3.02 PLUG VALVES:

A. Install valves in horizontal piping with shaft horizontal such that in open position, plug is located in upper part of valve body. Orient valves so that in closed position, flow is against the face of the plug.

3.03 VALVE BOXES:

A. Provide Standard Type "A" valve boxes conformation to requirements of Section 02085 – Valve Boxes, Meter Boxes, and Meter Vaults.

B. Provide valve box for each buried valve and where indicated.

C. Set box so top is flush with finished surface and so box does not bear on valve, or pipe.

3.04 FIELD TESTING:

A. Test valves using a hydrostatic pressure test in accordance with AWWA C 600.

B. Pressure test valves with pipeline pressure testing.

C. Test functions of each valve.

D. Make all adjustments necessary to place valves in specified working order at time of above tests.

E. Remove all replace valves and appurtenances at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that valves will perform the service specified, indicated and as submitted and accepted.

3.05 FIELD TOUCH-UP PAINTING:

A. After installation and accepted testing by the Construction Manager, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

3.06 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01770 – Closeout Procedures.

END OF SECTION

Section 15106

ELECTRIC MOTOR OPERATORS FOR VALVES AND GATES

PART 1 GENERAL

1.01 DESCRIPTION

A. Electric motor operators for valves and gates as shown on Drawings.

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.

1.03 REFERENCES

A. AWWA C540-02 - Power-Actuating Devices for Valves and Slide Gates.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications

1. Operators and appurtenances provided under this Section shall be the standard product in regular production by manufacturers, except for the modifications required to meet functional requirements, whose products have proven reliable in similar service for at least 5 years.

2. Insofar as possible all equipment of the same specific type shall be the product of one manufacturer.

1.05 ACCEPTABLE MANUFACTURERS

A. Motor Operators:

1. EIM Controls

2. Rotork

3. Limitorque

4. Auma

5. Approved Substitute

1.06 SUBMITTALS

A. Submit shop drawings and product data under provisions of Sections 01330—Submittal Procedures.

B. Shop Drawings

1. Submit for review detailed drawings, data, and descriptive literature on all valves and appurtenances, including:

a. Dimensions

b. Size

c. Materials of construction

d. Weight

e. Protective coating

f. Actuator weight

g. Calculations for actuator torque

C. Manufacturer's Certifications.

1. Submit manufacturer's certificates of compliance with ANSI, AWWA, and other standards listed herein.

1.07 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01782—Operations and Maintenance Data.

B. Submit a detailed operation and maintenance manual for all gates and appurtenances provided under this section.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 01610—Basic Product Requirements.

B. Store and protect products under provisions of Section 01610—Basic Product Requirements.

C. Store equipment off the ground in enclosed shelter.

1.09 WARRANTY

A. Provide Warranty under provisions of Section 01610—Basic Product Requirements.

PART 2 PRODUCTS

2.01 ELECTRIC MOTOR OPERATORS

A. Provide an electric motor-driven (multi-turn type) actuator for slide gates, as indicated on the Drawings, adequately sized to lift and lower gates without over torquing actuators (conform to manufacturer's requirements). Submit complete data on the proposed actuators including electrical data, torque calculations, shaft sizing, and details.

B. Actuator shall be of the non-intrusive design and include the motor operator, unit gearing, limit switch gearing, limit switches, torque switches, fully-machined drive sleeve, manual override, drive coupling, integral motor controls, and auxiliary handwheel as a self-contained operator designed to IP68 and NEMA 6 standards with a temperature range between -20 °F to +150 °F. Actuators must be capable of a 12 inch per minute (maximum) closing time/operating speed.

C. The electric motor shall meet the following criteria:

1. Motor shall be specially designed for slide gate operator service and shall be of high-torque, totally-enclosed, non-ventilated construction with motor leads brought into the limit switch compartment without having external piping or conduit box.

2. Motor shall be of sufficient size for rated torque when voltage to motor terminals is 10 percent above or below nominal voltage. Power available for the actuators is as shown on the drawings, and in the Specifications.

3. The motor shall be pre-lubricated, and all bearings shall be of the anti-friction roller bearing type.

4. The motor will be of the induction type with class F insulation and protected by means of thermal switches imbedded in the motor windings.

5. Maximum Horsepower = 1.0 HP

D. All gearing shall be oil or grease lubricated and designed to withstand the full stall torque of the motor. Power gearing shall consist of machined helical or spur gears of heat- treated steel and worm gearing. The worm shall be hardened alloy steel. The worm gear shall be of alloy bronze accurately cut with a hobbing machine. All power gearing shall be oil lubricated. The gear train shall be sealed. Ball or roller bearings shall be used throughout.

E. Limit switches and gearing shall be an integral part of the valve operator. Limit switches shall be furnished at each end of travel. Limit switch adjustment shall not be altered by manual operation. Limit switch drive shall be by countergear. One set of normally open and one set of normally closed contacts will be furnished at each end of travel. Each actuator limit switch enclosure shall have a dial position mechanical indicator or LCD to show valve position. Fasteners on limit switch and terminal compartments shall be captured to prevent loss while covers are removed.

F. Each operator will be equipped with a double torque switch. The torque switch shall be adjustable and shall be responsive to load encountered in either direction of travel. It shall operate during the complete cycle to protect the valve should excessive load be met by obstructions in either direction of travel. Torque switches shall trip when the valve load exceeds the torque switch setting.

G. A permanently mounted crank-type lifting mechanism (handwheel) shall be provided for manual operation. The handwheel shall not rotate during electric operation, but must be responsive to manual operation at all times except when being electrically operated. The motor shall not rotate during hand operation. When in manual operating position, the unit shall remain in this position until motor is energized at which time the operator shall automatically return to electric operation and shall remain in motor position until handwheel operation is desired. The maximum rim pull shall not exceed 80 lbs. A seized or inoperable motor shall not prevent manual operation.

H. The terminal enclosure shall be provided with an environment seal, isolating the field wiring and conduit entries from the controls. The terminal enclosure shall be provided with three conduit entries, two 1-inch and one 1-1/2 inch. The enclosure shall be integral with the operator.

I. An integral motor starter and power disconnect enclosure attached to the operator shall be provided with the following controls: reversing contactor, control power transformer with fused primary and secondary, two high intensity LED indicating lights for open and close positions, a selector switch (local, off, remote) padlockable in any position and three push buttons or selector switch for open, stop, and close. The selector switch padlockable device shall be provided to accommodate a City of Houston padlock shank diameter.

J. Phase sequence protection shall be provided to assure proper motor rotation and prevent motor operation if phase sequence is not correct. Provide a seal-in circuit with internal LED indicating light to indicate a phase sequence problem has been detected.

K. Motor overcurrent relay protection shall be provided.

L. Power monitor relays shall be provided. One relay shall monitor line voltage and one relay shall monitor the output of the control power transformer.

M. Actuator enclosure shall be of non-intrusive design and hermetically sealed at the factory to prevent condensation.

N. All actuators shall be furnished with stem protectors made of non-yellowing, ultra-violet resistant, clear acrylic with ¼" wall thickness for extra durability.

O. The actuator shall be proof-of-design and performance tested to AWWA C540-02 Section 5.2 and 5.3 requirements. Provide test reports as required by these sections prior to shipment. The actuator gear box shall also be pressure tested to 30 psi for two minutes to demonstrate seal integrity.

P. Provide a drawing (8" x 10") showing the location of the valves relative to the site plan and the lines where they are installed.

Q. The operator shall be capable of pre-set the percentage (%) opening of gate.

R. The operator shall have a weatherproof enclosure which is consistent with the requirements presented in Division 16.

2.02 FIELDBUS COMMUNICATIONS

A. The actuator shall be equipped with a Profibus DP interface card (for connection to plant SCADA system).

B. The connections shall not impinge on any of the actuator functions and an analogue position feedback is to be provided.

C. The data available from the actuator shall, at a minimum include the end of travel indication and local/remote selector status.

D. The card shall support data rates between 9600 baud and 1.5Mbaud.

E. Configuration and parameterization settings for all actuators are to be made over the Profibus highway using a Type 2 master.

2.03 SPECIAL PROVISIONS FOR RETROFITS

A. Where gate is existing and retrofit of the existing operator/pedestal is required, adaptation and mounting hardware (i.e., mounting plates, floor stands) shall be provided as necessary to accommodate existing conditions. Adaptation/mounting hardware shall consist of stainless steel with Type 316 stainless steel fasteners.

2.04 FACTORY FINISHING

A. Factory finish all carbon steel components of gates as specified below so that they are ready for service without application of additional coatings.

B. Do not paint plastic and stainless steel materials.

C. Finish carbon steel in accordance with Specification Section 09902 – Protective Coating.

2.05 FASTENERS

A. Use stainless steel fasteners for all bolted connections.

B. Use stainless steel expansion anchors as specified in Section 05500 – Miscellaneous Metal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install operators in accordance with Drawings, approved shop drawings, and the manufacturer's installation instructions.

B. Adjust and lubricate in accordance with the manufacturer's instructions and leave in proper working condition.

3.02 REQUIRED MANUFACTURER SERVICES

A. Retain a qualified representative of the manufacturer to perform the following services:

1. Inspect the completed installations and note deficiencies.

2. Be present and assist the Contractor during start-up, adjusting, and site testing of completed gate operator installations.

3. Furnish test forms and procedures for field testing.

4. Instruct Owner personnel in the operation and maintenance of the gates.

5. Prepare manufacturer's installation reports and submit within 30 days after completion of field testing.

   a. Field testing results.

   b. Description(s) of installation deficiencies not resolved to the manufacture's satisfaction.

   c. Description(s) of problems or potential problems.

   d. Names of owner personnel who attended operations and maintenance training sessions.

   e. Record copy of materials used for training session including outline summary of course.

3.03 FIELD TESTING

A Provide all test gear required at no extra cost to Owner.

B. Follow testing procedures recommended by the manufacturer and approved by Engineer.

END OF SECTION

Section 15110

WALL PIPES, FLOOR PIPES, AND PIPE SLEEVES

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all floor pipes, pipe sleeves, wall pipes, other wall pieces, and escutcheons to complete the Work.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate with the installation of floor pipes, pipe sleeves, wall pipes, other wall pieces and escutcheons that must be installed with or within formwork, walls, partitions, ceilings and panels.

C. Related Sections:

1. Division 3, Concrete.

2. Division 15, Mechanical.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices

1 No separate payment will be made for wall pipes, floor pipes, and pipe sleeves under this section. Include payment in Lump Sum with price breakdown included in the Schedule of Values.

2 Refer to Section 01270 - Measurement and Payment, and Section 01292 - Schedule of Values.

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

1.3 REFERENCES

A. Standards referenced in this Section are listed below:

1. American National Standards Institute, (ANSI).

a. ANSI 816.1, Cast-Iron Pipe Flanges and Flanged Fittings.

b. ANSI 816.4, Gray-Iron Threaded Fittings.

2. American Water Works Association, (AWWA).

a. AWWA C104 (ANSI A21.4), Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

b. AWWA C110 (ANSI A21.10), Standard for Ductile-Iron and Gray-Iron Fittings, for Water.

c. AWWA C111 (ANSI A21.11), Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

d. AWWA C115 (ANSI A21.15), Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.

e. AWWA C151 (ANSI A21.51), American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.

f. AWWA C200, Steel Water Pipe 6-Inches and Larger.

1.4 QUALITY ASSURANCE

A. Component Supply and Compatibility:

1. Obtain all equipment included in this Section regardless of the component manufacturer from a single wall pipes, floor pipes and pipe sleeves manufacturer.

2. The wall pipes, floor pipes and pipe sleeves manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.

3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly

by the wall pipes, floor pipes and pipe sleeves manufacturer.

1.5 SUBMITTAL$

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Detailed drawings and data on all wall and floor pipe, and pipe sleeves.
Submit and coordinate these with Shop Drawings required for all piping systems.

1.6 DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements of Section 15050, Buried Piping Installation, and Section 15053, Exposed Piping Installation.

PART 2 P R 0 D U CT S

2.01 MATERIALS

A. Wall and Floor Pipes:

1. Material: Same as specified for the piping connected to wall or floor pipe, unless otherwise approved by City.

2. End Connections: As shown.

3. Thickness: Same as specified for the piping connected to wall or floor pipe.

4. Collars: Provide collars at mid-point of wall for anchorage and watertightness.

5. Pipes ends shall be flush with wall face, unless otherwise shown.

6. Drill and tap flanged ends and mechanical joint bells for studs. Provide studs of same material as connected piping, except submerged and buried studs shall be of Type 316 stainless steel.

B. Pipe Sleeves:

1. Ferrous and Plastic Pipe: Use standard weight galvanized steel pipe, unless otherwise shown.

2. Copper Pipe: Use Type K hard drawn copper pipe, unless otherwise shown.

C. Cast Wall Sleeves:

1. Material: Ductile iron furnished with integral wall collar.

2. Dimensions: As required for mechanical joint pipe to pass through sleeve. Length as required.

D. Link Seals: Provide link type mechanical seals suitable for 20 psi working pressure, corrosive service and accessible from one side, with glass-reinforced nylon pressure plate and stainless steel bolts and nuts.

1. Products and Manufacturers: Provide one of the following:

a. Link-Seal, as manufactured by Thunderline Corporation.

b. Or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Wall and Floor Pipes: Install as shown and in accordance with approved Shop Drawings.

B. Pipe Sleeves:

1. Use sleeves wherever pipes pass through walls, partitions, floors, and roofs, unless otherwise shown.

2. Extend all sleeves through floor slabs a minimum of 2-inches above finished floor.

3. Anchor sleeves to concrete and masonry walls as shown or otherwise approved.

4. All sleeves through walls shall be flush with wall face.

5. All pipe joints and annular spaces in exterior walls or walls subjected to hydrostatic pressure shall be completely watertight.

6. Use link type seals to seal sleeve against hydrostatic pressure. Size sleeves to provide annular space required to suit the link type mechanical seals that are used.

7. Do not install sleeves and pipes through structural members, unless specifically shown and approved by City.

8. Size sleeves to provide annular space as follows:

Pipe Size	Sleeve ID Minus Pipe Or Insulation OD
Less than 2-inches	1/2-inches to 3/4-inches
2-inches to 4-inches	3/4 inches to 1-1/4-inches.
6-inches to 12-inches	1-1/4 inches to 2-inches
Over 12-inches	2-inches to 3-inches

C. Install wall and ceiling plates in accordance with the manufacturer's recommendations and approved Shop Drawings.

END OF SECTION

Section 15130

PRESSURE GAUGE

PART 1 GENERAL

1.01 SECTION INCLUDES

Furnishing and subsequent installation of pressure gauges as shown on Drawings and specified herein.

1.02 UNIT PRICES

A. No separate payment will be made for pressure gauges and other work performed under this Section. Include cost in lump sum price bid for work of which this is a component part.

1.03 RELATED REQUIREMENTS

Other related work as called for on PLANS or, specified elsewhere in other Technical Specification Sections.

1.04 SUBMITTALS

Submit the following in accordance with Specification Section 01330 Submittal Procedures.

A. Shop drawings are required only when specified manufacturer, type, and/or features are/is deviated from. Shop drawings, when required, to include catalog data cut sheet showing manufacturer and highlighted with the exact model number.

B. Operation and Maintenance Manual to be provided in accordance with Specification Section 01782 Operations and Maintenance Data.

1.05 QUALITY ASSURANCE

A. All products of a given type to be furnished by a single manufacturer.

B. All products to provide satisfactory operation and to require minimal maintenance under the following environmental conditions.

1. Temperature: 0°F to 140°F.

2. Relative Humidity: 100 percent.

1.06 DELIVERY, STORAGE, AND HANDLING

Deliver and store to protect against damage.

PART 2 PRODUCTS

2.01 MANUFACTURER(S)

Manufacturer, type, and catalog number to be U.S. Gauge, Solfrunt Type No. 1981 L, Dresser-Ashcroft or approved substitute.

2.02 MATERIALS AND/OR EQUIPMENT

A. General

Gauge and gauge seal materials to be equal to or better than the process piping materials of construction.

B. Materials and Features

1. Type: Glycerine-filled bourdon tube-type pressure indicator.

2. Requirements

a. Glycerine-filled with throttle screw.

b. 316 stainless steel bourdon tube.

c. Phenolic or stainless steel case and ring.

d. Stainless steel movement components.

e. Heat-resistant acrylic window.

f. White dial with black markings.

g 1/2-inch NPT 316 stainless steel stem connection.

h. Overload stop high-pressure protection.

i. ±0.5 percent of span accuracy.

j. Pressure range: 0 to 160 psi.

3. Diaphragm seal.

a. 316 stainless steel wetted parts.

b. Zinc-plated carbon steel top.

c. Silicone-filled.

d. Factory-installed and provided as a gauge and seal assembly ready for field installation as a complete unit.

4. Needle Valve

a. Carbon steel body with stainless steel stem.

b. ½- inch FNPT connections.

2.03 SOURCE QUALITY CONTROL

Each device to be factory tested over its full operating range.

PART 3 EXECUTION

3.01 GENERAL

A. Gauge and appurtenances to be installed in accordance with PLANS, approved shop drawing when required, and manufacturer's recommended installation instructions.

B. Installation to occur after major piping is installed and tested.

3.02 FIELD QUALITY CONTROL

A. Field Calibration

Gauge to be calibrated at 10, 50, and 90 percent of span using test instruments to simulate inputs. Outputs of test instrument to be rated to an accuracy that is at least five times greater than the specified accuracy. Such test instruments to have accuracies traceable to the National Bureau of Standards.

END OF SECTION

Section 15138

ELECTRIC VALVE ACTUATORS

PART 1 GENERAL

1.1 SUMMARY

A. The Contractor shall provide electric valve actuators and appurtenances, complete and operable, in accordance with Drawings and specifications. See Appendix A – Actuator Schedule at the end of this Section.

1.2 MEASUREMENT AND PAYMENT

A. Payment for actuators is on a unit price basis for each. Payment includes labor, equipment, and material necessary for installation of the valve actuator to existing or proposed valve in its current location and configuration. Payment includes all necessary requirements from the manufacturer to adapt to the valve and for installation, start-up and testing procedure(s) for the actuator.

1.3 SUBMITTALS

A. General: Submittals shall be furnished in accordance with Section 01330 – Submittals.

B. Field Visit: Contractor and/or representative of actuator manufacturer shall visit the site(s) and verify existing conditions prior to making submittal(s).

C. Shop Drawings: Complete catalog information, including dimensions, weight, and specifications. Product Data and Samples shall be in accordance with Section 01340. Submitted together with the valve submittals as a complete package.

D. Provide operation and maintenance data containing operating instructions, as built shop drawings, parts list, test data, preventative maintenance instructions and related information in accordance with Section 01782 Operations and Maintenance Data.

1.4 QUALITY ASSURANCE

A. Actuator manufacturers shall have at least five (5) years of experience manufacturing actuators similar to those

specified herein.

B. Single Actuator Manufacturer: One actuator manufacturer shall supply all actuators.

C. Training: Provide classroom and field operation and maintenance instructions including all materials, slides, videos, handouts and preparation to lead and teach classroom and field instructional sessions.

D. The information included in Appendix A – Actuator Schedule is provided for the Contractor's use in determining the size of the actuators to be installed on the existing pump control valves and new flow control valves as shown on the Drawings and listed in Appendix A. The Contractor shall coordinate with the original valve manufacturer to determine the torque requirements based on the existing pump operating curves and existing valve shaft dimensions for all replacement actuators. The original valve manufacturer shall be responsible for sizing the replacement actuators and shall guarantee performance under the existing pump operating conditions. For actuators on new valves, the valve manufacturer shall be responsible for sizing the actuator and shall guarantee performance under the proposed system operating conditions. The Contractor shall also provide the services of the valve manufacturer, for both new and existing valves, for valve/actuator installation assistance and start-up and operator training services.

E. Existing valve manufacturer is the Henry Pratt Company, 401 S. Highland Avenue, Aurora, IL 60506; Toll Free: (877) 436-7977; Fax: (630) 844-4124.
Their local sales representative is The Scruggs Company, 8530 Hansen, Houston, TX 77075; Toll Free: (866) 226-8164; Fax: (713) 649-1975.

PART 2 PRODUCTS

2.1 GENERAL

A. General: Where indicated on the Drawings, provide electric-operated valve actuators complete and operable with mounting hardware, motors, gears, controls, wiring, solenoids, hand-wheels, levers, chains, and extensions, as applicable. Actuators shall be capable of holding the valve in any intermediate position between fully open and fully closed without creeping or fluttering.

B. Standard: Unless otherwise specified, actuators shall comply

with ANSI/AWWA C 540 - AWWA Standard for Power-Actuating Devices for Valves and Sluice Gates.

C. Manufacturers: Actuators shall be manufactured by Bernard Controls, 15740 Park Row Suite 100, Houston, TX 77084, (281)-578-6666 or Owner-approved equal.

D. Mounting: Securely mounted by means of brackets or hardware specially designed and sized for this purpose and of ample strength. Displayed on each actuator an arrow indicating direction to open in counter-clockwise direction and equipped with position indicators. Unless otherwise shown on Drawings locate electric actuators between 48 and 60 inches above finished grade.

E. Functionality: Coordinate actuator installation and testing with power and instrumentation equipment.

2.2 ELECTRIC MOTOR ACTUATORS

A. Gearing: Include motor, reduction gearing, reversing starter, torque switches, and limit switches in a weather-proof NEMA 4 assembly. The actuator shall be a single or double reduction unit consisting of spur or helical gears and
worm-gearing. The spur or helical gears shall be of hardened alloy steel and the worm-gear shall be alloy bronze. Gearing shall be accurately cut with hobbing machines. All power gearing shall be grease- or oil-lubricated in a sealed housing. Ball- or roller-bearings shall be used throughout.

B. Starting Device: Unit shall not be designed so a hammer blow is imparted to the stem nut when opening a closed valve or closing an open valve. Actuator shall be designed so torque supplied is sufficient to open a closed valve and close an open valve.

C. Switches and Wiring: Govern travel in the opening and closing directions by switch responsive to:

1. Mechanical torque developed in seating valve

2. By an obstruction met in opening or closing the valve

3. By an on-board microprocessor

Torque switch shall be adjustable and function without auxiliary relays or devices, or adjustable in one-percent increments, sensed by a potentiometer driven absolute encoder. Limit position setting

shall be set by optical absolute position encoder (no battery backup device required).

Actuator shall be wired in accordance with the actuator's schematic diagram. All wiring for external connections shall be connected to marked terminals. Provide one 1-inch and two 3/4-inch conduit connection in enclosing case.

D. Handwheel Operation: Provide a permanently-attached declutched free manual handwheel for emergency manual operation. The handwheel shall not rotate during electrical operation. The maximum torque required on the handwheel under the most adverse conditions shall not exceed 60 ft-lb, and the maximum

force required on the rim of the handwheel shall not exceed 60 lb. A permanently-affixed or cast arrow and either the word "open" or "close" shall be on the handwheel to indicate the appropriate direction to turn the handwheel.

E. Torque Monitoring: Actuator shall be capable of providing and recording full torque information at all stages of travel.

F. Motor: Totally-enclosed, non-ventilated, high-starting torque, low-starting current type for full voltage starting. Suitable for operation on 460-volt,
3-phase, 60-Hz current, Class F insulation and motor frame with dimensions complying with the latest NEMA MG Standards. Observed temperature rise by thermometer shall not exceed 55 degrees C above an ambient temperature of 40 degrees C when operating continuously for 15 minutes under full rated load. With line voltage ranging between 10 percent above to 10 percent below rated voltage, motor shall develop full-rated torque continuously for 15 minutes without causing the thermal contact protective devices imbedded in the motor windings to trip or the starter overloads to drop-out. All bearings shall be provided with suitable seals to confine the lubricant and prevent the entrance of dirt and dust. Contractor to provide watertight electrical conduit connections. Incorporate the use of stator and rotor as independent components from valve operation such that failure of either item shall not require actuator disassembly or gearing replacement. Furnish with space heater suitable for operation on 120-volt, single-phase, 60-Hz circuit.

G. Communications. Actuators shall be provided with the Intelli+ control option with Profibus DPV1 communication option, or Owner-approved equal.

H. Electric Motor Actuators (AC Reversing Control Type):

1. General: AC reversing type complete with integral control interface with local/off/remote and open/close/stop selector switches.

2. Actuator Appurtenances: Supply with open and close status lights; open, close and lock-out-stop selector switches, and all other devices indicated.

3. Starter: The starter shall be suitably sized amperage rated reversing starter with its coils rated for operation on 460-volt, 3-phase, 60-Hz current. A control power transformer shall be included to provide a 120-volt source for actuator use only, unless otherwise indicated. Its control circuit shall be wired as indicated. The integral weatherproof compartment shall contain a suitably sized 120-volt ac, single-phase, 60-Hz space heater to prevent moisture condensation on electrical components. Contractor to provide a thermal magnetic circuit breaker in NEMA 4 enclosure if not part of the integral valve package.

4. Manufacturers: Bernard Controls, 15740 Park Row Suite 100, Houston, TX 77084, (281)-578-6666 or Owner-approved equal.

I. Electric Motor Actuators (AC Modulating Control Type):

1. General: Where indicated, modulating electric motor actuators shall be the ac modulating-type complete with a local integral interface with local/off/remote, open/close/stop, and position indicating functions.

2. Control Module: The control module shall be of the electronic solid-state ac-type with proportional pulse output to control the speed of the motor.

3. Starter: The actuator shall control a solid-state reversing starter designed for minimum susceptibility to power line surges and spikes. The solid-state starter and control module shall be rated for continuous modulating applications. Power supply shall be 460-volt, 3-phase,
60-Hz.

4. Construction: The control unit shall be microprocessor-based and shall contain an analog/digital converter, separate input-output switches, non-volatile random access memory for

storage of calibration parameters and push-button calibration elements for field-setup. In addition, the controller shall contain as standard feature a loss of command signal protection selectable to lock in last or lock in pre-set valve position and a valve position output signal in 4-20 mA. As an alternative to the construction requirement, the motor shall be capable of modulating at a rate of 1200 starts per hour at the 50 percent to 85 percent travel range of the valve.

5. Manufacturer: Bernard Controls, 15740 Park Row Suite 100, Houston, TX 77084, (281)-578-6666 or Owner-approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. All valve actuators and accessories shall be installed in accordance with manufacturer's recommended installation instructions. Actuators shall be located to be readily accessible for operation and maintenance, without obstructing walkways. Actuators shall not be mounted where shock or vibrations will impair their operation, nor shall the support systems be attached to handrails, process piping, or mechanical equipment.

B. Field modifications shall be performed by the manufacturer or by its authorized representative.

3.2 SERVICES OF MANUFACTURER

A. Field Adjustments: Representatives of electric actuator manufacturer shall adjust actuator controls and limit-switches in the field for the required function.

B. Provide witness testing of the valve actuator packages. Provide the Owner and Engineer a 30-day notification of the proposed test date and location.

3.3 ACCEPTANCE TEST

A. Upon completion of the installation of each valve actuator, an acceptance test will be conducted to verify the satisfactory operation and performance of each actuator. Each valve shall be opened and closed in auto mode and manually. The test shall be conducted in a manner approved by and in the presence of the Engineer and the Owner.

B. Each valve actuator must perform in a manner acceptable to the Engineer before final acceptance will be made by the Owner.

END OF SECTION

Section 15140

PIPE HANGERS, SUPPORTS AND RESTRAINTS

PART 1 — GENERAL

1.01 SECTION INCLUDES

A. Pipe and equipment hangers, supports, and associated anchors.

B. Equipment bases and supports.

C. Sleeves and seals.

1.02 UNIT PRICES

A. No separate payment will be made for pipe hangers, supports, restraints, and other work performed under this Section. Include cost in lump sum price bid for work of which this is a component part.

1.03 REFERENCES

A. ANSI/ASME B31.1 - Power Piping, Sections 120 and 121 of ASME B31.1.

1.04 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01330 - Submittal Procedures and Section 15050 - Basic Mechanical Materials and Methods.

B. As a minimum, submit the following items:

1. A layout of the systems including location on fixed and movable joints.

2. Details of design and fabrication of joints.

3. Details of support brackets, cradles, pads, thrust resisting elements, and other supporting elements.

4. Other pertinent elements necessary for a complete installation.

5. Design calculations for submitted items.

PART 2 — PRODUCT

2.01 HANGERS AND SUPPORTS

A. For uninsulated lines 2 inches and less and for drainage and downspout lines provide hangers which are adjustable swivel ring type fabricated of malleable iron.

B. For uninsulated lines larger than 2 inches and for insulated lines, except drainage and downspout piping, provide adjustable clevis type hangers. Size hangers to allow insulation to extend unbroken through the hanger.

C. Fabricate hangers installed in valve vaults, wet wells, and other below grade areas of cadmium plated or stainless steel.

2.02 INSERTS

A. Make inserts for individual hangers of galvanized malleable iron; include removable nuts held in place by V-type teeth on the insert body and nut. Make continuous-slotted channel inserts of galvanized steel with integral anchors at 6-inch centers. Provide factory finished steel snap-on cover plates on channel inserts between support attachments.

2.03 EXPANSION BOLTS

A. Use expansion bolts for support which are stainless steel wedge type. Do not use expansion bolt anchors with lead.

2.04 PIPE SADDLES

A. Fabricate pipe saddles of hot dip galvanized steel. Saddles for supporting pipe from the floor shall be at least 9 inches in length and as wide as the outside diameter of the pipe. Make a bearing support of 120 degrees. Mount saddles on concrete pads at least 2 inches high.

2.05 FRAMING HANGERS

A. Use factory fabricated metal framing systems with factory applied primer paint as framing for wall type hangers, trapeze hangers, and tunnel stanchions. Attach supports to structures with inserts for new concrete, with surface mounting methods for masonry or existing concrete, and with welding or clamps for structural steel. Make pipe supports fabricated on

the site of structural steel members with raw edges ground and dressed. Rest floor supports in areas with uncovered concrete floors on concrete pads not less than 2 inches high.

PART 3 — EXECUTION

3.01 INSTALLATION

A. Hang piping inside structures supported from the floor or racked adjacent to walls.

B. Provide inserts cast in concrete walls or slabs for hanging and supporting pipe. If materials not galvanized or cadmium plated, paint them with primer before installation.

C. Design fabricate, and install support components in general conformance with Sections 120 and 121 of ANSI B31.1, Power Piping, except as modified in this Section.

3.02 PIPE HANGERS AND SUPPORTS

A. Support, brace, and anchor interior piping to prevent movement in any direction because of pressure, temperature, flow, or water hammer, except at properly located expansion joints and fittings.

B. Provide two pipe guides on each side of expansion joints at which pipe movement occurs. The first guide shall be not more than 4-pipe diameters from the joint and the second not more than 14 diameters. Provide additional guides as required to maintain pipe alignment, spaced as required for the pipe size, fluid pressure and temperature inside the pipe, and as recommended by the expansion joint manufacturer or as shown.

C. Maximum support spacing and hanger rod sizes for metal pipe containing liquids are as follows:

Nominal Pipe Size (Inches)	Support Spacing (Feet)	Rod Diameter in Inches One Rod	Two Rods
1 and Smaller	7	3/8	3/8
1-1/4 and 1-1/2	8	3/8	3/8
2	10	3/8	3/8
2-1/2	11	1/2	3/8
3	12	1/2	3/8
4 and 5	14	1/2	3/8
6 and 8	17	1/2	3/8
10	17	5/8	1/2
12	17	3/4	1/2
14	17	3/4	5/8
16	17	7/8	5/8
18 and 20	17	1	3/4
24	17	1-1/8	7/8

D. For valves 4 inches and larger in unburied horizontal lines support the valve on both sides when located within 18 inches of the valve or meter. Provide additional supports where required so that piping loads do not place damaging stresses on supports, valves, and equipment. Where necessary, block up pipe at supports to permit installation of insulation.

E. Support unburied horizontal runs of rubber hose and non-metallic pipe for the entire length by means of troughs consisting of structural steel channels or angles supported at not more than 10-foot intervals.

F. Support piping not included in the foregoing tabulation as indicated or in accordance with the pipe manufacturer's recommendations, if not indicated.

G. Anchor buried pressure pipe at each fitting causing a change in direction of 10 degrees or more. Concrete thrust blocks or other restraining devices in any satisfactory combination may be used. Submit the details of the method proposed for use, together with design calculations, to the City Engineer before installation.

END OF SECTION

Section 15145

PIPE AND EQUIPMENT INSULATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish and install all pipe and equipment insulation, complete and operable, in accordance with the requirements of the Contract Documents. In addition to the insulation shown and specified, the CONTRACTOR shall insulate any cold or hot piping and exhausts that could be hazardous to plant personnel upon contact.

1.02 UNIT PRICES

A. No separate payment will be made for pipe insulation, equipment insulation, and other work performed under this Section. Include cost in lump sum price bid for work of which this is a component part.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Codes: All codes, as referenced herein, are specified in Section 01422, Reference Standards.

B. Federal Specifications:

HH-1-558B	Insulation Blocks, Boards, Blankets, Felts, Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering, Thermal (Mineral Fiber, Industrial Type)

C. Commercial Standards:

ASTM C 547	Specification for Mineral Fiber Preformed Pipe Insulation
ASTM E 84	Test Method for Surface Burning Characteristics of Building Materials

1.04 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall submit complete shop drawings of all thermal insulation, with manufacturer's data on materials, covering, jackets, and finish, in accordance with Section 01330, "Submittal Procedures."

1.05 CLEANUP

A. After completion of all insulation, the CONTRACTOR shall remove all debris from the site, clean all parts of the work to hand over the system in perfect condition.

PART 2 PRODUCTS

2.01 GENERAL

A. All components of the insulation, including covering, mastics and adhesives shall have a flame-spread rating of not over 25, and a smoke development rating of not over 50. Ratings shall be as established by tests in accordance with ASTM E 84 and Federal Specification standards. The integrated insulation assemblies shall also conform to the above specifications. Insulation shall be applied in strict accordance with the manufacturer's instructions.

2.02 BASIC MATERIALS

A. Standard Insulation: This type of insulation shall be employed for process, cold and hot water, steam, and condensate piping and equipment with surface temperatures up to 85 degrees F. Pipe insulation and jacketing shall be applied to piping where shown, and shall include fittings, flanges and valves. Pipe insulation shall be molded-type pipe covering, made of fibrous glass with a minimum k-factor of 0.23 at 75 degrees F mean temperature. Unless otherwise specified, the insulation thickness shall be as follows:

Pipe Application	Minimum Thickness of Insulation (inches)
1. Process and Water Lines - 6 inches and smaller	1-1/2
2. Heat traced piping – 3 inches and smaller	1

B. The insulation shall be oversized for installation over electric heating cable. Insulation shall have a factory-applied white fire-retardant vapor-barrier jacket of Kraft paper and aluminum foil laminated together and reinforced with fiberglass yam. Fittings and valves shall be covered with the same material as the pipe, cut in segments to fit snugly without open spaces, held in place with copper wire or cement, and then covered with the same jacketing material as the pipe. Insulated fittings adjacent to vapor-barrier insulation shall be sealed with acceptable vapor barrier cement before installation of the finish jacket. Pipe insulation and vapor barrier shall be continuous through hangers and supports. Insulation shall be coordinated with the pipe hangers and supports and where

insulation protection shields are provided the top half section of pipe insulation at support locations shall be of the same specified density, and the bottom half insulation segments provided between the pipe and the insulation protection shields shall have a density of not less than 6 lb/cu ft. All insulation shall be covered with smooth aluminum preformed jacketing with a factory-attached moisture barrier. The jacket for the fittings shall consist of precision-formed smooth-sided sections and shall be sized to cover and protect the insulated fitting. Each section shall be manufactured from aluminum and all joints shall be sealed with silicon mastic or solvent welding to provide a continuous air and weathertight joint. Strapping shall be 1/2-inch wide, Type 3003 aluminum or stainless steel.

C. Manufacturers:

1. Armstrong Contracting and Supply Corp.;
2. Certain-Teed Corporation;
3. Manville;
4. Owens-Corning Fiber Glass Corp.;
5. P.P.G. Industries, Inc.

PART 3 EXECUTION

3.01 INSTALLATION

A. All insulation shall be installed by a qualified insulation contractor in strict accordance with the manufacturer's recommendations.

END OF SECTION

Section 15170

LOW VOLTAGE MOTORS

PART 1 - G E N E R A L

1.01 SECTION INCLUDES

A. Specification for low voltage motors.

1.02 REFERENCES

A. American National Standards Institute/Anti-Friction Bearing Manufacturers Association (ANSI/AFBMA): Load Ratings and Fatigue Life for Ball Bearings.

B. American National Standards Institute/national Electrical Manufacturers Association (ANSI/NEMA): MG 1 - Motors and Generators.

C. American National Standards Institute/National Fire Protection Association (ANSI/NFPA): NFPA 70 - National Electrical Code (NEC).

D. American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
   1. IEEE112 - Standard Test Procedure for Polyphase Induction Motors and Generators
   2. IEEE114 - Standard Test Procedure for Single-Phase Induction Motors

E. American National Standards Institute/Underwriters Laboratories, Inc. (ANSI/UL)
   1. UL547 - Thermal Protectors for Motors
   2. UL674 - Electric Motors and Generators for Use in Hazardous Locations, Class I Groups C and D, Class II Groups E, F and G

F. Institute of Electrical and Electronics Engineers (IEEE)
   1. 85 - Test Procedure for Airborne Sound Measurements on Rotating Electric Machinery
   2. 43 - Recommended Practice for Testing Insulation Resistance of Rotating Machinery

G. American Society of Heating, Refrigerating, and Air-conditioning Engineers, Inc. / Illumination Engineering Society of North America (ASHRAE / IES): 90.1-1989, Table 5.1 - Minimum Acceptable Nominal Full-load Motor Efficiencies for Single Speed Polyphase Motors.

****

The attached motor data sheets are part of this specification and shall be filled out by the Specifier and completed by the motor manufacturer.

****

1.03 SUBMITTALS

B. Submit the following under the provisions of Section 01330 - Submittals:
1. Outline drawings
2. Completed motor data sheets
3. Assembly drawings
4. Anchor bolt location drawings
5. Electrical schematics and wiring diagrams
6. Equipment performance curves and data
7. Bill of installation/assembly materials
8. Equipment weights
9. Catalog data
10. Assembly/disassembly sizes and weights
11. Operating instructions
12. Maintenance and lubrication recommendations
13. Recommended spare parts for startup including prices
14. Special maintenance tool requirements
15. Recommended spare parts list for one year operation
16. Quality control procedures
17. Nondestructive test procedures
18. Acceptance test procedure
19. Surface preparation and painting procedure
20. Shipping, handling, and storage procedures
21. Installation/erection procedure
22. Code compliance certificate
23. Electrical equipment heat run test records
24. Nameplate data
25. Performance/acceptance test report
26. Code data reports

1.04 QUALITY ASSURANCE

A. Tests
1. Inspect and test motors in accordance with specified NEMA standards. Test polyphase motors to the requirements of ANSI/IEEE 112. Test single phase motors to the requirements of ANSI/IEEE 114. See data sheets for other standard test requirements that may be specified.

1.05 DELIVERY, STORAGE AND HANDLING

A. Prepare each unit for the type and mode of shipment specified. The preparation shall be suitable for at least six months of outdoor storage from time of shipment requiring no disassembly prior to operation (except for bearing and seal inspections).

B. Provide instructions as necessary to preserve the integrity of the storage preparation after the equipment arrives at the jobsite.

C. Coat exterior machined surfaces with a suitable rust preventative.

D. After drained and cleaned, coat internal areas of bearings and auxiliary equipment in oil lubrication systems fabricated from carbon steel with a suitable oil-soluble rust preventative.

E. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic plugs or caps.

F. When sleeve bearings are furnished, block the rotor to prevent axial and radial movement.

G. When space heaters are furnished, make heater leads accessible without disturbing the shipping package. Tag the leads for identification.

PART 2 P R O D U C T S

2.01 MANUFACTURERS

A. General Electric.

B. Reliance Electric.

C. Siemens.

D. Toshiba.

E. U.S. Motors.

F. Westinghouse

2.02 DESIGN

A. This specification defines the minimum requirements for low-voltage, random-wound, squirrel-cage, induction motors in the NEMA frame sizes for classified electrical hazardous and nonclassified area service.

B. Use this specification for the selection and purchase of induction motors purchased separately or furnished with driven equipment as a package.

C. This specification, along with the reference documents make up the requirements for motors up to and including 200 hp. Use driven equipment specifications and motor data sheets to supplement this specification and identify special project requirements.

D. Motors purchased with this specification will drive pumps, compressors, fans, agitators, conveyors and other similar equipment. Motors will be installed in a plant environment that may include high humidity, storms, salt-laden air, insects, plant life, fungus, rodents as well as traces of petroleum and/or chemicals.

E. Motors shall perform satisfactorily for the application and unusual conditions specified on the data sheets.

F. Motors, electrical components and installation shall be suitable for the hazardous area classification (class, group, and division) specified on the data sheets and shall meet the requirements of ANSI/UL 674 and the NEC.

G. Make motors suitable for operation in an outdoor corrosive and wet environment.

H. When motors are furnished with the driven equipment as a package, motors shall also meet the requirements of the driven equipment specification.

I. Design motors for operation at a temperature of up to 40o/104oF ambient and at an elevation of up to 1000 m/3300 ft above sea level unless specified otherwise on the data sheets.

2.03 PERFORMANCE REQUIREMENTS

A. Confirm motors have ample capacity to supply the maximum output demanded by the driven equipment and have a speed-torque-current characteristic appropriate to the driven equipment.

B. Confirm motors ability to overcome starting load inertia and accelerate the load to rated speed within 15 seconds at 80 percent of rated nameplate voltage, without exceeding the motor time-temperature damage curve.

C. Design and construct motors for continuous full load duty, and for continuous or intermittent operation under any extreme environmental condition noted on the data sheets.

D. Three-phase induction motors shall be ANSI/NEMA MG 1 Design B. Motors driving high-torque loads may be NEMA Design C or D, providing so stated in the proposal.

E. Single-phase fractional horsepower motors shall be NEMA Design N.

F. The single speed, polyphase motors shall have efficiencies as shown in ASHRAE/IES Standard 90.1 - 1989, Table 5-1.

****

Specify high-efficiency motors when their use is proven cost-effective.
****

2.04 ENCLOSURES AND FRAMES

A. Motors in Class I, Division 1 hazardous areas and single-phase fractional horsepower motors in Division 2 hazardous areas shall have NEMA totally enclosed, fan-cooled (TEFC) explosion proof enclosures and shall bear the UL label of approval for the hazardous area classification specified.

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Three-phase motors in Class I, Division 2 hazardous areas or located in outdoor or wet indoor nonclassified areas shall have TEFC enclosures unless specified otherwise on the data sheets. For details, see NEC 501.8.b, including temperature considerations.
****

B. Motors in Class II, Division 1 hazardous areas shall have TEFC explosionproof/ dust-ignitionproof enclosures and shall bear the UL label of approval for the hazardous are classification specified.

C. Motors in Class II, Division 2 areas shall have TEFC or TEFC / Dust-ignitionproof enclosures and shall be certified approved for the hazardous area classification specified.

D. Motors frames, enclosures, terminal boxes, fan cover guards and air passages shall be cast iron or heavy fabricated steel of such design or proportions as to hold all motor components rigidly in proper position, and shall meet all NEMA requirements for the type of enclosure employed. End

bells shall be cast iron. Steel sheet or plate used shall have a thickness of at least 1/8 in. Fans, breathers, drains, screens, covers and hardware shall be corrosion-resistant materials. Fractional horsepower motors may have rolled steel stator frame and cast iron brackets with integral mounting feet.

E. Make motor enclosure fans low inertia, nonsparking type, and suitable for bidirectional rotation and mount on hub with stainless steel bolts.

F. Furnish each enclosure with a stainless steel automatic breather/drain located at the low point of the enclosure.

G. Motor frame and enclosure shall have provisions for grounding to the main grounding system. Drill and tap rear foot on horizontal motors and the flange base on vertical motors on the junction box side for a service post ground connector.

H. Provide motors weighing more than 300 lbs. with lifting eyebolts, rings or lugs capable of supporting the weight of the motor.

2.05 ELECTRICAL REQUIREMENTS

C. Design motor for 60 Hz power at the nominal operating voltages listed below, unless specified otherwise on the data sheets.
   1. 115/230V, single-phase.
   2. 460V, three-phase.

****

3/4 hp and smaller: 115/230 V, single-phase.
1 to 200 hp: three-phase 460 V.
Fractional horsepower motors rated 1/4 hp and above used for critical service pumps, critical service compressor auxiliaries and other critical service loads shall be designed for three-phase operation.

****

D. Induction motors shall be random-wound, squirrel-cage rated for continuous duty and suitable for across-the-line starting, at rated voltage.

E. Determine motor horsepower, speed, torque and special operating requirements from the requirements of the driven equipment and as specified on the data sheets.

****

Special operating requirements, such as frequent starting, variable or multi-speed and reversing requirements will be specified on the data sheets. Induction motors to be operated form solid-state or other types of variable-frequency or variable-voltage power supplies, or both, for adjustable-speed-drive applications may require individual consideration to provide satisfactory performance. Especially for operation below rated speed it may be necessary to reduce the motor torque load below the rated full-load torque to avoid overheating the motor. The motor manufacturer shall make the recommendation for selecting a motor for such applications.
****

F. Use copper for motor windings and terminal leads. Aluminum is not an allowable material for any portion of the motor other than die-cast rotor (fabricated aluminum rotors are not acceptable). Copper rotors shall not be fabricated using brazing maler and any copper alloy must contain less than two percent phosphorous.

G. Provide three-phase single speed motors with three leads.

H. Provide two-speed motors with two windings.

I. Motors shall have a 1.15 service factor (SF) rating unless specified otherwise on the data sheets.

J. Motor insulation shall be a minimum of Class F epoxy nonhygroscopic material with temperature rise limited to Class B design rise of 90oC by resistance method at 1.15 SF.

K. Motors shall operate successfully under running conditions at rated load with variation in voltage and frequency up to the limits set by ANSI/NEMA MG 1-12.44.

L. Unless specified otherwise on the data sheets, motors shall be suitable for the number of full-voltage starts as required by ANSI/NEMA MG 1-12.50 as a minimum.

2.06 TERMINAL BOXES

A. Make motor terminal boxes weatherproof and with threaded conduit entrances with water-resistant seals between boxes and motor frame. Design the line-terminal box to allow box to be rotated in four 90 degree steps for bottom, side or top entry of conduit or cable. The box shall be on the left-hand side (NEMA F1) of the motor when viewed from the connecting

shaft end unless specified otherwise on the data sheets. Locate terminal box for space heaters (when supplied) on the same side as the line terminal box.

B. Size the line terminal box so that feeder cables can be connected to motor leads for terminals without damage to the cable or the leads. Oversize the terminal box to exceed the minimum volumes shown in the NEC Section 430-12 and provide adequate space to mount and enclose all devices mounted within.

C. Furnish the line terminal box with suitable compression ring-type, permanently numbered, cable connectors for incoming bolted-cable connections and one clamp-type ground terminal lug of sufficient size to contain a conductor the same size as motor leads.

D. Wire accessory leads to a terminal board in a terminal box or boxes separate from the line leads. Supply separate terminal boxes for the leads for space heaters, and temperature detectors, current transformers, and other similar accessories, when supplied.

2.07 ELECTRICAL ACCESSORIES

A. Arrange space heaters, when specified on the data sheets, to provide optimum uniform heating of the stator winding and prevent condensation in the motor at ambient temperature when motor is not in operation. Space heaters shall be rated 240 V but shall be connected for operation at 115V. Space heaters shall have maximum sheath temperature of 150°C and shall be approved for the specified hazardous area classification.

B. Provide winding thermal protection, when required, in accordance with ANSI/UL 547 and consisting of differential heat sensing devices embedded in each motor winding. The devices shall be sensitive to both overtemperature and rate of temperature rise.

2.08 BEARINGS AND LUBRICATION

A. Grease or oil-lubricated anti-friction ball or roller bearings are preferred within the application limits. Sleeve-type bearings may be acceptable when recommended by the manufacturer for a particular application and/or specified on the data sheets. Sealed grease-lubricated bearings are acceptable only for fractional horsepower motors in noncritical service.

B. Motors shall have proper bearing insulation to prevent circulation of shaft currents and resulting damage. Provide also insulating means for any oil-

supply connections and monitoring equipment to prevent electrical bypassing of the bearing insulation.

C. Unless specified otherwise on the data sheets, bearings for all direct--connected and belted service motors shall have an L_{10} rating life in accordance with ANSI/AFBMA 9, of at least 40,000 hours.

D. Size bearing housing for grease-lubricated bearings adequately to minimize need for frequent lubrication. Design bearing housing to prevent loss of grease from the bearing cavity and to prevent entry of foreign material into the bearings. Provide housing for grease-lubricated bearings with two plugged openings accessible from the exterior of the motor, one for receiving a pressure grease fitting, and the other to serve as a drain and vent during greasing.

E. Provide oil-lubricated bearing housings a reservoir of sufficient depth, to serve as a settling chamber for foreign materials, with a drain plug, and vents as required, accessible from the exterior of the motor. Furnish oil-lubricated motors with a constant oil-level sight gauge mounted on the motor housing and marked with running- and stopped-oil levels.

F. Provide motors with suitable seals to prevent moisture from entering through the shaft openings. For applications where hoses and water are used for cleanup, provide an Inpro/Seal isolator (labyrinth seal) on the shaft end of the motor.

G. For in-line pumps, special high thrust bearings are required for drive motors, except for pumps where the thrust bearings are provided as an integral part of the pump. When motors are purchased separately, bearing thrust requirements will be specified on the data sheets.

2.09 ADDITIONAL REQUIREMENTS FOR VERTICAL MOTORS

A. Solid shaft vertical motors are acceptable for all applications except when the connection to the driven equipment consists of sectional driven shaft which may unscrew and lengthen in the event of reversal of direction.

B. Hollow-shaft vertical motors are acceptable for all applications when the thrust is in the direction to engage the coupling.

C. Hollow-shaft vertical motors coupled to a sectional drive shaft with screwed joints shall have special couplings described as follows:

1. Provide motors, except the explosionproof type, with self-releasing couplings designed to disconnect motor from driven equipment and permit lengthening of drive shaft upon reversal of rotation.
2. Provide explosionproof motors with nonreversing couplings of spark-resisting construction, designed to prevent reverse rotation.

D. Design vertical motor thrust bearings conservatively to carry maximum axial thrusts (up and down) imposed by driven equipment.

E. Vertical motors shall preferably have oil-lubricated, top and bottom bearings.

F. Vertical motor bases shall be NEMA Type P.

G. Provide vertical motors with a positive, nonreversing, corrosion-resistant ("anti-ratchet") mechanism.

H. Provide vertical motors with fan-end splash shields.

2.10 SLIDING BASE AND SOLE PLATE REQUIREMENTS

A. Motors for adjustable belt and chain drives, 1 hp larger, shall be provided with slide rails, or a double-screw adjusting heavy duty sliding based. Fractional horsepower motors shall have slotted holes. Fabricate sliding base from heavy steel to withstand vibration and corrosive environment and paint it the same color with the same paint system as the motor.

B. Mating surfaces shall be ± 0.0002 in./ft and finished to 250 microinches, and shall be protected during shipping.

C. Motors without sliding bases and that will not be directly mounted on equipment bases shall be equipped with sole plates. Sole plates will be set into buyer's foundation and the motor will be mounted onto the plate.

2.11 ROTOR BALANCING AND VIBRATION

A. Balance motor rotors dynamically according to NEMA standards. Depositing weld metal, solder and the like on the rotor to effect a balance will not be acceptable. Remove parent metal to achieve balance without affecting the structural strength of the rotor. Chiseling or sawing parent metal is prohibited.

B. Measure vibration in all directions with the motor running uncoupled at no load, normal voltage and frequency, and at each speed of the operating range. Motor vibration shall not exceed the total amplitude, peak-to-peak

values given in ANSI/NEMA MG 1-12.05A as measured in accordance with ANSI/NEMA MG 1-12.07.

2.12 NAMEPLATES

A. Fasten motor stainless steel nameplates securely to the motor with stainless steel screws. Nameplates shall include as a minimum the information required by ANSI/NEMA MG 1-16.61.

2.13 FINISH

A. Motors shall be primed and finished using the motor manufacturer's standard epoxy painting system unless specified otherwise on the data sheets.

B. Cover internal surfaces, e.g., shaft, rotor, stator, and other similar components, with a corrosion-resistant coating of epoxy or equal material for increased life.

2.14 NOISE LEVELS

A. Determine motor noise level in accordance with IEEE 85. Levels or noise generated by a motor shall not exceed 85 dbA at a distance of 1 m/3.3 ft unless specified otherwise on the data sheet.

B. Noise level requirements may be also covered by a separate noise requirements specification included with the driven equipment specification.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Verify dimensions of motor foundation with sole plates or slide rails in place.

3.02 INSTALLATION

A. Install the motor in accordance with the Manufacturer's published instructions using the necessary tools and instrument to ensure proper fit and alignment with the driven machine.

B. Before coupling up with the driven machine, the following work should be performed.
   1. Test the motor winding insulation resistance in accordance with IEEE 43.
   2. Terminate cables to the motor leads.

3. Energize motor momentarily to check rotation.
4. Check shaft of driven machine to ensure free movement.

C. Couple motor up with driven machine.

D. Record motor nameplate data.

END OF SECTION

DATA SHEET 1 of 3

1. **IDENTIFICATION**
2. CLIENT _____ MANUFACTURER _____
3. PROJECT _____ MODEL NO. _____
4. JOB NO. _____ SIZE _____
5. PLANT LOCATION _____ SERIAL NO. _____
6. ITEM NO. _____ INQUIRY NO. _____
7. SERVICE _____ P.O. NO. _____
8. NO. ITEMS REQUIRED _____
9. _____
10. **SITE DATA**
11. TYPE INSTALLATION _____
12. AREA CLASSIFICATION: CLASS ____ DIVISION _____ GROUP _____ NONCLASSIFIED _____
13. UNUSUAL ENVIRONMENTAL CONDITIONS: (E.G., DUST, INSECTS, FUNGUS) _____
14. AMBIENT TEMP: MAX _____ ^{o}F MIN _____ ^{o}F, ALTITUDE _____FT ABV S.L.
15. OTHER: _____
16. **OPERATING DATA**
17. _____ HP _____ SYNC RPM _____ V MOTOR TORQUES:
18. PH _____ FREQ _____ SF _____ STD (PER NEMA MG 1, PT 12) _____
19. INSUL CLASS _____ LOCKED ROTOR (MIN) _____ % _____ FULL LOAD
20. DUTY: CONTINUOUS _____ INTERMITTENT _____ BREAKDOWN (MIN) __ % _____FULL LOAD
21. DESIGN EFFICIENCY: STD ___ HIGH __ MULTISPEED: (NO. SPEEDS & WINDINGS) _____
22. STARTING METHOD: FULL VOLTAGE (FV) _____ VARIABLE TORQUE _____ S - __ W
23. _____ RED VOLTAGE _____% FV CONSTANT TORQUE _____ S - _____ W
24. STARTING VOLTAGE _____% RATED VOLTAGE CONSTANT HP_____S - _____ W
25. STARTING CONDITION: LOADED ___ UNLOAD _____ SPECIAL WINDINGS _____
26. EXT LOAD INERTIA _____ LB/FT^2@ _____ RPM OTHER _____
27. **CONSTRUCTION**
28. ENCLOSURE: _____
29. ROTATION: (VIEWED FROM END OPPOSITE COUPLING) CW _____ CCW _____
30. TYPE DRIVE: (E.G., DIRECT, V-BELT) _____ TYPE MTG: (E.G., NEMA F-1, W-1) _____
31. VERTICAL MOTORS: MAX THRUST _____ LB UP/DN SHAFT: HOLLOW _____ SOLID _____
32. MODIFICATIONS: (CHECK IF REQD & DETAIL IN "OTHER") _____
33. BASE: SLIDING _____ RAILS _____ SOLEPLATE _____OTHER _____
34. BEARING: BALL/ROLLER _____ SLEEVE _____ BEARING L_{10} RATING LIFE _____
35. LUBRICATION: _____
36. COUPLING-PRESSED ON: NONE ___ HALF-COUPLING _____ V-BELT SHEAVE _____ BRAKE: _____
37. SHAFT EXTENSION: STD ___ EXTRA LONG __ DOUBLE-ENDED _____BREATHER & DRAIN: ___
38. SCREENED OPENINGS _____ SPECIAL TESTS _____ PAINT _____
39. AIR FILTERS: MFR _____ PROVISIONS ONLY _____ DIFF PRESS SWITCH REQD _____
40. MAIN TERMINAL BOX: OVERSIZED _____ SPACE FOR STRESS CONES _____ OTHER DEVICES __
41. SURGE PROTECTION: SURGE ARRESTERS _____ SURGE CAPACITORS _____
42. CT'S FOR DIFF PROTEC.: NO. _____ RATIO ____ SELF-BALANCE ARRANG. ___TRADITIONAL ARRANG. _
43. GROUND CONNECTION: IN TERM BOX _____ EXTERNAL FRAME _____
44. SPACE HEATERS: _____ V _____ PH MAX. SHEATH TEMP _____ ^{o}C
45. RTD'S: MATLS TYPE _____ NO. PH _____ OHMS _
46. BEARING: HEATER: _____ V _____ PH BRG INSUL: NONDRIVE END BOTH BRGS ___
47. VIRBRATION DEVICES; _____
48. OTHER: _____
49. _____

50. _____

DATA SHEET 2 of 3

1. **MANUFACTURER'S INFORMATION**
2. RATING _____ HP _____ V _____ Hz SF _____ DUTY _____
3. SYNCHRONOUS SPEED _____ RPM, FULL LOAD SPEED _____ RPM
4. ENCLOSURE _____
5. HAZ AREA CLASS: SUITABLE FOR CL _____ GR _____ DIV _____NONCLASSIFIED _____
6. MFR'S TYPE _____ FRAME SIZE _____
7. ROTATION: (VIEWED FR END OPPOSITE CPLING) CW _____ CCW _____
8. MOTOR CHARACTERISTICS: _____ V _____ PH _____ Hz
9. % LOAD: 1/2 3/4 FULL LOAD SF
10. CURRENT, A_____ _____ _____ _____
11. EFFICIENCY_____ _____ _____ _____
12. POWER FACTOR_____ _____ _____ _____
13. CURRENT: LOCKED ROTOR (LR) @ RATED VOLTAGE __ A, LR @ _% RATED VOLTAGE _____ A
14. ACCELERATION TIME: @ 80% RATED VOLTAGE __ SEC @ 100% RATED VOLTAGE _____ SEC
15. ALLOWABLE TIME @ LOCKED ROTOR: MOTOR HOT (@ FL TEMP & 40°C AMBIENT) _____ SEC
16. MOTOR COLD (40°C AMBIENT) _____ SEC
17. TRANSIENT REACTANCE _____ PER UNIT SUBTRANSIENT REACTANCE _____PER UNIT
18. INSUL SYSTEM CLASS _____ TEMPERATURE RISE _____ °C
19. TORQUE, FT-LB: LOCKED ROTOR _____ PULL-UP _____ BREAKDOWN _____
20. ROTOR WK^2 ($LB\text{-}FT^2$ AT MOTOR SPEED) _____
21. OPEN-CIRCUIT TIME CONSTANT _____ SEC
22. BRG CPLG END: MFR TYPE _____ PART NO. _____
23. BRG OUTBD END: MFR TYPE _____ PART NO. _____
24. BRG THRUST TOP (BOTTOM) MFR TYPE _____ PART NO. _____
25. PRESSURE LUBRICATION: RANGE _____ PSIG FLOW RANGE _____ GPM
26. TEST REPORT REFERENCE: ROUTINE _____ COMPLETE _____ IMMERSION ___
27. MOTOR OUTLINE DWG NO. _____ ACCELERATION CURVE NO. _____
28. WEIGHTS: NET _____ LB ROTOR __ LB SHIPPING _____ LB
29. MAX ERECTION _____ LB MAX MAINTENANCE _____ LB
30. OTHER: _____
31. _____
32. _____
33. **ACCESSORIES**
34. WINDING RTD RATING: OHMS _____ ALARM SETTING _____°C 2-WIRE _____ 3-WIRE _____
35. THERMAL TEMPERATURE SWITCH CONTACTS: NORMALLY OPEN _____ NORMALLY CLOSED ___
36. OPENING SETTING _____°C CLOSING SETTING __° C
37. BEARING TEMPERATURE DET RECOMMENDED SETTING: ALARM _____°C TRIP _____°C
38. SPACE HEATERS: WATTAGE _____ kW, VOLTAGE _____ V, _____ PH
39. MAXIMUM SURFACE TEMPERATURE _____°C
40. CURRENT TRANSFORMERS: DIFFERENTIAL _____ RATIO _____ NO. MOUNTED _____
41. PH _____ RATIO _____
42. OTHER _____ RATIO _____
43. SURGE PROTECTION: LIGHTNING ARRESTER NO. _____, VOLTAGE _____V
44. CAPACITOR NO. _____ CAPACITANCE _
45. FILTER: MFR _____ TYPE _____
46. OTHER: _____
47. _____
48. _____
49. _____
50. _____

DATA SHEET 3 of 3

MANUFACTURER'S INFORMATION

PRESSURE LUBE SYSTEM

MAIN PUMP: INTEGRAL _____ SEPARATE _____ IF SEPARATE, VERTICAL _____ HORIZONTAL _____

TYPE DRIVE: STEAM TURBINE _____ MOTOR _____

DRIVE CHARACTERISTICS: PRESSURE _____ PSIG TEMP RANGE _____ °F TO _____ °F

_____ V _____ PH _____ Hz

FILTER: SINGLE _____ DUPLEX _____

PRESSURE CONTROLLER NO. _____ RELIEF VALVE NO. _____ SETTING __ PSIG

COOLERS: TWIN _____ SINGLE _____ CONSTRUCTION MATLS _____

VIBRATION INDICATOR IDENTIFICATION: CHARACTERISTICS: SETTING: _____

_____ V

AUX CONTACTS: NO ___ NC _____

OTHER: _____

WINDING AIR COOLERS

NO. OF SECTIONS _____ SECTION RATING, % OF FULL LOAD _____

CONSTRUCTION MATL DATA SHEET REFERENCE: AIR/AIR _____ AIR/WATER _____

WATER PRESS: MAX _____ PSIG MIN _____ PSIG

WATER FLOW: MAX _____ GPM MIN _____ GPM

FLOW SENSING DEVICE: IDENTIFICATION: _____ _____ V

AUX RELAY CONTACTS: NO _____ NC _____

HIGH-FLOW ALARM SETTING _____ GPM

LOW-FLOW SHUTDOWN SETTING _____ GPM

OTHER: _____

Section 15190

MECHANICAL IDENTIFICATION

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Identification of mechanical products installed under Division 15.

1.02 UNIT PRICES

A. No separate payment will be made for mechanical identification and other work performed under this Section. Include cost in lump sum price bid for work of which this is a component part.

1.03 REFERENCES

A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.

1.04 SUBMITTALS

A. Submit product data and manufacturer's installation instructions under provisions of Section 01330 - Submittal Procedures.

B. Submit list of working, symbols, letter size, and color coding for mechanical identification.

C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Seton.

B. W.H. Brady Company.

C. Approved substitute.

2.02 MATERIALS

A. Color: Unless specified otherwise, conform with ANSI/ASME A13.1.

B. Plastic Nameplates: Laminated three-layer plastic with engraved black letters on light contrasting background color.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and fluid being conveyed.

PART 3 – EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 09902 – Painting and Protective Coatings, for stencil painting.

3.02 INSTALLATION

A. Plastic Nameplates: Install corrosive-resistant mechanical fasteners, or adhesive.

B. Plastic Tags: Install with corrosive-resistant chain.

C. Equipment: Identify heat transfer equipment with plastic nameplates.

D. Valves: Identify valves in main and branch piping with tags.

E. Piping: Identify piping, concealed or exposed, with plastic pipe markers. Tags may be used on small diameter piping. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

Section 15200

CHLORINATION CONTROL EQUIPMENT AND ACCESSORIES

PART 1 GENERAL

1.01 WORK INCLUDES

A. This section specifies the design and installation of chlorination control equipment and accessories which includes online chlorination analyzers and sample pumps. The analyzers will be used to control chemical feed systems for chlorination.

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.

1.03 QUALITY ASSURANCE

A. All materials used shall be of new and of high grade and of properties best suited to the Work required.

B. Manufacturer's Qualifications:

1. Equipment provided undert his section shall be a standard product in regular production by manufacturers whose products have proven reliable in similar services for at least five (5) years.

2. Insofar as possible, all equipment of the same specific type shall be the product of one (1) manufacturer.

1.04 SUBMITTALS

A. Submit shop drawings and product data under provisions of Sections 01330 – Submittal Procedures.

B. Shop drawings

1. Submit for review detailed drawings, data and descriptive literature on al equipment and all accessories including:

a. Performance characteristics

b. Dimensions

c. Materials of construction

d. Weight

e. Protective coating

f. Testing data (where applicable)

g. Electrical characteristics (where applicable)

h. Wiring diagram (where applicable)

1.05 OPERATING AND MAINTENANCE MANUALS

A. Submit operation and maintenance data under provisions of Section 01782 – Operation and Maintenance Data.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 01610 – Basic Product Requirements.

B. Store and protect products under provisions of Section 01610 – Basic Product Requirements.

1.07 WARRANTY

A. Provide guaranty under provisions of Section 01610 – Basic Product Requirements.

PART 2 PRODUCTS

2.01 DPD COLORIMETRIC RESIDUAL CHLORINE ANALYZER

A. Residual chlorine analyzers utilizing the DPD colorimetric method shall be Superior 702 Water Guard Analyzer (WG-702T), no exceptions. The analyzers will automatically take in an appropriate amount of sample, test the blank sample to adjust for existing color and turbidity, apply buffering and indicator solutions, test the sample, and discharge the sample.

B. The analyzer will have a user-selectable cycle time between 90 seconds and 10 minutes. Unit shall display the total chlorine residual on the face of the instrument in the range of 0 to 10 mg/L, measured to 0.01 mg/L, and accuracy shall be ±5%.

C. Provide analyzers in a NEMA 4X enclosure with clear plastic window to view the optical chamber allowing viewing of the sample and reaction of the reagents before, during, and after a reading.

D. The analyzers in this subsection will run on 115 VAC, 60 Hz frequency, and draw a maximum of 25 watts.

E. Each analyzer shall produce a 4-20 mA output proportional to chlorine residual, with an adjustable full span between 0 and 10 mg/L.

F. Each analyzer will be capable of 30 days continuous operation without replacing reagents.

G. Each analyzer will also show alarm conditions on its face and produce alarm outputs for programmable chlorine concentrations or for system malfunctions from a self-diagnostics system. The status and alarm conditions shall be wired into the existing chemical feed PLC and used in the control algorithms.

H. Accessory Equipment.

1. ¼-inch NPT inlet valve

2. Inlet interconnecting tubing and fittings

3. Sample tubing, valves, and fittings

4. Stainless steel mounting hardware

5. 30-day supply of reagents

6. Follow all manufacturers' recommendations regarding installation of these accessories.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install all equipment and accessories detailed in this section as shown in the drawings in accordance with manufacturer's instructions. Install analyzers at locations shown on the drawings.

3.02 FIELD SERVICES

A. Provide the services of a factory-trained representative of the manufacturer for installation, startup, and correction of any defects or malfunctions.

3.03 TESTING AND ACCEPTANCE

A. Start-Up. Beneficial use will not occur until after the start-up activities have been performed and accepted by the City Engineer. Start-up activities include the following:

1. Receipt and acceptance by the City Engineer of draft Operation and Maintenance manuals, including the wiring and ladder diagrams.

2. Satisfactory operation of chlorination system for 7 consecutive days under the City's control. If malfunctions or other operational problems halt the 7-day test period, the Contractor shall make appropriate corrections and restart the 7-day test period.

3. Provide the services of a factory-trained technician for a period of 4 hours to train the City's operating and maintenance personnel, including calibration of the analyzers. Training session shall be scheduled and coordinated by the Contractor.

B. Acceptance. After the start-up operation has been successfully completed, the City will accept the chlorination system when final Operation and Maintenance manuals have been received, reviewed, and accepted by the City. Include ladder logic diagrams and wiring and termination diagrams for both power and instrumentation systems

END OF SECTION

Section 15250

MECHANICAL INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.02 DESCRIPTION OF WORK

A. Extent of mechanical insulation required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Types of mechanical insulation specified in this section include the following:

1. Mineral-Fiber Insulation:

   a. CertainTeed Manson.
   b. Knauf FiberGlass GmbH.
   c. Owens-Corning Fiberglas Corp.
   d. Schuller International, Inc.

2. Cellular-Glass Insulation:

   a. Pittsburgh-Corning Corp.

3. Flexible Elastomeric Thermal Insulation:

   a. Armstrong World Industries, Inc.
   b. Rubatex Corp.

4. Polyolefin Insulation:

   a. Armstrong World Industries, Inc.
   b. IMCOA.

5. Closed-Cell Phenolic-Foam Insulation:
   a. Kooltherm Insulation Products, Ltd.

C. Refer to Division-15 Section "Supports and Anchors" for protection saddles, protection shields, and thermal hanger shields; not work of this section.

D. Refer to Division-15 Section "Sheet Metal Duct" for duct linings; not work of this section.

E. Refer to Division-15 section "System Identification" for installation of identification devices for piping, ductwork, and equipment; not work of this section.

1.03 QUALITY ASSURANCE

A. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulation similar to that required for this project.

B. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site. Do not install insulation.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Armstrong World Industries, Inc.
2. Certainteed Corp.
3. Knauf Fiber Glass GmbH.
4. Owens-Corning Fiberglas Corp.
5. Pittsburgh Corning Corp.
6. FGH Fabricators, Inc. KoolPhen K Phenolic Foam Insulation.

B. Adhesives shall be as manufactured by Minnesota Mining, Arabol, Benjamin-Foster, Armstrong, or Insulmastic, Inc., and shall have the same adhesive properties, fire rating, vapor seal, etc., as the types specified herein, subject to review by the City.

2.02 PIPING INSULATION MATERIALS

A. Fiberglass Piping Insulation: ASTM C 547, Class 1 unless otherwise indicated. (Indoor locations) shall be used for hot water and domestic cold and hot water system only.

B. Cellular Glass Piping Insulation: ASTM C 552, Type II, Class 2.

C. Water Pipe and Round Duct Insulation: (Outdoor locations) Foamglass insulation as manufactured by Pittsburgh Corning or Koolphen phenolic foam 2.2 # density as manufactured by FGH Fabricators, Inc.

D. Jackets for Piping Insulation: ASTM C 921, Type I (vapor barrier) for piping with temperatures below ambient, Type II (water vapor permeable) for piping with temperatures above ambient. Type I may be used for all piping at Installers option.

1. Encase pipe fittings insulation with one-piece pre-molded 16 MIL aluminum fitting covers, fastened as per manufacturer's recommendations.
2. Encase exterior piping insulation with 16 MIL aluminum jacket with "Z" closures for weather-proof construction.

E. Staples, Bands, Wires, and Cement: As recommended by insulation

manufacturer for applications indicated.

F. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated. White all service jacket "ASJ" vapor barrier with dual self-seal strips for all insulation except flexible unicellular.

2.03 DUCT INSULATION MATERIALS

A. Rigid Fiberglass Duct Insulation (Indoor application): ASTM C 612, Class 1.

B. Flexible Fiberglass Duct Insulation (Indoor application): ASTM C 553, Type I, Class B-4.

C. Foam Glass Duct Insulation (Outdoor application): ASTM C 240, Type I.

D. Flexible Unicellular Duct Insulation: ASTM C 534, Type II.

E. Jackets for Duct Insulation: ASTM C 921, Type I for duct with temperatures below ambient; Type II for duct with temperatures above ambient.

F. Jackets for outdoor Duct Insulation: Encase exterior duct insulation with 16 MIL aluminum jacket with "Z" closures for weather-proof construction.

G. Duct Insulation Accessories: Provide bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

H. Mechanical Fasteners:

1. Gemco Type IH-A from Goodloe E. Moore, Inc., Danville, IL 800-331-1164.
2. Eckoustic-Klip from Eckel Industries Inc., Cambridge, MA 617-491-3221.
3. INC Stick-Pin from Industrial Noise Control Inc. Addison, IL 312-620-1998.

I. Duct Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

1. 15-141 from King Co., St. Louis, MO 314-772-9953.
2. Tuffbond from Goodloe E. Moore, Inc., Danville, IL 800-331-1164.

3. INC C-700 from Industrial Noise Control Inc., Addison, IL 312-620-1998.

J. Duct wrap shall be allowed only within the concealed ceiling space. All external duct wrap shall be in accordance with the IEC -2002 code with R-5 and R-8 for the required applications, and is required on all and supply air and return air duct that is not internally insulated or located exposed on the roof.

K. Jacketing Material for ducts within Equipment Room: Provide pre-sized glass cloth jacketing material, not less than 8 ounces per square yard, except as otherwise indicated.

L. Duct lining for the return air boot shall be fiberglass insulation with a surface acrylic coating that will not support biological growth similar to Foster 40-20. This coating shall also guard against incursion of dust and dirt into the insulation. This coating shall be damage resistant, which does not tear or abrade easily. Duct lining shall be capable of being cleaned per NAIMA Duct Cleaning Standards. Duct lining shall be minimum density meeting the requirements of NFPA 90-A. Duct lining shall be suitable up to 4,000 fpm air velocities. Duct lining and adhesive shall comply with ASTM E-84 and shall have a maximum flame spread rating of 25 and smoke rating of 50. Duct lining adhesive shall conform to ASTM C916 "Specifications for Adhesive for Duct Thermal Insulation." Fasteners shall comply with SMACNA HVAC Duct Construction Standards Article S2.11.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer. As a minimum the surface to be installed shall be clean, dry and above the ambient air due point before and during insulation application.

3.02 DUCT SYSTEM INSULATION

A. Insulation Omitted: Do not insulate exhaust duct, or lined duct.

B. Cold Ducts: Temperatures below the space dew point shall have the insulation vapor barrier be continuous and unbroken through inside walls, sleeves and floor openings. Where connection is made to fire or fire/smoke damper in wall or floor the vapor barrier must extend to the wall or floor to prevent ambient air water vapor from condensing on the

cold surfaces of the fire damper.

C. Duct Wrap: Fasten all longitudinal and circumferential laps with outward clinching staples 3" on center. On rectangular ducts over 24" wide, apply as above and hold insulation in place on bottom side with mechanical pins and clips on 12" centers.

D. Duct Wrap: Seal all joints, fastener penetrations and other breaks in vapor barrier with 3 inch wide strips of the same facing materials with factory applied vapor barrier adhesive, or 3 inch wide strips of white glass fabric embedded between two coats of a vapor barrier mastic, Childers CP-30 or approved equal.

E. Cold Duct (Below Ambient Temperature):

1. Application Requirements: Insulate the following cold duct:

   a. HVAC supply duct between fan discharge, or HVAC unit discharge, and room terminal outlet.
      1) Insulate neck, backside, and bells of supply diffusers.

   b. HVAC return duct between room terminal inlet and return fan
   inlet, or HVAC unit inlet.
   c. HVAC plenums and unit housings not pre-insulated at factory or lined.

2. Insulate each duct system specified above with one of the following types and thickness of insulation:

   a. Rigid Fiberglass: 1 ½ " thick, 3 PCF density, increase thickness to 2" in equipment rooms or any other exposed to view indoor locations.
   b. Flexible Fiberglass: R-5 with *foil faced continuous vapor barrier*. This application is limited to concealed indoor locations only.
   c. Foamglass: two (2) layers of 1" thick insulation blocks or 2" thick Armstrong Type II Armaflex flexible elastomeric closed cell sheet insulation or approved equal. (For outdoors locations)

3. Ductwork **exposed to view, installed in the mechanical rooms**, and installed outdoors shall be insulated with Rigid Fiberglass 2" thick, 3 PCF density and then finished above the insulation with canvas jacket of UL listed fabric of 8 oz. per square yard. Canvas joints and laps shall be glued and sealed with vapor seal mastic such as Foster 30-30 vapor barrier. Only outdoor ducts shall be

covered with 0.02" thick smooth aluminum jacket utilizing longitudinal "zee" closures.

3.03 INSTALLATION OF DUCT INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its indented purpose.

B. Install insulation materials with smooth and even surfaces.

C. Clean and dry duct prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

D. Maintain integrity of vapor-barrier on duct insulation, and protect it to prevent puncture and other damage,

E. Extend duct insulation without interruption through walls, floors and similar duct penetrations, except where otherwise indicated.

F. Duct wrap: Attach external duct wrap on top, sides and bottom of vertical duct and sides and bottom of horizontal duct with full cover coat of cement, duct dimensions up to 16 inches, provide stick clips or screws and cap for dimension over 16 inches, space 16 inches O.C., maximum. Provide canvas cover with two coats of suitable mastic for all wrapped exposed to view ducts. Finish shall be smooth and suitable for painting color selected by Architect.

G. Corner Angles: Except for hood exhaust duct insulation, install corner angles on external corners of insulation on duct in exposed finished spaces before covering with jacketing suitable for painting.

END OF SECTION 15250

Section 15255

METERING PUMPS & ACCESSORIES

PART 1 GENERAL

1.01 DESCRIPTION

A. This section provides requirements for the supply and installation of metering pumps and accessories for a Sodium Bisulfite chemical feed system.

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.

1.03 REFERENCES

1.04 QUALITY ASSURANCE

A. All materials used shall be new and of high grade and of properties best suited to the Work required.

B. Manufacturer's Qualifications:

1. Equipment provided under this Section shall be a standard product in regular production by manufacturers whose products have proven reliable in similar service for at least five (5) years.

2. Insofar as possible, all equipment of the same specific type shall be the product of one (1) manufacturer.

1.05 ACCEPTABLE MANUFACTURERS

A. Acceptable Manufacturers

1. Sodium Bisulfite Pumps:

a. Prominent Delta Series

b. Wallace & Tiernan

c. Pulsafeeder
d. LMI

e. Approved Equal

1.06 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01330—Submittal Procedures and 15050—Basic Mechanical Materials and Methods.

B. Submit shop drawings of the pumps, multifunction valves, and pressure indicators. Drawings to include mounting pads, brackets, and fixtures. Include drawings of proposed system and reference standards of all materials used.

C. Include written test procedures and results of all tests performed at the factory.

D. Submit pumping curves of Total Dynamic Head (TDH), and capacity over the entire operational range for each type of pump. Include installation instructions and diagrams of electronic control devices.

1.07 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01782—Operating and Maintenance Data.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment to site under provisions of Section 01610—Basic Product Requirements.

B. Store and protect products under provisions of Section 01610—Basic Product Requirements.

C. Store equipment off the ground in original shipping crates in enclosed shelter.

1.09 WARRANTY

A. Provide warranty under provisions of Section 01610—Basic Product Requirements.

PART 2 PRODUCTS

2.01 METERING PUMPS

A. All pumps shall be microprocessor-controlled, simplex, reciprocating, solenoid-driven, diaphragm type pumps.

B. The pump shall have a built-in pump control panel. The housing shall be rated NEMA 4X.

C. The power supply shall be 120 VAC, 60Hz, single phase.

D. The liquid end shall be physically separated from the drive unit by a backplate with weep hole creating an air gap.

E. The diaphragm shall be constructed of a steel core, vulcanized into nylon-reinforced EPDM, with PTFE-faced fluid contact surface.

F. The liquid end shall be either plexiglass (acrylic) with EPDM seals, with built-in coarse valve and needle valve for air bleed, manually adjusted for continuous degassing of process fluid and self-priming against pressure

G. The suction and discharge valves shall be PVC, with double ball check design.

H. The pumps shall be provided with auto-degassing technology or an auto-degassing valve. Auto-degassing technology shall allow option to de-gas upon loss of pressure and/or periodically for prevention. The pump shall self detect and correct for air lock (i.e. loss of pressure).

H. Sodium Bisulfite Pumping requirements:

1. Operating temperature of 50 to 100 °F

2. Fluid Specific Gravity of 1.324

3. Flow Rates of 0 to 18.44 gph at ±1% accuracy

4. Accuracy to be upheld with available NPSH.

2.02 ACCESSORIES

A. Multifunction Valve

A pump-mounted, multifunction, fixed-spring pressure diaphragm-type valve

for backpressure/anti-siphon protection, pressure relief, priming, and discharge line drain, constructed of PVDF, shall be provided with each pump.

B. Flexible Tubing

Tubing to be same diameter of pump inlet and outlets and have enough slack to facilitate removal of pumps. All wetted fittings and connectors are to be resistant to Sodium Bisulfite. External clamps or sleeves are to be stainless steel.

C. Pressure Gauge

Each discharge header is to be equipped with a pressure gauge and diaphragm seal. The gauge is to have a ball valve preceding it for easy removal.

D. Mounting Hardware

All mounting and bracing materials in chemical handling buildings are to be fiberglass, unless otherwise stated here or in plans.

E. Pump Stands

Supply fiberglass pump stands at locations indicated in Plans. Submit shop drawings of proposed stands to Engineer.

F. Spare Parts

Furnish one complete set of manufacturer's recommended spare parts for each type of pump and any special tools required for disassembly. Spare parts are to be vacuum sealed and labeled as to pump size and series. Include at least the following: seals, gaskets and diaphragms.

G. Electronic Controls

1. Stroke length control shall be manually adjusted between 0% and 100% on the pump face control panel. The LCD shall digitally display stroke length setting in 1% increments in the full range between 0% and 100%.

2. Programming shall allow pump to be calibrated so as to display pump output in gallons/hour or liters/hour. Calibration shall be maintained when stroke length is altered up to plus or minus 10% on the stroke length knob. If stroke length is altered by more than 10%, a yellow

warning light will light and a flashing message "calib" will appear.

3. The pump shall be equipped with the programmable function of pressure levels to allow pump to operate at reduced pressures from the maximum rated pressure of the pump.
4. The pump shall be equipped with the programmable function of electronic interlocking of the keypad by access code to prevent unauthorized adjustments to the pump.

5. Keypad shall allow for scrolling and display on LCD such parameters as stroke frequency, stroke length, stroke counter, pump output in gals/hr or L/hr, dosing quantity, mA current input being received by pump, and indication of external mode.

6. Stroke frequency control shall be manually adjusted by touch keypads, with the set stroke rate displayed on the LCD. The metering pump shall be capable of receiving a 4-20 mA input via optional external control. The pump shall be capable of remote ON-OFF operation using the pause function via a voltage free contact relay through an optional control cable. In addition, the pump shall be configured with analog input functionality. The pump shall accept an analog signal such that stroke frequency is proportional to 0/4-20mA or 20-4/0mA, the choice of which is programmable at the pump. The pump shall allow the setting of a maximum stroke rate, which corresponds to the maximum analog signal, with stroke rate proportional to signal strength below that rate. Programming for curve processing shall also be possible, in which any stroke frequency ratio in proportion to the electrical signal can be configured. Analog to digital converters external to the pump shall not be allowed.

7. The pump shall be equipped with the programmable function of auxiliary frequency control, allowing for quick priming of the pump or for slug feed after system shutdown. Stroke frequency shall be programmable to a maximum of 180 spm, and the auxiliary frequency function shall be capable of interfacing with a contact closure relay for control purposes.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install fiberglass pump stands flat and level using stainless steel quick bolts. Attach pumps according to manufacturer's instruction using bolts, nuts, and washers of 316 stainless steel. When tightening anchor bolts, use only that force necessary to securely attach pump stand. Do no crack the mounting

feet. Use lock washers to prevent the nuts from vibrating loose. When piping has been assembled, tested, and cleaned, attach to pump.

3.02 TESTING

A. Follow manufacturer's start-up instructions. Perform pumping test using clean water and under the guidance of the manufacturer's technical representative. Set relief valve pressure to 20% above normal operating pressures, and set the back pressure valve to produce at least 5 Psi. The pulsation dampeners should be precharged to recommend settings, and test run at maximum and expected daily capacity.

3.03 START-UP AND ACCEPTANCE

A. Beneficial use will not occur until after the start-up activities have been performed and accepted by the City Engineer. Start-up activities include the following:

1. Receipt and acceptance by the City Engineer of draft Operation and Maintenance manuals, including the wiring and ladder diagrams.

2. Installation inspection by City operating, electrical and instrumentation staff followed by any corrective measures required by the Contractor.

3. Satisfactory operation of Metering Pumps for 7 consecutive days under the City's control. If malfunctions or other operational problems halt the 7-day test period, the Contractor shall make appropriate corrections and restart the 7-day test period.

4. Provide the services of a factory-trained technician for a period of 8 hours to train the City's operating and maintenance personnel. Training session shall be scheduled and coordinated by the Contractor. Furnish the representative for the additional time to correct or supervise correction of any defects of malfunctions.

B. Acceptance. After the start-up operation has been successfully completed, the City will accept the Metering Pumps when final Operation and Maintenance manuals have been received, reviewed, and accepted by the City. Include ladder logic diagrams and wiring and termination diagrams for both power and instrumentation systems.

END OF SECTION

Section 15257

CHEMICAL STORAGE TANKS

PART 1 GENERAL

1.01 SECTION INCLUDES:

A. This section provides requirements for the installation of fiberglass chemical storage tanks, fittings, insulation, and containment sealants. Two (s) 6,500 gallon sodium bisulfite tanks are to be provided.

1.03 RELATED WORK

A. Division 16 – Electrical

1.04 REFERENCE STANDARDS

A. ASTM D883, "Standard Definitions of Terms Relating to Plastics".

B. ASTM D2563, "Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts".

C. ASTM D2583, "Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor".

D. ASTM D3299, "Standard Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Chemical-Resistant Tanks".

E ASTM D4097, "Standard Specification for Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks".

F. NSF/ANSI Standard 61, AWWA – Drinking Water System Components

1.05 SUBMITTALS

A. Shop Drawings and Product Data

1. Submit shop drawings for tanks and accessory equipment including principal dimensions, location of fittings and unit foundation.

B. Design Data

1. Storage Tank

2. Accessory equipment

C. Test Reports

1. Shop hydrostatic test

2. Submit results of hydrostatic and dynamic testing

3. Inspection Field hydrostatic test

4. Preoperational test

5. In-service test

D. Certificates

1. Submit written verification on the fabricator's letterhead that surface preparation and coating application were performed in accordance with the manufacturer's printed recommendations for the coating system.

E. Manufacturer's Instructions

1. Storage Tank

F. Operation and Maintenance Data

1. Storage Tank
2. Accessory equipment

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. Tank manufacturer shall have at least five completed installations involving storage of sodium bisulfite, having tanks of the type specified herein, and tanks of comparable size.

2. The installation described above shall have been in service for at least one year without any leakage, deterioration or failures.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage

1. Inspect materials delivered to site for damage; unload and store with minimum handling.

2. Store materials on-site in enclosures or under protective coverings.

2. Protect materials not suitable for outdoor storage to prevent damage during periods of inclement weather, such as subfreezing temperatures, precipitation, and high winds.

3. Store materials susceptible to deterioration by direct sunlight under cover and avoid damage due to high temperatures.

4. Do not store materials directly on ground.

5. If special precautions are required, prominently and legibly stencil instructions for such precautions on outside of equipment or its crating.

B. Handling

1. Handle storage tanks in such a manner as to ensure delivery to final location in sound, undamaged condition.

2. Take special care not to damage interior and exterior surfaces of storage tank.

3. Make satisfactory repairs to damaged materials at no cost to Government. Carry and do not drag materials.

1.08 WARRANTY

A. Provide warranty under provisions of Section 01610—Basic Product Requirements.

PART 2 PRODUCTS

2.01 TANKS

A. Chemical Storage Requirements.

1. Quantity = 2.

2. Volume = 6,500 gallons each

   a. Tank Diameter = 10-ft
   b. Tank Height (to bottom of dome) = 12-ft

3. Chemical

   a. Sodium Bisulfite
      Specific gravity -1.3
      38% trade solution (vol.)

4. Pressure. Atmospheric

5. Temperature.

   a. Sodium Bisulfite. Ambient (70°F minimum)

B. Basic materials shall be as follows:

1. Tanks shall be constructed with an interior corrosion barrier made up of a 20 mil min. thickness inner surface and a 100 mil min. thickness internal layer. The inner surface shall include a polyester surfacing veil, and shall have a 90% resin-to-glass ration. The internal layer shall include chopped Type E glass fiber reinforcement, and the glass content of the combination liner and interior layer shall be 27±5% by weight.

2. The balance of the laminate in the cylindrical shell shall be wound with continuous filament Type E glass fiber, up to the final thickness required for structural loadings. A minimum of two layers of weft unidirectional Type E glass fabric shall be included to make up 10% of the structural layer wall thickness for longitudinal strength.

3. Epoxy-based vinylester resin shall be utilized exclusively throughout the laminate.

4. As per ASTM D 3299, the allowable strain of the vessel wall shall not

exceed 0.0010 in./in. when filled with the specified content, and the vessel wall shall have longitudinal strength of at least 25% of the hoop strength.

5. Resin utilized throughout the laminate shall be confirmed specifically suitable for the intended tank service through laboratory and field testing.

6. Tanks shall have a protective exterior 5 to 10 mil thickness of isophthalic gel coat, containing ultraviolet stabilizer (min U.V. 8) and pigmented in gray.

C. Bracketed flat surfaces shall be provided on each tank for the installation of a nameplate and certification plate.

D. Suitable lifting lugs shall be provided on each tank as required for handling and erection. Provisions shall be made for anchoring each completed tank to the concrete base.

E. Accessories shall be provided on each tank as indicated on the Drawings and as specified herein.

F. Access manholes shall have an inside diameter of at least 21 inches and shall be provided on the top of each tank as indicated on the Drawings. Each manhole shall be flanged, fully gasketed, and furnished with a blind flange having the same properties as the tank construction. Flange drilling and diameter shall confirm to ANSI B16.5, 150 lb.

G. Each tank shall be provided with a nameplate to identify the material stored.

H. A stainless steel certification plate shall be installed below each storage tank nameplate. At least the following data shall be included on the certification plate:

1. Name of tank manufacturer.

2. Date of manufacture.

3. Tank Dimensions

4. Capacity in Gallons.

5. Material of construction

6. Maximum allowable concentration and temperature of the specified chemical solution that can be stored safely.

7. Maximum specific gravity of the material that can be stored.

2.02 ACCESSORIES

A. Each tank shall have the following accessories:

1. Fiberglass access ladders shall be provided with the vertical fiberglass chemical storage tanks at locations as shown. Use proper chemical resistant materials when anchoring to tank dome or sidewall. Safety cages shall be added to ladders as required. Ladders must be designed to OSHA standard 2206: 1910.27. Secure ladders to tank and concrete to allow for tank expansion/contraction due to temperature and loading changes.

2. Provide passive restraints to tie down tank to concrete pad.

3. Sodium Bisulfite tank shall be insulated with 2" of urethane foam. Insulated tanks shall be furnished with an exterior pigmented protective gel coat. Color of the protective gel shall be white to reflect the rays of the sun.

4. Sodium Bisulfite tank shall be heat traced, as well as all Sodium Bisulfite fill lines and suction lines to the chemical handling building. Heat tracing must be capable of maintaining tanks and lines at 70°F.

B. Each tank shall have the following fittings:

1. One (1) two-inch (2") molded-in drain line located at the bottom of the sidewall and having flanged fittings.

2. One (1) two-inch (2") molded-in chemical feed line located at the bottom of the sidewall and having flanged fittings.

3. Site gage & Level Indicator: See Division 13 specifications.

4. One (1) SCH 80 PVC U-Vent overflow/vent (sized by tank manufacturer).

5. One (1) two-inch (2") fill line and supports entering tank through the roof and extending down three quarters (3/4) of the tank height.

6. Nuts, bolts, gaskets, mounting hardware, and all accessories are to

be chemically resistant to Sodium Bisulfite.

2.03 TANK SIGNAGE:

A. National Fire Rating (NFR):

1. Provide signage for the National Fire Rating System (NFR) designation conforming to NFPA 704, for the chemicals contained in the tanks.

2. Provide two (2) signs per tank. Location to be determined in the field by the Construction Manager for proper visibility.

3. Signs to be vinyl, screen printed with UV resistant inks, and a minimum of 18 inches per side. No mechanical fasteners are allowed.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install tanks in accordance with Drawings, approved submittals and the manufacturer's installation instructions.

B. Anchor tanks with stainless steel anchor bolts.

C. Use gaskets chemically resistant to sodium bisulfite to make piping connections.

D. The concrete bases for the tanks shall be constructed in accordance with the provisions of the concrete section and shall be level and smooth to the tolerances permitted by the tank manufacturer. The tanks shall be installed in accordance with the manufacturer's recommendations and to the satisfaction of the Owner and made ready for the installation of piping and other appurtenances as indicated on the Drawings and specified under other Sections. Grouting under the tank, if recommended by the manufacturer, shall be done with nonshrinking grout as specified in the grouting section.

E. Coat the concrete containment basin with the following system as manufactured by Tnemec Company, Inc. (or approved equal). Application and surface preparation shall conform to manufacturer's recommended procedures:

1. Surface preparation: Acid etch to a CSP 1 standard. High pressure

wash minimum 3,500 psi with oscillating tip to remove contaminants. All acid must be removed prior to coating the substrate and must be clean dry and free of all contaminants.

2. Concrete primer: Series 201 Epoxoprime (One (1) coat at 6-8 mils dry thickness).

3. Top coat: Series 282 Tneme-glaze CR (Two (2) coats at 6-8 mils dry thickness each)

F. After completion of installation, the tanks shall be filled with water to the overflow elevation and allowed to stand full for a period of not less than 48 hours.

1. During testing, connections may be plugged by the installation of temporary plugs on the outside of the tank but shall not be blocked or plugged on the inside.

2. All leaks or indications of leaks shall be repaired by the Contractor and made completely watertight.

3. A leaking tank, upon repair, shall be retested to the satisfaction of the Owner.

G. When installation has been completed and all connections have been made, all tank surfaces, interior and exterior, shall be thoroughly cleaned as recommended by the manufacturer and to the satisfaction of the Engineer. Abrasive cleaning agents shall not be used.

3.02 STARTUP AND ACCEPTANCE

A. Start-Up. Beneficial use will not occur until after the start-up activities have been performed and accepted by the City Engineer. Start-up activities include the following:

1. Receipt and acceptance by the City Engineer of draft Operation and Maintenance manuals, including the wiring and ladder diagrams.

2. Installation inspection by City operating, electrical and instrumentation staff followed by any corrective measures required by the Contractor.

3. Satisfactory operation of Chemical Storage Tanks for 7 consecutive days under the City's control. If malfunctions or other operational problems halt the 7-day test period, the Contractor shall make appropriate corrections and restart the 7-day test period.

4. Provide the services of a factory-trained technician for a period of 8 hours to train the City's operating and maintenance personnel. Training session shall be scheduled and coordinated by the Contractor. Furnish the representative for the additional time to correct or supervise correction of any defects of malfunctions.

B. Acceptance. After the start-up operation has been successfully completed, the City will accept the Chemical Storage Tanks when final Operation and Maintenance manuals have been received, reviewed, and accepted by the City. Include ladder logic diagrams and wiring and termination diagrams for both power and instrumentation systems.

END OF SECTION

Section 15310

AERATION PIPING AND FITTINGS

PART 1. GENERAL

1.01 WORK INCLUDES

A. All exposed aeration piping, related accessories specified herein.

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.

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials International (ASTM):

1. ASTM A53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

2. ASTM A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

3. ASTM A276: Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems

B. American National Standards Institute

1. ANSI B1.1: Unified Inch Screw Threads, UN and UNR Thread Form

2. ANSI B16.5: Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard

3. ANSI B18.2: Wrench-Head Bolts and Nuts and Wrench Openings

1.04 SUBMITTALS

A. Shop Drawings and Product Data

1. Comply with the general requirements of Section 01330 – Submittal Procedures and the supplemental requirements below.

2. Show the layout of all air piping on shop drawings using plan and, when necessary, sectional and detail views. Call out the following information:

   a. Pipe Sizes.

   b. Length of all runs and risers.

   c. Valve types, sizes, and locations.

   d. Joint types and locations.

   e. Fitting types, sizes and locations.

   f. Support types and locations.

   g. Elevation of all air release points.

   h. Component details of the aeration equipment showing gaskets, retainer rings, supports, threaded union and/or flanged joints and a purge system.

3. Submit the following product data:

   a. Publications illustrating and describing construction of valves and flexible couplings.

   b. Data sheets describing piping materials used and reference standards.

4. Submit recommendations, if any, regarding changes in pipe sizes and elevations from those shown on Plans.

5. Submit installation instructions for piping assemblies.

B. Operation and Maintenance Data

1. Comply with the requirements in Section 01782 – Operations and Maintenance Data.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Comply with the general requirements in Section 01610 – Basic Product Requirements.

1.06 WARRANTY

A. Warrant all parts to be free from defects in materials and workmanship for a period of one year after installation.

B. Furnish replacement parts to the Owner for any items found to be defective within the one year warranty period.

PART 2. PRODUCTS

2.01 AERATION PIPING

A. Galvanized Steel – Pipe, Fittings and Supports

1. All pipe shall conform to ASTM A 53. Pipe shall be Schedule 40 unless otherwise shown on the Drawings or specified.

2. Fittings shall conform to ASTM A 153, and be equal to Crane standard malleable galvanized iron fittings. Fittings shall be the same weight as the pipe unless otherwise shown on the Drawings or specified.

3. Galvanized 6 inches and larger (flanged) piping to be fitted and fabricated, then galvanized. Where field welds are permitted on galvanized piping, clean and coat welded area with ZRC manufactured by Sealube Company of Wakefield, MA.

B. Joints

1. Joints smaller than 4-inches shall be of the threaded type. Threads shall be neatly cut with sharp tools and the jointing procedure shall conform to best plumbing practice. Before jointing, all scale shall be removed from pipe. After cutting, all pipe shall be reamed. All pipe shall be screwed together with an application of an approved compound applied to all threads, and after a joint has been screwed tight, it shall not be backed off unless the threads are recleaned and new compound applied.

2. Joints 4-inches and larger shall be welded.

   a. All welds shall be sound and free from embedded scale or slag, shall have tensile strength across the weld not less than that of the thinner of the connected sections, and shall be watertight. All field welds shall comply with AWWA C206.

   b. Use butt welds for fabrication of bends and other specials. Use fillet welds for flange attachment in accordance with AWWA C207.

   c. After installation of pipe, fittings and specials, all unlined or uncoated ends adjacent to welded field joints, including the weld proper, shall be cleaned, primed, lined and coated as specified for the pipe adjacent to the weld. Preparation of surfaces to be lined and coated shall be as stipulated for shop application of coal tar primers and enamels except that all foreign matter, including all damaged lining or coating materials, shall be removed by scraping, chipping or brushing and the surfaces cleaned to bright metal free of all rust, slag and scale by means of wire brushing or sandblasting. Entry for application of interior linings to unlined ends shall be from open ends. Pour holes shall not be provided.

   d. Provide drain connections on air piping in any situation where moisture condensation may become a problem; specifically, where the air main lowers then rises its invert elevation without an outlet at the lower elevation.

2.02 ACCESSORIES

A. Expansion Coupling

1. Metal Bellows Expansion Joint designed for 200 degree F temperature differential. Joints shall be Victaulic Depend-O-Lok FxE or equal.

B. Bolts, Studs and Nuts

1. All bolts, studs and nuts shall have American National form right-hand machine cut threads which shall be in conformity with the current ANSI B1.1, "Screw Threads", Coarse Thread Series, unless otherwise specified.

2. Bolt heads and nuts shall be semi-finished and shall be in conformity with ANSI B18.2, "Wrench-Head Bolts and Nuts and

Wrench Openings", Heavy Series, unless otherwise specified. All nuts shall be hexagonal in shape.

3. Anchor bolts, flange bolts, studs and nuts shall be Type 316 stainless steel in conformity with ASTM A276.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install piping in accordance with the plans, approved shop drawings, the manufacturer's installation instructions, and the supplemental requirements below.

B. Layout and install support anchors in accordance with equipment manufacturer's recommendations and anchor setting plan.

3.02 TESTING

A. Test with dry air. Test pressure to hold up to 25 psi with no pressure drop. Determine location of leaks with soapsuds. Hold test pressure for not less than 2 hours.

END OF SECTION

Section 15360

DISINFECTION SYSTEM PIPING AND VALVES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. All piping, valves, and related accessories as specified herein for chlorination system improvements.

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.

1.03 REFERENCED SECTIONS

A. Section 02220 - Facilities Demolition

B. Section 02506 - Polyvinyl Chloride Pipe

1.04 SUBMITTALS

A. Shop Drawings and Product Data

1. Comply with the general requirements of Section 01330—Submittal Procedures and the supplemental requirements below.

2. Show the layout of all piping and valves on shop drawings using plan and, when necessary, sectional and detail views. Call out the following information:

a. Pipe sizes.

b. Lengths of all runs and risers.

c. Valve types, sizes, and locations.

d. Joint types and locations.

e. Fitting types, sizes and locations.

f. Support types and locations.

3. Submit the following product data:

a. Publications illustrating and describing construction of valves and flexible couplings.

b. Data sheets describing piping materials used and reference standards.

4. Submit recommendations, if any, regarding changes in pipe sizes and elevations from those shown on Plans.

5. Submit installation instructions for piping and valve assemblies.

B. Operation and Maintenance Data

1. Comply with the requirements in Section 01782—Operations and Maintenance Data.

C. Manufacturer's Installation and Field Testing Reports

1. Submit as specified in Part 3.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Comply with the general requirements in Section 01610—Basic Product Requirements.

PART 2 PRODUCTS

2.01 MANUFACTURER REQUIREMENTS

A. Obtain all system components specified in this section from a single firm, where applicable, and require that firm to assume responsibility for performing the manufacturer functions specified.

B. Comply with the requirements of Section 01630 – Product Substitution Procedures, when making substitutions.

2.02 CHLORINATION/DECHLORINATION PIPING, VALVES, AND FITTINGS

A. Piping and Fittings: Use Schedule 80 PVC piping and fittings (CPVC for aboveground work) in accordance with Section 02506 – Polyvinyl Chloride Pipe. All metallic fittings must be Type 316 SS.

B. Hose: Provide Teflon reinforced flexible hose.

C. CPVC Check Valves:

1. Check valves shall be manufactured of chlorinated polyvinyl chloride (CPVC) material with Viton seats and deals.

2. CPVC shall be Type 4, Grade 1, in accordance with the requirements of ASTM D1784.

3. Valves shall be true union type or flanged, rated for 150 psi service minimum, and shall be suitable for installation in either the horizontal or vertical plane.

4. Product and Manufacturer: Provide one of the following:

a. Nibco, Incorporated.
b. Hayward Manufacturing Company.
c. ASAHI/America.
d. Or equal.

D. CPVC Ball Valves:

1. Ball valves piping shall be manufactured of chlorinated polyvinyl chloride (CPVC) material with Viton seats and seals.

2. CPVC shall be Type 4, Grade 1, in accordance with the requirements of ASTM D1784.

3. Valves shall be true union type and rated for 225 psi service at 70° F.

4. Product and Manufacturer: Provide one of the following:

a. Nibco, Incorporated.
b. Hayward Manufacturing Company.
c. ASAHI/America.
d. Or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install piping, and ancillary equipment in accordance with the Drawings, approved shop drawings, and manufacturer's installation instructions.

B. Integrate new equipment with existing equipment and controls and leave in proper working condition to the City's satisfaction.

3.02 FIELD QUALITY CONTROL

A. Retain a qualified representative of the manufacturer to perform the following services.

1. Oversee installation of the equipment installation as specified herein.

2. Inspect the completed installation and note deficiencies.

3. Be present and assist the Contractor during start-up, adjusting, and site testing of completed installation.

4. Furnish test forms and procedures for field testing.

5. Instruct Owner personnel in the operations and maintenance of the pre-chlorination system.

6. Prepare manufacturers installation reports and submit within 30 days after completion of field testing. Include the following information:

a. Field testing results

b. Description of installation deficiencies not resolved to the manufacturer's satisfaction.

c. Description of problems-or potential problems.

d. Names of Owner personnel who attended operations and maintenance training sessions.

e. Record copy of materials used for training session including outlined summary of course.

B. Field Testing

1. Demonstrate to the satisfaction of the Owner's representative that the following performance criteria can be met:

   a. New chlorination equipment is compatible and was integrated with existing equipment and controls to the Owner's satisfaction.

2. Provide all test gear required at no extra cost to the City.

3. Follow testing procedures recommended by the manufacturer and approved by the Engineer.

END OF SECTION

Section 15430

PLUMBING SPECIALTIES

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Water service lines, meters, hose bibbs, backflow preventers and sump pumps.

1.2 REFERENCES

A. ANSI/ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.

B. ANSI B36 - Stainless Steel Pipe.

C. AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Type.

D. City of Houston Standards for water main construction and materials.

E. City of Houston Standards for water taps and service lines, 3/4-inch through 2-inch and for meter and sprinkler connections.

1.3 SUBMITTALS

A. Submit under provisions of Section 01330 - Submittals.

B. Manufacturer's Installation Instructions: Indicate assembly and support requirements.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01782 - Operations and Maintenance Data.

B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01610 - Basic Product Requirements.

B. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 P R O D U C T S

2.01 SUMP PUMPS (When stated in the design drawings)

A. Manufacturers:

1. Vanton Pump & Equipment Corp. Model REM 1.5.

2. Goulds Model 3872.

3. Approved equal.

B. Pump Material: Corrosion Resistant Thermoplastic.

C. Seal System: Mechanical.

D. Level Regulator: Automatic ON/OFF Mercury Float Switch Control.

E. Oil Filled Motor: High-Grade Turbine Oil.

F. Discharge: 1-1/2-inch NPT.

G. Discharge Piping: 1-1/2-inch Schedule 40, ANSI B36 stainless steel with ANSI B1.20.1 threaded joints.

H. Capacity: 40 gpm at 12 foot head; 60 gpm at 10 foot head.

I. Basin Cover: Fiberglass grating as detailed on Drawings.

2.02 WATER SERVICE LINES AND METERS

A. Refer to the following City of Houston Standards:

1. Specifications for Water Main Construction and Materials.

2. Specifications for Water Taps and Service Lines, 3/4-Inch through 2-Inch, and for Meter and Sprinkler Connections.

2.03 HOSE BIBBS

A. Manufacturers:

1. Crane.

2. Other acceptable manufacturers offering equivalent products.

a. Stockham

b. . Jenkins.

3. Approved equal.

B. Hose Bibbs: Rough bronze or chromium plated sediment faucets with 3/4-inch flanged female inlets and 3/4-inch hose thread outlets. Provide bibbs with lock shield caps and removable wheel handles.

2.04 BACKFLOW PREVENTERS

A. Manufacturers:

1. Febco, Model 825Y.

2. Other acceptable manufacturers offering equivalent products.

a. Hersey Sparling.

b. Watts Regulator Company.

3. Approved equal.

B. Reduced Pressure Backflow Preventers: Bronze body construction, stainless steel internal parts. Device shall have two independently acting check valves, together with an automatically operating pressure differential relief valve located between the two check valves. A positive shut-off valve shall be near the inlet and outlet sides of the device, and approved test cocks provided on the device. A fourth test cock shall be provided on the upstream side of the inlet shut-off valve. A strainer with 20 mesh stainless steel screen shall be included between the shut-off valve and device.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install water service lines, valves, meters and backflow prevention devices in compliance to City of Houston Standards. Installation shall be by plumbers certified by the City of Houston.

B. Locate water meters and backflow preventer as shown on Drawings.

C. Pipe the discharge of backflow preventer relief valve to drain and prevent water damage.

D. Install backflow preventer in a freeze and vandal-protected enclosure as detailed on Drawings.

E. Install sump pumps in accordance with manufacturer's written instructions.

END OF SECTION

Section 15770

HEAT PUMP

PART 1 - G E N E R A L

1.01 SECTION INCLUDES

A. Packaged heat pump unit, unit controls and wall mounting frame.

B. Stainless Steel Cage, to prevent theft.

1.02 REFERENCES

A. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

B. ARI 210 - Unitary Air Conditioning Equipment.

C. ARI 310 - Packaged Terminal Air Conditioners.

D. ARI 380 - Packaged Terminal Heat Pumps.

1.03 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01300 - Submittals.

B. Indicate electrical service and duct connections on shop drawings or product data.

C. Submit preparation and application procedures for corrosion coating.

D. Submit manufacturer's installation instructions.

1.04 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01730 - Operations and Maintenance Data.

B. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

1.05 WARRANTY

A. Provide five year manufacturer's warranty under provisions of Section 01700 - Contract Closeout.

1.06 SYSTEM DESCRIPTION

A. Single piece, through-the-wall electrically controlled unit using hermetic rotary compressor for cooling and heat pump. Unit shall supply 6,600 to 13,500 BTUH - sensible cooling and 5,800 to 12,200 BTUH heating.

1.07 QUALITY ASSURANCE

A. Unit shall be rated in accordance with ARI Standard 380 or ARI Standard 310 and certified by UL and CSA.

1.08 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled per manufacturer's recommendations.

PART 2 P R O D U C T S

2.01 MANUFACTURERS

A. Carrier Model No. 52SQ

B. Trane Model No. PTHB

C. Singer Model No. KG/EKG

D. Approved equal

2.02 EQUIPMENT

A. Equipment Description: Factory-assembled single piece, heating and cooling unit. Contained within the unit enclosure shall be compressor, coils, fans and fan motor, heating means, controls, all wiring and piping, and a full non-CFC refrigerant charge.

B. Front Panel, Wall Sleeve, and Extensions: Field fabricated wall sleeve, wall sleeve extension and front panel shall be of polymeric material. Front panel to have louvers in front surface.

C. Outdoor Grille: Architectural type, polymeric material. Grille to have louvers in intake surface.

D. Fans and Motor:

1. Evaporator fan shall be a single-inlet squirrel cage blower with a corrosion resistant finish. Fan shall be dynamically balanced.

2. Condenser fan shall be a propeller type with corrosion resistant finish, discharging air out the rear of the unit, and shall be dynamically balanced.

3. Motor shall be totally enclosed, permanently lubricated and multiple speed.

E. Compressor: The compressor shall be fully hermetic with internal and external vibration isolation.

F. Coils: The coils shall have aluminum plate fins mechanically bonded to seamless copper tubes internally enhanced (grooved) with all joints brazed.

G. Refrigerant Components: Piping, compressor and expansion devices shall be included.

H. Controls and Safeties:

I. Controls shall consist of push-button OFF/FAN/HEAT/COOL selector switch, adjustable thermostat with upper and lower limits, VENT OPEN/CLOSE and FAN CYCLE switches. Additional controls for heat pumps include outdoor coil defrost thermostat and adjustable outdoor temperature thermostat.

J. Safeties shall consist of automatic reset over-temperature and over-current protection for compressor; inherent, automatic reset, over-temperature protection for fan motor; and two over-temperature protectors for heater.

K. Operating Characteristics: Unit shall be capable of starting and running at 115 degrees F ambient outdoor temperature per maximum load criteria of ARI Standard 210. Compressor with standard controls shall be capable of operation down to 25 degrees F ambient outdoor temperature for heat pump and 55 degrees F ambient outdoor temperature for cooling.

L. Electrical Requirements: 230/208 volt shall be pre-wired with one plug to use with appropriate wall receptacle as specified on unit nameplate. Receptacle should be no more than two feet from edge of unit.

M. Corrosion Protection:

N. Provide air dried VR500 Heresite Phenolic on unit casing, evaporator and condenser coils and refrigerant tubing.

O. Thoroughly clean surfaces before applying protective coating.

P. Apply 3 mils thick coating on coils, fins and refrigerant tubing and 7 mils thick on unit casing.

Q. Corrosion protection shall be as applied by South-Port Systems, Inc., or approved equal.

R. Accessories: Provide standard non-electrical type subbase, universal drain kit, indoor trim strip and one-piece cleanable air filter with metal frame.

S. Outdoor Stainless Steel cage, to prevent theft, per Structural Drawings..

PART 3 E X E C U T I O N

3.01 EXAMINATION

T. Verify that building wall is ready to receive work and opening dimensions are as indicated on shop drawings.

U. Verify that proper power supply is available.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

END OF SECTION

Section 15782

PACKAGED, OUTDOOR, HEATING AND COOLING AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes cooling and heating rooftop Constant Volume Packaged DX air conditioning units.

1.3 DEFINITIONS

A. DDC: Direct-digital controls.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, and location and size of each field connection. Prepare the following by or under the supervision of a qualified professional engineer:

1. Design Calculations: For selecting and designing restrained vibration isolation roof-curb rails.
2. Mounting Details: For securing and flashing roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
3. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Rooftop replacement-air units to roof-curb mounting details drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Size and location of rooftop replacement-air unit mounting rails and anchor points and methods for anchoring units to roof curb.
2. Required roof penetrations for ducts, pipes, and electrical raceways, including size and location of each penetration.

D. Startup service reports.

E. Operation and Maintenance Data: For rooftop replacement-air units to include in emergency, operation, and maintenance manuals.

F. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of rooftop replacement-air units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2009, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IESNA 90.1-2009 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2009, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 COORDINATION

A. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

B. Coordinate size, location, and installation of rooftop replacement-air unit manufacturer's roof curbs and equipment supports with roof Installer.

1. Coordinate installation of restrained vibration isolation roof-curb rails, which are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components listed below that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.

2. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than 10 years from date of Substantial Completion.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: One set sets] for each belt-driven fan.

2. Filters: One set for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Trane.

2. York.

3. Daikin.

4. Carrier.

2.2 CONFIGURATION

A. Each unit shall be specifically designed for outdoor rooftop application and include a weatherproof cabinet. Each unit shall be completely factory assembled

and shipped in one piece. Packaged units shall be shipped fully charged with Refrigerant 410A and oil.

B. The unit shall undergo a complete factory run test prior to shipment. The factory test shall include final balancing of the supply fan assemblies, a refrigeration circuit run test, a unit control system operations checkout, a unit refrigerant leak test and a final unit inspection.

C. All units shall have decals and tags to indicate caution areas and aid unit service. Unit nameplates shall be fixed to the main control panel door. Electrical wiring diagrams shall be attached to the control panels. Installation, operating and maintenance bulletins and start-up forms shall be supplied with each unit.

2.3 CABINET

A. Construction: Casing construction shall be minimum 18 guage galvanized steel, having corrosion protection coating, and exterior finish. Casings shall have removable panels or access doors for inspection and access to internal parts, a minimum of 2" inch thick thermal insulation coated to meet IAQ requirements, knockouts for electrical and piping connections and an exterior condensate drain connection and lifting lugs.

B. Exterior Casing: Galvanized steel with baked-enamel paint finish with lifting lugs and knockouts for electrical and piping connections. Paint finish to include a base primer with a high quality, polyester resin topcoat of factory standard color. Finished panel surfaces to withstand a minimum 750-hour salt spray test in accordance with ASTM B117 standard for salt spray resistance.

C. Base Rails: Galvanized steel rails for mounting on roof curb.

D. Service Doors: Hinged access doors with neoprene gaskets.

E. Internal Insulation: Fibrous-glass duct lining complying with ASTM C 1071, Type II.

1. Thickness: 2 inches close cell Engineered Polymer Foam.
2. Insulation Adhesive: Comply with ASTM C 916, Type I.
3. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to casing without damaging liner and without causing air leakage when applied as recommended by manufacturer.

F. Condensate Drain Pans: Formed sections of stainless steel designed for self-drainage. Fabricate pans and drain connection to comply with ASHRAE 62.1-2009. The drain pan must be easily accessible for cleaning, must slope to a single drain connection and permit no standing water. The drain pan shall extend under the complete coil section, including coil headers, access and plenum sections between multiple coils, and shall be rigid and watertight with threaded pipe drain connections on one side of pan at low point of pan. Drain pan shall be of the double insulated type with a 304 stainless steel inner pan and outer pan. Insulation shall be UL Listed and shall be 1" thick high-density fiberglass cemented and vapor sealed between the inner and outer pan, or ½" thick foamed-in-lace closed cell insulation.

G. Roof Curb: Full-perimeter curb of sheet metal, minimum 16 inches high, with wood nailer, neoprene sealing strip, and welded Z-bar flashing.

H. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2009.

2.4 SUPPLY-AIR FAN

A. Fan: Supply fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan blade design shall be a double blade with the airfoil geometry, a backward inclined blade fan wheel design will not be acceptable. The fan wheel shall be Class II construction with aluminum fan blades welded to the back plate and end rim. The supply fan shall be mounted using solid-steel shafts and wheel hubs with mating keyways.

B. All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment. All fan assemblies shall employ solid steel fan shafts. Heavy-duty pillow block type, self-aligning, grease lubricated ball bearings shall be used. Bearings shall be sized to provide L-50 life at 250,000 hours. The entire fan assembly shall be isolated from the fan bulkhead and mounted on 1" spring isolators.

C. Motor: Open drip proof premium efficiency inverter duty motor for VFD applications.

D. Drive: V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly with minimum 1.4 service factor.

E. Mounting: Fan wheel, motor, and drives shall be mounted in fan casing with spring isolators.

2.5 REFRIGERATION SYSTEM

A. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

B. Compressors: Reciprocating or scroll compressors with integral vibration isolators, internal overcurrent and over temperature protection, internal pressure relief, and crankcase heater.

C. Minimum Efficiency: As defined by ASHRAE/IESNA 90.1-2009, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

D. Refrigerant: R-407C or R-410A.

E. Refrigeration System Specialties:

1. Expansion valve with replaceable thermostatic element.
2. Refrigerant dryer.
3. High-pressure switch.
4. Low-pressure switch.
5. Thermostat for coil freeze-up protection during low ambient temperature operation or loss of air.
6. Brass service valves installed in discharge and liquid lines.
7. Operating charge of refrigerant.

F. Capacity Control: Patented, Rawal APR control with zero to 100 percent modulating capacity control using hot-gas bypass. Evaporator coil shall be continuously active for dehumidification.

G. Hot Gas By Pass: Valve, piping and controls shall be included on the refrigerant circuits to allow operation at LOW air flow, avoiding coil frosting and damage to

the compressor. When suction pressure falls below valve adjustable set point, the valve modulates hot gas to the inlet of the evaporator.

H. Refrigerant Coils: Evaporator and condenser coils shall be designed, tested, fabricated, and rated according to ARI 410 and ASHRAE 33. Coils shall be leak tested under water with air at 315 psig.

1. Capacity Reduction: Circuit coils for interleaved control.
2. Tubes: Copper.
3. Fins: Aluminum with minimum fin spacing of 0.071 inch.
4. Fin and Tube Joint: Mechanical bond.
5. Suction and Distributor: Seamless copper tube with brazed joints.
6. *Coating: Phenolic epoxy corrosion-protection coating on both evaporator and condenser coils.*
7. Source Quality Control: Test to 450 psig, and to 300 psig underwater.

I. Condenser Fan: Propeller type, directly driven by motor.

J. Safety Controls:

1. Compressor motor and outside-coil fan motor low ambient lockout.
2. Overcurrent protection for compressor motor and outside-coil fan motors.

2.6 ELECTRIC-RESISTANCE HEATING

A. Electric-Resistance Heating Elements: Coiled resistance wire of 80 percent nickel and 20 percent chromium; surrounded by compacted magnesium oxide powder in tubular-steel sheath; with spiral-wound, copper-plated, steel fins continuously brazed to sheath.

B. Electric-Resistance Heating Elements: Open-coil resistance wire of 80 percent nickel and 20 percent chromium; supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame.

1. Heating Capacity: Low density 35 W per sq. in., factory wired for single-point wiring connection; with time delay for element staging, and overcurrent and overheat protective devices.
2. Safety Controls:
   a. Blower-motor interlock, air-pressure switch.
   b. Quiet mercury contactors.
   c. Time delay between steps.
   d. Integral, non-fused power disconnect switch.

2.7 COOLING COILS

A. The direct expansion (DX) coil section shall be installed in a draw through configuration, upstream of the supply air fan. The coil section shall be complete with a factory piped cooling coil and an ASHRAE 62.1 compliant double sloped drain pan.

B. Provide heavy duty aluminum fins mechanically bonded to internally enhanced, copper tubes Manufacturers do not provide control valves.

C. Direct expansion (DX) cooling coils shall be fabricated of seamless high efficiency copper tubing that is mechanically expanded into high efficiency

aluminum plate fins. Coils shall be a multi-row, staggered tube design with a minimum of 6 rows for maximum dehumidification effect. All units shall have two independent refrigerant circuits and shall use an interlaced coil circuiting that keeps the full coil face active at all load conditions. All coils shall be factory leak tested with high pressure air under water.

D. A positively sloped drain pan shall be provided with the cooling coil. The slope of the drain pan shall be in two directions and comply with ASHRAE Standard 62.1. The drain pan shall have a minimum slope of 1/8" per foot to provide positive draining. The drain pan shall extend beyond the leaving side of the coil. The drain pan construction shall be a stainless steel design. The drain pan shall be connected to a threaded drain connection extending through the unit base. Drain pan shall be removable from the side of the unit without the removal of the cooling coil.

E. Provide a thermostatic expansion valve for each refrigeration circuit. All coils shall be leak tested at the factory to ensure pressure integrity. The evaporator coil is pressure tested to 450 psig.

2.8 CONDENSER SECTION

A. Provide all Aluminum Micro-channel condenser coils. All condenser coils shall be leak tested at the factory to ensure pressure integrity and pressure tested to 650 psig.

B. Provide integral sub-cooling circuit(s) to prevent premature refrigerant flashing and to insure maximum operating efficiency.

C. Provide vertical discharge, direct drive fans with steel blades, and three phase motors. Fans shall be statically balanced. Motors shall be permanently lubricated, with built-in current and thermal overload protection in a weather tight casing.

D. Provide tool-less factory installed corrosion resistant louvered hail/vandalism guards to protect condenser coils from hail or physical damage. Wire-mesh coil guards not acceptable.

E. Condenser fans shall be direct drive, axial type designed for low tip speed and vertical air discharge. Condenser fan rpm shall be 1140 rpm maximum. Fan blades shall be constructed of steel and riveted to a steel center hub. Condenser fan motors shall be heavy-duty, inherently protected, three-phase, non-reversing type with permanently lubricated ball bearing and integral rain shield.

F. Each circuit shall have fan cycling of at least one condenser fan to maintain positive head pressure. An ambient thermostat shall prevent the refrigeration system from operating below 0° F.

G. Condenser coils shall be protected from hail damage as an integral part of the unit design. Hail guards shall be provided on all units with vertical mounted condenser coils.

H. Each unit shall have multiple, heavy-duty scroll compressors. Each compressor shall be complete with gauge ports, crankcase heater, sight-glass, anti-slug protection, motor overload protection and a time delay to prevent short cycling and simultaneous starting of compressors following a power failure. Compressors shall be isolated with resilient rubber isolators to decrease noise transmission.

I. Each unit shall have two independent refrigeration circuits. Each circuit shall be complete with a low pressure control, filter-drier, liquid moisture indicator/sight-glass, thermal expansion valve, and a manual reset high pressure safety switch. The thermal expansion valve shall be capable of modulation from 100% to 25% of its rated capacity. Sight-glasses shall be accessible for viewing without disrupting unit operation. Each circuit shall be dehydrated and factory charged with Refrigerant 410A and oil.

J. Each refrigeration circuit shall have isolation ball valves on the suction and discharge sides of the compressor.

2.9 OUTDOOR-AIR INTAKE AND DAMPERS

A. Dampers: Leakage rate, according to AMCA 500, shall not exceed 2 percent of air quantity at face velocity of 2000 fpm through damper and pressure differential of 4-inch wg.

B. Damper Operators: Electric.

C. Mixing Boxes: Parallel-blade, galvanized-steel dampers mechanically fastened to steel operating rod inside cabinet. Connect operating rods with common interconnecting linkages so dampers operate simultaneously.

D. Outdoor-Air Intake Hoods: Galvanized steel, with bird screen complying with ASHRAE 62.1-2004 and finish to match cabinet.

2.10 FILTERS

A. Comply with NFPA 90A.

B. Pre-Filters: 2" thick MERV 8 disposable filters.

C. Panel Filters: 12-inch thick, factory-fabricated, flat-panel-type, disposable air filters with holding frames, with a minimum efficiency MERV 14 according to ASHRAE 52.76 and 90-95 percent average arrestance according to ASHRAE 52.1.

1. Media: Interlaced glass fibers sprayed with nonflammable adhesive.

2. Frame: Galvanized steel.

2.11 ELECTRICAL

A. Unit wiring shall comply with NEC requirements and with all applicable UL standards. All electrical components shall be UL recognized where applicable. All wiring and electrical components provided with the unit shall be number and color-coded and labeled according to the electrical diagram provided for easy identification. The unit shall be provided with a factory wired weatherproof control panel. Unit shall have a single point power terminal block for main power connection. A terminal board shall be provided for low voltage control wiring. Branch short circuit protection, 115-volt control circuit transformer and fuse, system switches, and a high temperature sensor shall also be provided with the unit. Each compressor and condenser fan motor shall be furnished with contactors and inherent thermal overload protection. Supply fan motors shall have contactors and external overload protection. Knockouts shall be provided in the bottom of the main control panels for field wiring entrance. A GFI receptacle shall be unit mounted. The receptacle shall be powered by a factory installed and wired 120V, 15 amp power supply. The power supply shall be wired to the line side of the unit's main disconnect, so the receptacle is powered when the main unit disconnect is off. This option shall include a GFI receptacle, 2.0 KVA

transformers and a branch circuit disconnect. The electrical circuit shall be complete with primary and secondary overload protection.

B. A single non-fused disconnect switch shall be provided for disconnecting electrical power at the unit. Disconnect switches shall be mounted internally to the control panel and operated by an externally mounted handle.

2.12 CONTROLS

A. General: Microprocessor controls shall be provided for all 24 volt control functions. The resident control algorithms shall make all heating, cooling and/or ventilating decisions in response to electronic signals from sensors measuring indoor and outdoor temperatures. The control algorithm maintains accurate temperature control, minimizes drift from set point and provides better building comfort. A centralized microprocessor shall provide anti-short cycle timing and time delay between compressors to provide a higher level of machine protection.

B. The stand-alone DDC controllers shall not be dependent on communications with any on-site or remote PC or master control panel for proper unit operation. The microprocessor shall maintain existing set points and operate standalone if the unit loses either direct connect or network communications. The microprocessor memory shall be protected from voltage fluctuations as well as any extended power failures. All factory and user set schedules and control points shall be maintained in nonvolatile memory. No settings shall be lost, even during extended power shutdowns.

C. The DDC control system shall permit starting and stopping of the unit locally or remotely. The control system shall be capable of providing a remote alarm indication. The unit control system shall provide for outside air damper actuation, emergency shutdown, remote heat enable/disable, remote cool enable/disable, heat indication, cool indication, and fan operation.

D. All digital inputs and outputs shall be protected against damage from transients or incorrect voltages. All field wiring shall be terminated at a separate, clearly marked terminal strip.

E. The DDC controller shall have a built-in time schedule. The schedule shall be programmable from the unit keypad interface. The schedule shall be maintained in nonvolatile memory to insure that it is not lost during a power failure. There shall be one start/stop per day and a separate holiday schedule. The controller shall accept up to sixteen holidays each with up to a 5-day duration. Each unit shall also have the ability to accept a time schedule via BAS network communications.

F. The keypad interface shall allow convenient navigation and access to all control functions. The unit keypad/display character format shall be 4 lines x 20 characters. All control settings shall be password protected against unauthorized changes. For ease of service, the display format shall be English language readout. Coded formats with look-up tables will not be accepted.

G. The following set points shall be accessible in the unit control panel:

- Supply air cooling set point,
- Morning warm up set point,
- Reset set point,
- Reset amount,

- Static pressure set point,
- Static pressure dead band.

H. Factory-wire connection for controls' power supply.

I. Control devices, including sensors, transmitters, relays, switches, thermostats, humidistats, detectors, operators, actuators, and valves, shall be manufacturer's standard items to accomplish indicated control functions.

J. Unit Controls: Solid-state control board and components with field-adjustable control parameters.

K. Supply-Fan Control: Units shall be electrically interlocked with corresponding exhaust fans, to operate continuously when exhaust fans are running. Time clock shall switch operation from occupied to unoccupied. Night setback thermostat shall cycle fan during unoccupied periods to maintain space temperature.

1. Timer: Seven-day electronic clock.
2. Electrically interlock kitchen hood fire-extinguishing system to de-energize replacement-air unit when fire-extinguishing system discharges.

L. Remote Mounted Status Panel:

1. Cooling/Off/Heating Controls: Control operational mode.
2. Damper Position: Indicates position of outdoor-air dampers in terms of percentage of outdoor air.
3. The user interaction with the display shall provide the following information as a minimum:
   a. Filter dirty.
   b. Fan operating.
   c. Cooling operating.
   d. Heating operating.
   e. Return air temperature
   f. Discharge air temperature
   g. Control temperature (Changeover)
   h. Active alarms w/time and date
   i. Previous alarms with time and date

M. Refrigeration System Controls:

1. Unit-mounted enthalpy controller shall lock out refrigerant system when outdoor-air enthalpy is less than 28 Btu/lb of dry air or outdoor-air temperature is less than 50 deg F.
2. Outdoor-air sensor de-energizes dehumidifier operation when outdoor-air temperature is less than 50 deg F.
3. Wall-mounting, relative-humidity sensor energizes dehumidifier operation when relative humidity is more than 60 percent.

N. Electric-Resistance Heating Controls: Wall-mounting thermostat controls SCR.

O. Integral Smoke Alarm: Smoke detector installed in supply and return air.

P. DDC Temperature Control: Stand-alone control module for link between unit controls and DDC temperature-control system. Control module shall be compatible with temperature-control system specified in Division 23 Section "Instrumentation and Control for HVAC." Links shall include the following:

1. Start/stop interface relay, and relay to notify DDC temperature-control system alarm condition.
2. Hardware interface or additional sensors for the following:
   a. Room temperature.
   b. Discharge air temperature.
   c. Refrigeration system operating.
   d. Furnace operating.

2.13 MOTORS

A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation of rooftop replacement-air units.

B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

C. Examine roof curbs and equipment supports for suitable conditions where rooftop replacement-air units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Manufacturer shall furnish a factory trained service engineer without additional charge to start the unit(s). Package rooftop unitary manufacturers shall maintain service capabilities no more than 25 miles from the jobsite.

F. The manufacturer shall furnish complete submittal wiring diagrams of the package unit as applicable for field maintenance and service.

3.2 INSTALLATION

A. Install roof curb on roof structure, according to "Raised Curb Detail for Rooftop Units and Ducts. Install and secure rooftop replacement-air units on curbs and coordinate roof penetrations and flashing with roof construction.

B. Install restrained vibration isolation roof-curb rails on roof structure according to ARI Guideline B. Install and secure rooftop replacement-air units on rails and coordinate roof penetrations and flashing with roof construction.

C. Install wall- and duct-mounting sensors, thermostats, and humidistats furnished by manufacturers for field installation. Install control wiring and make final connections to control devices and unit control panel.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Duct Connections: Duct installation requirements are specified in Division 23 Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to rooftop replacement-air units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Air Duct Accessories."

C. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.

D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

1. Inspect for visible damage to furnace combustion chamber.
2. Inspect for visible damage to compressor, air-cooled outside coil, and fans.
3. Inspect casing insulation for integrity, moisture content, and adhesion.
4. Verify that clearances have been provided for servicing.
5. Verify that controls are connected and operable.
6. Verify that filters are installed.
7. Clean outside coil and inspect for construction debris.
8. Clean furnace flue and inspect for construction debris.
9. Inspect operation of power vents.
10. Purge gas line.
11. Inspect and adjust vibration isolators and seismic restraints.
12. Verify bearing lubrication.
13. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
14. Adjust fan belts to proper alignment and tension.
15. Start unit.
16. Start refrigeration system when outdoor-air temperature is within normal operating limits.
17. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
18. Operate unit for run-in period.
19. Calibrate thermostats.
20. Adjust and inspect high-temperature limits.
21. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
22. Start refrigeration system and measure and record the following:

a. Coil leaving-air, dry- and wet-bulb temperatures.

b. Coil entering-air, dry- and wet-bulb temperatures.

c. Outdoor-air, dry-bulb temperature.

d. Outdoor-air-coil, discharge-air, dry-bulb temperature.

23. Verify operational sequence of controls.

24. Measure and record the following airflows. Plot fan volumes on fan curve.

a. Supply-air volume.

b. Return-air volume.

c. Outdoor-air intake volume.

25. Simulate maximum cooling demand and inspect the following:

a. Compressor refrigerant suction and hot-gas pressures.

b. Short circuiting of air through outside coil or from outside coil to outdoor-air intake.

26. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

a. High-limit heat exchanger.

b. Alarms.

C. After startup and performance testing, change filters, verify bearing lubrication, and adjust belt tension.

D. Remove and replace components that do not pass tests and inspections and retest as specified above.

E. Prepare written report of the results of startup services.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain rooftop replacement-air units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

Section 15870

POWER VENTILATORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following types of power ventilators:

1. Roof- and wall-mounted exhausters.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 7 Section "Manufactured Metal Roof Panels" for roof curbs and equipment supports.
2. Division 15 Section "Testing, Adjusting, and Balancing" for air- handling systems testing, adjusting, and balancing requirements and procedures.

C. Products furnished but not installed under this Section include roof curbs for roof-mounted exhaust fans.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:

1. Product data for selected models, including specialties, accessories, and the following:

a. Certified fan performance curves with system operating conditions indicated.
b. Certified fan sound power ratings.
c. Motor ratings and electrical characteristics plus motor and fan accessories.
d. Materials gages and finishes, including color charts.
e. Dampers, including housings, linkages, and operators.

2. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.
3. Coordination drawings, in accordance with Division 15 Section "Basic Mechanical Requirements," for roof penetration requirements and for reflected ceiling plans drawn accurately to scale and coordinating penetrations and units mounted above ceiling. Show the following:

a. Roof framing and support members relative to duct penetrations.
b. Ceiling suspension members.
c. Method of attaching hangers to building structure.
d. Size and location of initial access modules for acoustical tile.
e. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.

4. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field- installed wiring.
5. Product certificates, signed by manufacturers of air-handling units, certifying that their products comply with specified requirements.
6. Maintenance data for air-handling units, for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 15 Section "Basic Mechanical Requirements."

1.04 QUALITY ASSURANCE

A. UL Compliance: Fans shall be designed, manufactured, and tested in accordance with UL 705 "Power Ventilators."

B. UL Compliance: Fans and components shall be UL listed and labeled.

C. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

D. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

E. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

1.05 DELIVERY, STORAGE, AND HANDLING

A. Lift and support units with the manufacturer's designated lifting or supporting points.

B. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.

C. Deliver fan units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.06 SEQUENCING AND SCHEDULING

A. Coordinate the installation of roof curbs, equipment supports, and roof penetrations specified in Division 7.

B. Coordinate the size and location of structural steel support members.

1.07 EXTRA MATERIALS

A. Furnish one additional complete set of belts for each belt-driven fan.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include but are not limited to, the following:

1. Centrifugal Roof Ventilators:

a. Twin City, Inc.
b. Cook (Loren) Co.
c. Greenheck Fan Corp.

2.02 SOURCE QUALITY CONTROL

A. Testing Requirements: The following factory tests are required:

1. Sound Power Level Ratings: Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating." Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.
2. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.

2.03 FANS, GENERAL

A. General: Provide fans that are factory fabricated and assembled, factory tested, and factory finished with indicated capacities and characteristics.

B. Fans and Shafts: Statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.

1. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fan's class.

C. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

1. Service Factor: 1.4.

D. Belts: Oil-resistant, non-sparking, and non-static.
E. Motors and Fan Wheel Pulleys: Adjustable pitch for use with motors through 15 HP; fixed pitch for use with motors larger than 15 HP. Select pulley so that pitch adjustment is at the middle of the adjustment range at fan design conditions.

1. Belt Guards: Provide steel belt guards for motors mounted on the outside of the fan cabinet.

F. Shaft Bearings: Provide type indicated, having a median life "Rating Life" (AFBMA (L(50)) of 200,000, calculated in accordance with AFBMA Standard 9 for ball bearings and AFBMA Standard 11 for roller bearings.

G. Factory Finish: The following finishes are required:

1. Sheet Metal Parts: Prime coating prior to final assembly.
2. Exterior Surfaces: Baked-enamel finish coat after assembly.

2.04 CENTRIFUGAL ROOF VENTILATORS

A. General Description: Belt-driven or direct-drive as indicated, centrifugal consisting of housing, wheel, fan shaft, bearings, motor and safety non-fused disconnect switch, drive assembly, curb base, and accessories.

B. Housing: Heavy-gage, removable, spun-aluminum, up-blast or dome top and outlet baffle; square, one-piece, hinged aluminum base with venturi inlet cone.

1. Fan Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.

C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.

D. Belt-Driven Drive Assembly: Resiliently mounted to the housing, with the following features:

1. Pulleys: Cast-iron, adjustable-pitch.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
4. Fan and motor isolated from exhaust air stream.

E. Accessories: The following items are required as indicated:

1. Disconnect Switch: Non-fusible type, with thermal overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.
2. Bird Screens: Removable 1/2" mesh, 16-gage, aluminum or brass wire.
3. Dampers: Counterbalanced, parallel-blade, back draft dampers mounted in curb base, factory set to close when fan stops.
4. Dampers: Motor-operated, parallel-blade, volume control dampers mounted in curb base.
   a. Blades: Die-formed sheet aluminum.
   b. Frame: Extruded aluminum, with waterproof, felt blade seals.
   c. Linkage: Nonferrous metals, connecting blades to counter weight or operator.
   d. Operators: Manufacturer's standard electric motor.
   e. Operators: Manufacturer's standard pneumatic motor.

5. Roof Curbs: Prefabricated, heavy-gage, galvanized steel; mitered and welded corners; 2-inch-thick, rigid, fiberglass insulation adhered to inside walls; built-in cant and mounting flange for flat roof decks; and 2″ wood nailer. Size as required to suit roof opening and fan base.

    a. Overall Height: 14 inches, unless noted otherwise.

2.05 MOTORS

A. Torque Characteristics: Sufficient to accelerate the driven loads satisfactorily.

B. Motor Sizes: Minimum sizes and electrical characteristics as indicated. If not indicated, large enough so that the driven load will not require the motor to operate in the service factor range.

C. Temperature Rating: 50 deg C maximum temperature rise at 40 deg C ambient for continuous duty at full load (Class A Insulation).

D. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.

E. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design B. Provide permanent-split capacitor classification motors for shaft-mounted fans and capacitor start classification for belted fans.

1. Bases: Adjustable.
2. Bearings: The following features are required:

    a. Ball or roller bearings with inner and outer shaft seals.
    b. Grease lubricated.
    c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
3. Enclosure Type: The following features are required:

    a. Open drip-proof motors where satisfactorily housed or remotely located during operation.
    b. Guarded drip-proof motors where exposed to contact by employees or building occupants.
4. Overload protection: Built-in, automatic reset, thermal overload protection.
5. Noise rating: Quiet.
6. Efficiency: Energy-efficient motors shall have a minimum efficiency as scheduled in accordance with IEEE Standard 112, Test Method B. If efficiency not specified, motors shall have a higher efficiency than "average standard industry motors" in accordance with IEEE Standard 112, Test Method B.
7. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, and special features.

F. Starters, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 16.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, roof curbs, equipment supports, and other conditions affecting performance of fans.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Install fans level and plumb, in accordance with manufacturer's written instructions. Support units as described below, using the vibration control devices indicated. Vibration control devices are specified in Division 15 Section "Vibration Controls."

1. Secure roof-mounted fans to roof curbs with cadmium-plated hardware.

a. Installation of roof curbs is specified in Division 7.

B. Arrange installation of units to provide access space around air- handling units for service and maintenance.

3.03 CONNECTIONS

A. Duct installations and connections are specified in other Division 15 sections. Make final duct connections with flexible connections.

B. Electrical Connections: The following requirements apply:

1. Electrical power wiring is specified in Division 16.
2. Temperature control wiring and interlock wiring are specified in Division 15 Section "DDC Temperature Control Systems."
3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Inspection: Arrange and pay for a factory- authorized service representative to perform the following:

1. Inspect the field assembly of components and installation of fans including ductwork and electrical connections.
2. Prepare a written report on findings and recommended corrective actions.

3.05 ADJUSTING, CLEANING, AND PROTECTING

A. Adjust damper linkages for proper damper operation.

B. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

3.06 COMMISSIONING

A. Final Checks before Start-Up: Perform the following operations and checks before start-up:

1. Remove shipping blocking and bracing.
2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
6. Verify manual and automatic volume control and that fire and smoke dampers in connected ductwork systems are in the full-open position.
7. Disable automatic temperature control operators.

B. Starting procedures for fans:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.

   a. Replace fan and motor pulleys as required to achieve design conditions.

2. Measure and record motor electrical values for voltage and amperage.

C. Shut unit down and reconnect automatic temperature control operators.

D. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for procedures for air-handling-system testing, adjusting, and balancing.

3.07 DEMONSTRATION

A. Demonstration Services: Arrange and pay for a factory-authorized service representative to train City's maintenance personnel on the following:

1. Procedures and schedules related to start-up and shutdown, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
2. Familiarization with contents of Operating and Maintenance Manuals specified in Division 1 Section "Project Closeout" and Division 15 Section "Basic Mechanical Requirements."

B. Schedule training with at least 7 days' advance notice.

END OF SECTION

Section 15890

SHEET METAL DUCT WORK

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Low pressure duct.

B. Duct pressure testing.

1.02 RELATED WORK

A. Section 15010 – Basic Mechanical Requirements.

B. Section 15250 - Mechanical Insulation.

C. Section 15990 - Testing, Adjusting and Balancing.

1.03 REFERENCES

A. ASHRAE - Handbook 1993 Fundamentals; Chapter 32 - Duct Design.

B. ASHRAE - Handbook 1992 HVAC Systems and Equipment; Chapter 16 - Duct Construction.

C. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.

D. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

E. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.

F. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

G. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.

H. SMACNA - Low Pressure Duct Construction Standards.

I. UL 181 - Factory-Made Air Ducts and Connectors.

J. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

K. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooling Equipment.

1.04 DEFINITIONS

A. Duct sizes shown are net inside clear dimensions. Duct shall be externally insulated. Where offsets or transitions are required, the duct shall maintain the equivalent diameter based on hydraulic diameter and rectangular duct size for equal flow, velocity and pressure drop as calculated by Huebscher formulae #30 and/or 31 in ASHRAE Duct Design Fundamentals Handbook and Figure 5 Friction Chart for round duct.

B. Low Pressure: Three pressure classifications: 1/2" WG positive or negative static pressure and velocities less than 2,000 fpm; 1" WG positive or negative static pressure and velocities less than 2,500 fpm, and 2" WG positive or negative static pressure and velocities less than 2,500 fpm. All ducts shall be sealed as specified, independent of SMACNA pressure class.

1.05 SUBMITTALS

A. Refer to Section 15010 for additional coordination drawings, duct shop drawings and product data and conform to provisions of Division 1.

B. Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work.

C. The Contract Documents are schematic in nature and are to be used only for design intent. The Contractor shall prepare coordination and sheet metal shop drawings, fully detailed and drawn to scale, indicating all architectural partitions, structural conditions, all plumbing pipe and light fixtures coordination, and all offsets and transitions as required to permit the duct to fit in the space allocated and built and show all bottom of duct elevations. All duct revisions required as a result of the Contractor not preparing fully detailed shop drawings will be performed at no additional cost to the City.

D. Sheet metal ductwork "shop" drawings shall be made after actual job measurements are obtained. Sheet metal ductwork drawings shall indicate the coordination of the Contractor with sprinkler piping and other mechanical and electrical services installed under Division 15 and 16. These "Shop Drawings" shall be submitted for review as specified in Section 15010. Ductwork joint, connection, ductwork "shop" drawing submittal. Details shall be indexed and index number shall appear on ductwork "shop drawing" at its point of use.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 1.

B. Store and protect products under provisions of Division 1.

C. Protect duct from contamination by dirt, dust or rain by covering openings; do not store duct in open on site.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Armco - "Zinc-Grip".

B. Flex-master.

C. Substitutions: Under provisions of Division 1.

2.02 MATERIALS

A. General: Non-combustible and conforming to requirements for Class 1 air duct materials, or UL 181.

B. Steel Ducts: ASTM A525 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25 oz per sq. ft. for each side in conformance with ASTM A90. Minimum gauge for all duct shall be 26 gauge (0.019").

C. Flexible Round Ducts:

1. Low pressure: Interlocking spiral wire of galvanized steel or aluminum construction with flexible trilaminate inner fabric rated to 6 inches WG positive and 1 inches WG negative for low pressure ducts, insulated with 1" thick fiberglass insulation and reinforced metalized outer vapor barrier; Flexmaster type 5-m insulated or equal, NFPA 90A and U.L. 181 class 1 listed;

D. Stainless Steel Ducts: ASTM A167, Type 304.

E. Fasteners: Rivets, bolts, or sheet metal screws.

F. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

G. Hanger Rod: Steel, galvanized; continuously threaded.

2.03 LOW PRESSURE DUCT

A. Fabricate and support in accordance with SMACNA Low Pressure Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated, except that all duct joints and longitudinal seams for all SMACNA classes of duct shall be sealed with U.L. Listed Hard cast DT-tape and sealant FTA-20 and must meet with the IEC-2010 requirements.

B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by approved shop drawings.

C. Construct tees, offsets, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide single thickness turning vanes for duct velocities up to 1500 fpm and for higher duct velocities, provide airfoil turning vanes.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever

possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

E. Use crimp joints with bead for joining round duct sizes 6 inch smaller with crimp in direction of air flow.

F. Use double nuts and lock washers on threaded rod supports.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Obtain manufacturer's inspection and acceptance of fabrication and installation of duct at beginning of installation.

B. Provide openings in duct where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal well and closure device to ensure against air leakage. Where openings are provided in insulated duct, install insulation material inside a metal ring.

C. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

D. Connect fan coil units to low pressure OA intake ducts with short length of flexible duct. Hold in place with corrosion resistant clamp or strap.

E. Connect air distribution devices to low pressure ducts with 6 feet maximum, 4 feet minimum, length of flexible duct. Hold in place with corrosion resistant strap or clamp.

F. During construction provide temporary closures of metal or taped polyethylene on open duct to prevent construction dust from entering duct system.

G. The interior surface of all duct shall be smooth. No sheet metal parts, tabs, angles, or anything else may project into the ducts for any reason, except as specified to be so. All seams and joints shall be external.

H. Where ducts pass through floors, provide structural angles for duct support. Where ducts pass through walls in exposed areas, install suitable sheet metal escutcheons.

I. All angles shall be carried around all four sides of the duct or group of ducts. Angles shall overlap corners and be welded or riveted.

J. All ducts shall be fabricated in a manner to prevent the seams or joints being cut for the installation of air distribution devices.

K. All rectangular duct located exposed on roof shall have top horizontal surface "crowned or sloped" to prevent water from ponding. Ref: Insulation for additional requirements.

L. Provide all new round flex duct minimum length 4'-0", maximum length 6'-0", for extension use round sheet metal duct externally insulated with 1-1/2" thick, 0.75 p.c.f. Density fiberglass insulation with "F-S-K-L" (foil-skrim-kraft-laminate) vapor barrier.

M. Provide round spin-in fittings with locking quadrant butterfly volume dampers for all round duct connections to rectangular ducts. Spin-in and flex duct shall be same size as air distribution device neck diameter. Secure flex duct to spin-in and air distribution device neck with stainless steel worm gear clamps and seal vapor barrier. Suspend flex duct from structure above; round and flexible duct shall be as detailed by SMACNA in section iii round, oval and flexible duct. Round duct seams shall be type RL-1 spiral seam or seam type RL-5 grooved seam flat pipe lock constructed in accordance with Smacna figure 3-1; flexible duct supports shall be constructed and installed in accordance with Smacna figures 3-9 and 3-10.

N. Duct dimensions shown are net clear Internal Dimensions; allowance must be made for 1-1/2" thick external insulation as specified; all rectangular and round supply air, return air, outside air and exhaust air duct shall be galvanized sheet metal.

O. Provide duct test wells at all locations required for testing, adjusting balancing, and temperature measuring.

P. All ducts shall be mounted tight to underside of structure and shall be top level with bottom and side transitions only, except that allowance shall be made for duct to be externally insulated, which shall be mounted 3" below structural beams and joists or other obstruction to allow installation of the external duct insulation. Some ducts may require the use of "ESS"-drive joints or flat seams to allow crossing of duct or installation of other equipment or piping. Raise existing duct where required to allow installation of other duct or equipment; use 45 degree radius elbows (center line radius = 1.5 times duct height) to offset.

Q. Typical supply, return and exhaust duct shall be as detailed by SMACNA in Section II fittings and other construction. All 90 degree elbows shall be constructed in accordance with SMACNA figure 2-2, style RE-1 radius elbow (center line radius = 1.5 times duct height or width), space permitting or style RE-2 square throat with turning vanes (provide duct access panel up stream of turning vanes for cleaning purposes).

R. Turning vanes shall be installed in accordance with SMACNA figure 2.3; single wall type with trailing edge for duct velocities up to 1500 fpm and double wall turning vanes above 1500 fpm duct velocity.

S. Parallel flow branches shall be constructed in accordance with figure 2-7. Rectangular duct branch connections shall be expanded 45 degree entry type and round branch duct connections shall be spin-in type in accordance with SMACNA figure 2-8 and offsets and transitions shall be in accordance with SMACNA figure 2-9.

T. Duct access doors shall be constructed in accordance with SMACNA figure 2-12

and shall have a frame type 3, position 3 hinge with a type 2 locking handle; single and multi-blade volume dampers shall be in accordance with SMACNA figures 2-14 and 2-15 respectively and shall have operator extensions when provided on externally insulated ducts; air distribution device connections shall be in accordance with SMACNA figure 2-16 and ceiling diffuser branch ducts shall be in accordance with SMACNA figure 2-17.

U. Rectangular duct connections at all air moving equipment shall be flexible neoprene fabric and installed in accordance with SMACNA figure 2-19.

V. Seal all non-welded duct joints of all SMACNA pressure classes with Hard-cast DT-cotton tape and duct sealer FTA-20 for indoor duct and duct sealer FTA-50 for exterior duct.

3.02 DUCT APPLICATION SCHEDULE

AIR SYSTEM	MATERIAL
Low Pressure Supply or return	Galvanized Steel
Return and Relief	Galvanized Steel
General Exhaust	Galvanized Steel
Outside Air Intake	Galvanized Steel

3.03 DUCT HANGERS AND SUPPORTS

A. All ducts shall be properly suspended or supported from the building structure. Hangers shall be galvanized steel straps or hot-dipped galvanized rod with threads pointed after installation. Strap hanger shall be attached to the bottom of the duct. The spacing, size and installation of hangers shall be in accordance with the recommendations of SMACNA, latest edition.

B. All duct risers shall be supported by angles or channels secured to the sides of the ducts at each floor with sheet metal screws or rivets. The floor supports may also be secured to ducts by rods, angles or flat bar to the duct joint or reinforcing. Miscellaneous steel supports for duct risers shall be provided under this Division.

3.04 ADJUSTING AND CLEANING

A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

END OF SECTION

Section 15910

DUCT ACCESSORIES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Volume control dampers.

B. Round Duct Taps.

C. Fire dampers.

D. Backdraft dampers.

E. Air turning devices.

F. Flexible duct connections.

G. Duct access doors.

H. Duct test holes.

1.02 RELATED WORK

A. Section 15890 – Sheet metal Duct.

1.03 REFERENCES

A. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

B. SMACNA - Low Pressure Duct Construction Standards.

C. UL 33 - Heat Responsive Links for Fire-Protection Service.

D. UL 555 and 555S - Fire Dampers and Ceiling Dampers.

E. E477 - Method of testing duct liner and prefabricated silencers for associated noise and airflow performance.

1.04 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division 1.

B. Provide shop drawings for shop fabricated assemblies indicated, including volume control dampers duct access doors duct test holes. Provide product data for hardware used.

C. Submit manufacturer's installation instructions under provisions of Division 1, for fire dampers.

PART 2 - PRODUCTS

2.01 VOLUME CONTROL DAMPERS.

A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.

B. Fabricate splitter dampers of material same gage as duct to 24" size in either direction, and two gages heavier for sizes over 24".

C. Fabricate splitter dampers of double thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum ¼ " diameter rod in self aligning, universal joint, action flanged bushing, with set screw.

D. Fabricate single blade dampers for duct sizes to 9 ½ " x 24".

E. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12" x 72".

1. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
2. On outside air, return air, and all other dampers required to be low leakage type, provide galvanized blades and frames, six inches wide maximum, with replaceable EPT rubber seals on blade edges and stainless steel side seals. Provide blades in a double sheet corrugated type construction for extra strength. Provide channel shape frames for strength and blade linkage enclosure to keep linkage out of the air stream. Construction leakage not to exceed ½ %, based on 2,000 fpm and 4" static pressure.

F. Provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

G. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where rod lengths exceed 30 inches provide regulator at both ends.

H. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

I. Control Dampers: Provide dampers with parallel blades for 2- position control, or opposed blades for modulating control. Construct blades of 16-ga steel, provide heavy-duty molded self- lubricating nylon bearings, 1/2" diameter steel axles spaced on 9" centers. Construct frame of 2" x ½ " x 1/8 " steel channel for face areas 25 sq. ft. and under; 4" x 1 ¼ " x 16-ga channel for face areas over 25 sq. ft. Provide galvanized steel finish with aluminum touch-up.

J. Counterbalanced or Spring Loaded Barometric Relief Dampers: Provide dampers with parallel blades, counterbalanced or spring loaded and factory-set to relieve at indicated static pressure. Construct blades of 16-ga aluminum, provide ½ " diameter ball bearings, ½ " diameter steel axles spaced on 9" centers. Construct frame of 2" x ½ " x 1/8" steel channel for face areas 25 sq. ft. and under; 4" x 1 ¼ " x 16-ga channel for face areas over 25 sq. ft. Provide galvanized steel finish on

frame with aluminum touch-up. Provide sound dampening material at control blade edges contact points with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

K. Manufacturer: Subject to compliance with requirements, provide dampers of one of the following:

1. Air Balance, Inc.
2. Airguide Corp.
3. American Warming & Ventilating, Inc.
4. Arrow Louver and Damper; Div. of Arrow United Industries, Inc. Louvers & Dampers, Inc.
5. Penn Ventilator Co.
6. Ruskin Mfg. Co.

2.02 ROUND DUCT TAPS

A. Taps to trunk duct for round flexible duct shall be spin-in fitting with locking quadrant butterfly damper, model No. GS-04 by Air Deflections, Inc. or approved equal for run outs to air distribution devices (24 gauge).

B. Taps to trunk duct for round flexible duct shall be conical spin-in fitting model No. GSC-01 by Air Deflections, Inc. or approved equal.

2.03 ACCEPTABLE MANUFACTURERS - FIRE DAMPERS

A. Louvers and Dampers Inc.

B. Ruskin.

C. Nailor Hart Industries.

2.04 FIRE DAMPERS

A. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.

B. Provide curtain type dampers of galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream.

C. Fabricate multiple blade fire dampers with 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

D. Fusible links, UL 33, shall separate at 160 degrees F. Provide adjustable link straps for combination fire/balancing dampers.

E. Dampers shall be Ruskin IBD-2, style "C", "CR" or "CO" or approved equal.

2.05 ACCEPTABLE MANUFACTURERS - BACKDRAFT DAMPERS

A. American Warming and Vent.

B. Louvers and Dampers Inc.

C. Ruskin.

D. Substitutions: Under provisions of Division 1.

2.06 BACKDRAFT DAMPERS

A. Gravity backdraft dampers, size 18 x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturer's standard construction.

B. Fabricate multi-blade, parallel action gravity balanced back draft dampers of 16 gage galvanized steel, or extruded aluminum, with blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.07 ACCEPTABLE MANUFACTURERS - AIR EXTRACTOR DEVICES

A. Young Regulator.

B. Titus.

C. Tuttle and Bailey.

2.08 AIR EXTRACTOR DEVICES

A. On duct sizes less than 12 x 12, multi-blade device with blades aligned in short dimension; steel or aluminum construction; with individually adjustable blades, mounting straps.

B. Multi-blade device with radius blades attached to pivoting frame and bracket, steel or aluminum construction, with worm drive mechanism with 18 inch long removable key operator.

2.09 TURNING VANES

A. Fabricated Turning Vanes: Provide fabricated turning vanes and vane runners, constructed in accordance with SMACNA "HVAC Duct Construction Standards".

B. Manufactured Turning Vanes: Provide turning vanes constructed of 1-1/2" wide curved blades set at 3/4" o.c., supported with bars perpendicular to blades set at 2" o.c., and set into side strips suitable for mounting in ductwork.

C. Acoustic Turning Vanes: Provide acoustic turning vanes constructed of airfoil shaped aluminum extrusion with perforated faces and fiberglass fill.

D. Manufacturer: Subject to compliance with requirements, provide turning vanes of one of the following:

1. Aero Dyne Co.
2. Airsan Corp.
3. Anemostat Products Div.; Dynamics Corp. of America.
4. Barber-Colman Co.
5. Duro Dyne Corp.
6. Environmental Elements Corp.; Subs, Koppers Co., Inc.
7. Hart & Cooley Mfg. Co.
8. Register & Grille Mfg. Co., Inc.

2.10 ACCEPTABLE MANUFACTURERS - FLEXIBLE DUCT CONNECTIONS

A. Metaledge.

B. Ventglass.

2.11 FLEXIBLE DUCT CONNECTIONS TO AIR MOVING EQUIPMENT

A General: Provide flexible duct connections wherever duct connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibration of connected equipment.

B. Fabricate in accordance with SMACNA Low or Medium Pressure Duct Construction Standards, and as indicated.

C. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 20 oz per sq yd, approximately 6 inches wide, crimped into metal edging strip.

D. Manufacturer: Subject to compliance with requirements, provide flexible connections of one of the following:

1. American/Elgen Co.; Energy Div.
2. Duro Dyne Corp.
3. Flexaust (The) Co.
4. Ventfabrics, Inc.

2.12 ACCEPTABLE MANUFACTURERS - DUCT ACCESS DOORS

A. American Warming and Vent.

B. Ruskin.

C. Durodyne Corp.

D. Air Balance Inc.

2.13 DUCT ACCESS DOORS

A General: Provide where indicated, duct access doors of size indicated. Review locations prior to fabrication.

B. Construction: Construct of same or greater gage as duct served. Fabricate rigid

and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. Provide insulated doors for insulated duct; for externally insulated duct insulation shall be replaceable without field cutting or patching. Provide flush frames for un-insulated duct, extended frames for externally insulated duct. Fabricate in accordance with SMACNA Low or Medium Pressure Duct Construction Standards.

C. Access doors smaller than 12 inches square may be secured with sash locks.

D. Provide one side hinged, other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.

E. Access doors with sheet metal screw fasteners are not acceptable.

F. Label access doors with ½ " high black stencil "fire damper access" or purpose of access door.

2.14 DUCT HARDWARE

A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

1. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
2. Permanent test holes shall be factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation. Provide in duct at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.

B. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for all damper lengths. Provide extended quadrant locks and end extended bearing plates for externally insulated duct.

C. Manufacturer: Subject to compliance with requirements, provide duct hardware of one of the following:

1. Ventfabrics, Inc.
2. Young Regulator Co.

PART 3 - EXECUTION

3.01 INSPECTION

A Examine areas and conditions under which duct accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF DUCT ACCESSORIES

A. Install duct accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install turning vanes in square or rectangular 90 degree elbows in supply, return, outside air and exhaust air systems whether or not indicated on floor plans.

C. Coordinate with other work, including duct, as necessary to interface installation of duct accessories properly with other work.

D. Balancing Dampers

1. Provide at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts and as required for air balancing. Use splitter dampers only where indicated.

2. All regulators mounted on externally insulated duct shall have 16 gauge elevated platforms at least 1/8 inch higher than the thickness of the insulation. Damper shaft shall have Ventlock No. 607 bearing mounted on duct within elevated platform. If duct is inaccessible the operating handle shall be extended and the regulator installed on the face of the wall or ceiling. Where regulators are exposed in finished parts of the building, they shall be flush type, Ventlock No. 666. All regulators shall be manufactured by Ventlock, or approved equal.

3. All dampers in externally insulated duct shall have bushing and or extension to prevent damper damage to insulation.

E. Fire Dampers:

1. Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
2. Demonstrate re-setting of fire dampers to authorities having jurisdiction

and City's representative.

F. Provide back draft dampers on exhaust fans, exhaust ducts nearest to outside and where indicated.

G. Provide flexible duct connections immediately adjacent to equipment in ducts associated with fans and motorized equipment. Provide at least one inch slack at all flexible duct connections.

H. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire, fire/smoke and/or smoke dampers, and elsewhere as required for access into the duct for items installed in the duct. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is to small for person to enter.

I. Provide duct test holes where indicated and required for testing and balancing purposes.

3.03 FIELD QUALITY CONTROL

A. Operate installed duct accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leak-proof performance.

3.04 ADJUSTING AND CLEANING

A. Adjusting: Adjust duct accessories for proper settings, install fusible links in fire dampers and adjust for proper action.

1 Label access doors in accordance with Division-15 section "System Identification & Pipe Marking".
2. Final positioning of manual dampers is specified in Division- 15 section "Testing, Adjusting, and Balancing".

B Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.05 EXTRA STOCK

A. Furnish extra fusible links to City, one link for every 10 installed of each temperature range; obtain receipt.

END OF SECTION

Section 15990

TESTING, ADJUSTING, BALANCING AND COMMISSIONING

PART 1 - GENERAL

1.01 INDEPENDENT TAB CONTRACTOR

A. An independent Testing, Adjusting and Balancing (TAB) Contractor for the HVAC systems shall be selected by City and ***paid by the Contractor*** *and approved by the City* and conform as part of this contract.

B. HVAC systems acceptance testing, and balancing data gathering, analysis and reporting will not be done by the Contractor.

C. The Contractor is to provide operational and access support, i.e., ladders, lifts, etc. for the air TAB Contractor.

D. Systems shall be complete and operational for TAB Contractor to perform his work on.

E. This Section includes testing, adjusting, balancing, and commissioning HVAC systems and alarm point reporting verification to produce design objectives, including the following:

1. Balancing airflow and water flow within distribution systems, including sub-mains, branches, and terminals, to indicated quantities according to specified tolerances.

2. Adjusting total HVAC systems to provide indicated quantities.

3. Measuring electrical performance of HVAC equipment.

4. Setting quantitative performance of HVAC equipment.

5. Verifying that automatic control devices are functioning properly and perform their intended functions.

6. Calibrating automatic temperature control sensors.

7. **Commissioning the Mechanical and HVAC system**.

8. Verification of building alarm and alarm remoting.

9. Reporting results of the activities and procedures specified in this Section.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Related Sections:

1. General requirements for testing agencies are specified in the Division-1.
2. Other Division-15 Sections specify balancing devices and their installation, and materials and installations of mechanical systems.
3. Individual Division-15 system sections specify leak testing requirements and procedures.

1.03 SUMMARY

A. This Section specifies the requirements and procedures total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.

B. Test, adjust, and balance the following mechanical systems:

1. Exhaust air systems;
2. Packaged DX units including supply, return and outside air;
3. Verify temperature control system operation;

C. Test systems for proper sound and vibration levels.

D. This Section does not include:

1. Testing boilers and pressure vessels for compliance with safety codes;
2. Specifications for materials for patching mechanical systems;
3. Specifications for materials and installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing, refer to the respective system sections for materials and installation requirements.
4. Requirements and procedures for piping and duct systems leakage tests.

1.04 DEFINITIONS

A. Systems testing, adjusting, and balancing is the process of checking and adjusting all the building environmental systems to produce the design objectives. It includes:

1. The balance of air distribution;
2. Adjustment of total system to provide design quantities;
3. Electrical measurement;
4. Verification of performance of all equipment and automatic controls;
5. Sound and vibration measurement;
6. Indoor and outdoor temperature measurement FDB/FWB;
7. Entering and leaving equipment air temperature and flow measurement;
8. Report of all observed system deficiencies and irregularities, including

noisy or abnormal operation of system.

B. Test: To determine quantitative performance of equipment.

C. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttling).

D. Balance: To proportion flows within the distribution system (sub-mains, branches, and terminals) according to specified design quantities.

E. Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.

F. Report forms: Test data sheets arranged for collecting test data in logical order for submission and review. These data should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.

G. Terminal: The point where the controlled fluid enters or leaves the distribution system. These are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.

H. Main: Duct or pipe containing the system's major or entire fluid flow.

I. Sub-main: Duct or pipe containing part of the systems' capacity and serving two or more branch mains.

J. Branch main: Duct or pipe serving two or more terminals.

K. Branch: Duct or pipe serving a single terminal.

1.05 SUBMITTALS

A. Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.

B. Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.

C. Procedures and Agenda: Submit a synopsis of the testing, adjusting, and balancing procedures and agenda proposed to be used for this project.

D. Maintenance Data: Submit maintenance and operating data that include how to test, adjust, and balance the building systems. Include this information in maintenance data specified in Division 1 and Section 15010.

E. Sample Forms: Submit sample forms, if other than those standard forms prepared by the NEBB are proposed.

F. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be

certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:

1. Draft reports: Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.
2. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports.
3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:
   a. General Information and Summary
   b. Air Systems
   c. Temperature Control Systems
   d. Special Systems
   e. Sound and Vibration Systems
4. Report Contents: Provide the following minimum information, forms and data:
   a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor, City, and Project. Include addresses, and contact names and telephone numbers. Also include a certification sheet containing the seal and name address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration and date of last calibration.
   b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.

G. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

1.06 QUALIFICATIONS OF TAB CONTRACTOR AND LEAD TECHNICIAN

A. The Contractor will provide the services of a qualified test and balance contractor. The qualifications of the TAB contracting firm shall be submitted, along with the specific qualifications of the lead site technician who will remain on site during all TAB work, within 30 days of notice to proceed. Recent projects shall be listed and described for both the company and the lead technician. Names and telephone numbers of the project contractors and facility managers will be provided.

B. The Owner must approve in writing the qualifications of both the company and the lead technician.

C. Agency Qualifications:

1. Employ the services of an independent testing, adjusting, and balancing agency approved by the City, meeting the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.
2. The independent testing, adjusting, and balancing agency certified by National Environmental Balancing Bureau (NEBB) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in the State in which the services are to be performed, certified by NEBB as a Test and Balance Engineer.

D. Codes and Standards:

1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
2. ASHRAE: ASHRAE Handbook, 1991 HVAC Applications Volume, Chapter 34, Testing, Adjusting, and Balancing.

E. Pre-Balancing Conference: Prior to beginning of the testing, adjusting, and balancing procedures, schedule and conduct a conference with the City and representatives of installers of the mechanical systems. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting, and balancing.

1.07 PROJECT CONDITIONS

A. Systems Operation: Systems shall be fully operational prior to beginning procedures.

1.08 SEQUENCING AND SCHEDULING

A. Test, adjust, and balance the air systems.
B. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 5 deg. F wet bulb temperature of maximum summer design condition, and within 10 deg. F dry bulb temperature of minimum winter design condition. Take final temperature readings during seasonal operation.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION

3.01 PRELIMINARY PROCEDURES FOR AIR SYSTEM BALANCING

A. Before operating the system, perform these steps:

1. Obtain design drawings and specifications and become thoroughly acquainted with the design intent.
2. Obtain copies of approved shop drawings of all exhaust fans, air handling equipment, air distribution devices (supply, return, and exhaust) and temperature control diagrams.
3. Compare design to installed equipment and field installations.
4. Walk the system from the system air handling equipment to terminal units to determine variations of installation from design.
5. Check filters for cleanliness.
6. Check dampers (both volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.
7. Prepare report test sheets for both fans and air distribution devices. Obtain manufacturer's air distribution device area factors (Ak) and recommended procedures for testing. Prepare a summation of required air distribution device air flow volume to permit a crosscheck with required fan air flow volume.
8. Determine best locations in main and branch duct for most accurate duct traverses.
9. Place air distribution device and manual balancing dampers in the full open position.
10. Prepare schematic diagrams of system "as-built" duct and piping layouts to facilitate reporting.
11. Lubricate all motors and bearings.
12. Check fan belt tension and pulley alignment.
13. Check fan rotation.

3.02 PROFESSIONAL REPORT

A. Before the final acceptance of the report is made, the TAB firm will furnish the City the following data to be approved by the City:

1. Summary of main supply, return and exhaust duct pitot tube traverses and fan settings indicating minimum value required to achieve specified air volume.
2. A listing of the measured air quantities at each outlet corresponding to the temperature tabulation as developed by the City and TAB firm.
3. Air quantities at each return and exhaust air distribution device.
4. Static pressure readings entering and leaving each supply fan, exhaust fan, filter, coil, balancing dampers and other components of the systems included in the retrofit Work. These readings will be related to performance curves in terms of the CFM handled if available.
5. Motor current readings at each equipment motor on load side of capacitors. The voltages at the time of the reading shall be listed.

6. The final report shall certify test methods and instrumentation used, final velocity reading obtained, temperatures, pressure drops, RPM of equipment, amperage of motors, air balancing problems encountered, recommendations and uncompleted punch list items. The test results will be recorded on standard forms.
7. A summary of actual operating conditions shall be included with each system outlining normal and ventilation cycles of operation. The final report will act as a reference of actual operating conditions for the City's operating personnel.
8. The final report shall contain logged results of all tests, including such data as:

    a. Tabulation of air volume at each air distribution devices.
    b. Outside dry bulb and wet bulb temperature for each day of testing.
    c. Inside dry bulb and wet bulb temperatures in each conditioned space room or area with a thermostat.
    d. Actual fan capacities and static pressures. Motor current and voltage readings at each fan motor.

B. AIR SYSTEMS: Perform the following operations as applicable to system balance and test:

1. Test and adjust blower rpm to design requirements.
2. Test and record motor full lead amperes.
3. Test and record system static pressures, suction and discharge.
4. Test and adjust system for design cfm, return air and outside air (+2%). Change-out fan sheaves as required to balance system.
5. Test and record entering air temperatures, db and wb.
6. Test and record leaving air temperatures, db and wb.
7. Adjust all zones to design cfm (± 5%).
8. Test and adjust each air distribution device to within ± 5% of design.

3.03 MEASUREMENTS

A. Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage.

B. Provide instruments meeting the specifications of the referenced standards.

C. Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.

D. Apply instrument as recommended by the manufacturer.

E. Use instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.

F. When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until 2 consecutive identical values are obtained.

G. Take all reading with the eye at the level of the indicated value to prevent parallax.

H. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.

I. Take measurements in the system where best suited to the task.

3.04 PERFORMING TESTING, ADJUSTING, AND BALANCING

A. Perform testing and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards.

B. Cut insulation, duct, and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.

C. Patch insulation, duct, and housings, using materials identical to those removed.

D. Seal ducts and piping, and test for and repair leaks.

E. Seal insulation to re-establish integrity of the vapor barrier.

F. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.

G. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

3.5 TEMPERATURE-CONTROL VERIFICATION:

A. Verify that each point on the "Points List" exists, is terminated properly, is functioning properly, and is calibrated.

B. Verify that controllers are calibrated and commissioned.

C. Check transmitter and controller locations and note conditions that would adversely affect control functions.

D. Record controller settings and note variances between set points and actual measurements.

E. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).

F. Verify free travel and proper operation of control devices such as damper and valve operators.

G. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.

H. Confirm interaction of electrically operated switch transducers.

I. Confirm interaction of interlock and lockout systems.

J. Verify main control supply-air pressure and observe compressor and dryer operations.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.06 TOLERANCES:

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans: Plus 5 to plus 10 percent.

2. Air Outlets and Inlets: 0 to minus 10 percent.

3. Heating-Water Flow Rate: 0 to minus 10 percent.

4. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.07 TESTING FOR SOUND AND VIBRATION

A. Test and adjust mechanical systems for sound and vibration in accordance with the detailed instructions of the referenced standards.

3.08 RECORD AND REPORT DATA

A. Record all data obtained during testing, adjusting, and balancing in accordance with, and on the forms recommended by the referenced standards, and as approved on the sample report forms.

B. Prepare report of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.

3.9 FINAL TEST AND BALANCE REPORT:

A. Certified Testing, Adjusting, and Balancing Reports: Submit 8 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.

B. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.

C. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of the instruments used for procedures, along with proof of calibration.

D. Final Report Contents: include the following:

1. Test & Balance field data sheets.
2. Control points verification sheets.
3. Control sequence verification sheets.
4. Alarm points verification sheets.
5. Pump curves.
6. Fan curves.
7. Manufacturers' test data.
8. Field test reports prepared by system and equipment installers.
9. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.

E. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of testing, adjusting, and balancing Agent.
3. Project name.
4. Project location.
5. Engineer's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of testing, adjusting, and balancing Agent who certifies the report.
10. Summary of contents, including the following:

    a. Design versus final performance.
    b. Notable characteristics of systems.

c. Description of system operation sequence if it varies from the Contract Documents.

11. Nomenclature sheets for each item of equipment.

12. Data for terminal units, including manufacturer, type size, and fittings.

13. Notes to explain why certain final data in the body of reports vary from design values.

14. Test conditions for fans and pump performance forms, including the following:

    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings, including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

F. System Diagrams: Present with single-line diagrams and include the following:

1. Quantities of outside, supply, return, and exhaust airflows.

2. Water and steam flow rates.

3. Duct, outlet, and inlet sizes.

4. Pipe and valve sizes and locations.

5. Terminal units.

6. Balancing stations.

G. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data: Include the following:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.

i. Sheave dimensions, center-to-center and amount of adjustments in inches.
j. Number of belts, make, and size.
k. Number of filters, type, and size.

2. Motor Data: Include the following:

a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center and amount of adjustments in inches.

3. Test Data: Include design and actual values for the following:

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static pressure differential in inches wg.
f. Preheat coil static-pressure differential in inches wg.
g. Cooling coil static-pressure differential in inches wg.
h. Heating coil static-pressure differential in inches wg.
i. Outside airflow in cfm.
j. Return airflow in cfm.
k. Outside-air damper position.
l. Return-air damper position.
m. Vortex damper position.

H. Apparatus-Coil Test Reports: For apparatus coils, include the following:

1. Coil Data: Include the following:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch.
f. Make and model number.
g. Face area in sq. ft..
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data: Include design and actual values for the following:

a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.

d. Outside-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Refrigerant expansion valve and refrigerant types.
i. Refrigerant suction pressure in psig.
j. Refrigerant suction temperature in deg F.
k. Inlet steam pressure in psig.

I. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data: Include the following:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btuh.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Airflow rate in cfm.
i. Face area in sq. ft..
j. Minimum face velocity in fpm.

2. Test Data: Include design and actual values for the following:

a. Heat output in Btuh.
b. Airflow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

J. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data: Include the following:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Sheave dimensions, center-to-center and amount of adjustments in inches.

2. Motor Data: Include the following:

a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center and amount of adjustments in inches.
g. Number of belts, make, and size.

3. Test Data: Include design and actual values for the following:

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

K. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data: Include the following:

a. System and air-handling unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Design airflow rate in cfm.
h. Design velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

L. Air-Terminal-Device Reports: For terminal units, include the following:

1. Unit Data: Include the following:

a. System and air-handling unit identification.
b. Location and zone.
c. Test apparatus used.
d. Area served.
e. Air-terminal-device make.
f. Air-terminal-device number from system diagram.
g. Air-terminal-device type and model number.
h. Air-terminal-device size.
i. Air-terminal-device effective area in sq. ft.

2. Test Data: Include design and actual values for the following:
a. Airflow rate in cfm.
b. Air velocity in fpm.

c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

M. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data: Include the following:

a. System and air-handling unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flow-meter type.

2. Test Data: Include design and actual values for the following:

a. Airflow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

3.09 DEMONSTRATION

A. Training:

1. Train the City's maintenance personnel on troubleshooting procedures and testing, adjusting, and balancing procedures. Review with the City's personnel, the information contained in the Operating and Maintenance Data specified in Division 1 and Section 15010.
2. Schedule training with at least 7 days prior notice.

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.

C. Bollards as shown and detailed on Project Drawings and the same provided are to be part of Division 16 costs.

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 Houston 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

E. 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.

F. Field Inspection

1. Electrical work shall be inspected and approved by the local code inspectors, the wastewater inspectors, and the Project Manager prior to starting the 7-day test or scheduling training.

2. Contractor shall give a minimum of two days notice to the Inspectors that the installation is ready for inspection and two days notice to the Project Manager.

3. Concealed work shall be inspected and approved by code inspectors and wastewater inspectors 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 _____
Houston, Texas _____
2. Plant Type and Size
3. Plant Site Elevation
4. Seismic Zone Zone 0
5. Wind Velocity 90 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

B. 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 City Engineer.

B. Conductor voltage drop shall not exceed 2 percent for feeders and 3 percent for branch circuits.

3.03 DEMONSTRATION

A. Test the electrical system to specification requirements and to demonstrate correct installation and operation of equipment. O & M Manual shall be furnished prior to testing for reference during testing and corrections for final O & M.

B. Before 7-days test, demonstrate the system to the wastewater inspectors 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, PLC failure, transducer failure, or UPS failure. This would exclude conditions not under the control of Contractor, such as: evident lightning strikes, 25-year rains, local power utility power failure longer than the specified duration of service from UPS. Failures due to uncontrollable situations would allow the 7-day test to continue, as soon as test conditions are restored and the City Engineer is notified.

D. The existing station shall remain in service during this test.

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:
****

A. Coordinate this specification with other related specifications including the following related Sections.

B. The Design Consultant shall prepare the electrical power studies, general design, construction drawings, and installation details in accordance with the Standard Specifications and the Design Guidelines.

C. Conductor voltage drop shall not exceed 2 percent for feeders and 3 percent for branch circuits.

E. Specific site conditions shall be taken into consideration by the consultant when preparing engineering, design and specifications for this project.
****

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 Houston Electrical Code.

1.03 SUBMITTALS

A. Annotate existing drawings to sequence the demolition of systems, equipment removal and temporary hook-ups.

B. Schedule with Project Manager 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 City Engineer before disturbing existing installation.

D. By beginning demolition, installer accepts existing conditions and warrants that he will maintain service to equipment and items not scheduled or indicated for removal, and that he will return to the City all items and systems in good operating condition.

PART 2 PRODUCTS

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 Houston Electrical Code.

PART 3 EXECUTION

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 City of Houston Utility Operations 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 City Engineer at least one week before partially or completely disabling system. Minimize 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 City of Houston.

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. This includes all associated support and anchoring systems. 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 and wiring size four and larger removed from existing facilities for City's reuse.

B. Material and equipment which can be reused or salvaged remains the property of the City of Houston. Equipment to be retained by the City of Houston 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 02220 - 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 Houston 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. 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 Conduit.

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 Houston 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. 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. 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 as required in Section 16402.

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 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. 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. Bonding strap connections shall be protected by minimum 40 mils PVC coating.

P. Where rigid galvanized conduit terminates in sheet metal enclosures, 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. Where PVC-coated rigid conduit is used, PVC-coated rigid threaded hubs will be used.

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. All transitions in PVC-coated conduit size shall be accomplished with PVC-coated RECs or manufactured reducing condulets. RE bushings shall not be used.

U. 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 stainless steel for PVC-coated conduit. Metal framing channel straps used for PVC-coated conduit shall be type 316 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 Conduits embedded in concrete lift station deck shall be PVC-coated rigid.

END OF SECTION

Section 16120

600-VOLT BUILDING WIRE AND CABLE

PART 1 - G E N E R A L

1.01. SECTION INCLUDES

A. Specifications for 600-volt building wire and cable.

1.02. 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 Houston Electrical Code

1.03. SUBMITTALS

A. Make submittals following Section 01330 - Submittal Procedures.

1. Manufacturer's cut sheets, catalog data

2. Instruction for handling and storage

3. Dimensions and weight

4. Conformance certificate

1.04. 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.

1.05. 1.05 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

2.01. 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.

2.02. 2.02 MATERIALS AND EQUIPMENT

A. Design. Provide cable designated as THWN/THHN stranded 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 in conduit. MTW stranded will be used in control panels.

B. 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.

C. 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.

D. 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.

E. 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

3.01. 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.

3.02. 3.02 INSTALLATION

A. Wiring Methods

1. Use wiring methods indicated on Drawings.

2. In general, use THHN/THWN stranded building wire for lighting, power and control wiring where conductors are enclosed in raceways like in above ground conduit system or in underground duct banks, or inside control panels.

3. Do not use solid conductors.

4. Use conductors not smaller than No. 12 AWG stranded for general lighting circuits.

5. Use conductors not smaller than No. 14 AWG stranded for control circuits, except when part of a multiconductor cable or internal panel wiring.

6. In general, do not splice conductors unless approved by the City Engineer.

7. Splices associated with taps for lighting and control circuits are allowed without approval.

8. Make splices in accessible junction boxes.

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

1. Do not install single conductor building wire and cable in cable tray.

2. For single conductor tray installation, see Section 16122 - 600 Volt Power Cable.

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, test insulation integrity of the wiring system before terminating.

2. Make sure to disconnect sensitive electronic equipment before testing insulation.

3. Use a 500 VDC megohmmeter and perform the wire system insulation test in accordance with the operating instructions.

F. Termination. After the 600-volt wiring system has been tested with satisfactory results, reconnect wire.

END OF SECTION

Section 16121

600-VOLT CONTROL CABLE

PART 1 - G E N E R A L

1.01 SECTION INCLUDES

A. 600-volt control cable.

1.02 REFERENCES

A. A. 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.

3. ASTM B 33 - Tinned Soft or Annealed Copper Wire for Electrical Purposes.

4. ASTM B 174 - Bunch-stranded Copper Conductors for Electrical Conductors.

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), 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. Make submittals following Section 01330 - Submittal Procedures.

1. Completed engineer's data sheets.

2. Completed manufacturer's data sheets.

3. Manufacturer's cut sheets, catalog data.

4. Installation, terminating and splicing procedure.

5. Instruction for handling and storage.

6. Dimensions and weight.

7. Conformance certificate.

1.04 QUALITY ASSURANCE

A. Tests.

1. Cable shall be tested at the factory to confirm that the cable complies with requirements of Part 6 of ICEA S-61-402, S-66-524 or S-68-516. Refer to data sheet for additional test requirements.

2. 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

A. 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 ACCEPTABLE MANUFACTURERS

A. Alpha Wire Corporation

B. Belden Division, Cooper Industries, Inc.

C. Cablec Continental Cables Company

D. General Cable Company

E. Manhattan Electric Cable Corporation

F. 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 600-Volt Control 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 600-Volt Control Cable Data Sheets.

B. Conductors. Provide conductors which are concentric or bunch-stranded, annealed tinned copper with physical and electrical properties conforming to ASTM B 3, ASTM B 8 or ASTM B 33 or ASTM B 174 and Part 3 of ICEA S-61-402, S-66-524, or S-68-516 unless otherwise specified on the 600-Volt Control Cable Data Sheets.

C. Insulation. Each conductor shall be insulated as specified on the 600-Volt Control Cable Data Sheets complying to 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 Section 3.2, Table 3-1 of ICEA S-61-402, S-66-524 or S-68-516 for 600 volt insulation unless otherwise specified on the 600-Volt Control 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 Class B, seven-stranded, tin-coated copper in accordance with ASTM B 3, ASTM B 8, or ASTM B 33 and as specified on the 600-Volt Control Cable Data Sheets.

E. Shielding. Cable shielding shall consist of laminated, nonburning, mylar-backed aluminum tape applied helically around conductors with the

aluminum side in continuous contact with the drain wire unless otherwise specified on the 600-Volt Control Cable Data Sheet. The tape shall be wrapped around the conductors with a 25 percent minimum overlap unless otherwise specified on the 600-Volt Control Cable Data Sheets.

F. Jacket.

1. When control cables are to be enclosed in conduit, ducts or in other raceway systems, the cables shall be of the non-metallic type and shall be covered by an overall nonmetallic jacket, as specified on the 600-Volt Control Cable Data Sheets, which complies with the requirements of Section 4.4 of ICEA S-66-524 or S-68-516, Section 4.3 of ICEA S-61-402, or Table 21-5 of Part 21 of UL 83.

2. Multi-conductor cables shall have a jacket thickness which complies with Table 4-7 of Part 4 of ICEA S-66-524, Table 4-5 of Part 4 of ICEA S-68-524, or Table 4-6 of Part 4 of ICEA S-61-402 unless otherwise specified on the 600-Volt Control Cable Data Sheets.

G. Armor. Where control cables are to be exposed, as in cable tray, cable channel or other cable support systems, the cables shall be protected by an interlocked metal tape armor 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 600-Volt Control Cable Data Sheets. An over-all jacket shall be provided as specified in the Data Sheets.

H. Conductor Identification. Identify individual conductors by method as specified on the 600-Volt Control Cable Data Sheets in conformance with Appendix L of ICEA S-66-524, Part 5 of ICEA S-68-516, or Appendix I of ICEA S-61-402.

I. Cable Marking. Print cable marking information on the jacket of each cable at 2-foot intervals. Use a permanent printing method with a color sharply contrasting the jacket color. See the 600-Volt Control Cable Data Sheets for the minimum information required.

PART 3 - E X E C U T I O N

3.01 PREPARATION

A. When control wiring requires installation in cable tray and other cable support systems, use the 600-Volt Multiconductor Control Cable.

B. Complete cable raceway systems, underground duct banks, and cable support systems before installing cables.

C. Verify sizing of raceways and pullboxes to ensure proper accommodation for the cables.

D. Check the length of the cable raceway system against the length of cable on the selected reel.

E. Do not install or work on PVC insulated or jacketed cables in temperatures below 32 F.

F. Clean conduits of all foreign matter before cables are pulled in.

G. Provide at least 30 percent spare conductors.

3.02 INSTALLATION

A. Cable in Conduit and Ductbank.

1. Install cables in accordance with the manufacturer's instructions and the National Electrical Code (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 wire pulling compounds approved by cable manufacturers to reduce friction. Lubricants must not be harmful to the conductor insulation or cable jacket. Mixtures containing soap or detergent shall not be used.

B. Cable in Tray

1. Install armored cable in cable tray.

2. 600-Volt Control Cable may be installed in cable tray with 600-volt power cables.

3. Install cables in trays in a neat and orderly manner. Tie cables to the rungs at approximate 15-foot intervals by use of cable ties.

C. Termination

1. Do not splice conductors unless approved by the Project Manager. For termination use crimp-on type, ring tongue, non-insulated, tin-plated copper lugs.

2. 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-on base of the terminal.

D. Tests

1. Test insulation integrity and conductor continuity before connecting the cables.

2. Use a 500 VDC megohmmeter and perform the cable insulation test in accordance with the operating instructions.

E. Termination. After the 600-volt control cable has been tested with satisfactory results, terminate the cable at both ends to designated terminal points.

END OF SECTION

DATA SHEET 1 of 3

IDENTIFICATION

CLIENT _____ MANUFACTURER _____
PROJECT _____ MODEL NO. _____
JOB NO. _____ SIZE _____
PLANT LOCATION _____ SERIAL NO. _____
ITEM NO. _____ INQUIRY NO _____
SERVICE _____ P.O. NO. _____
NO. ITEMS REQUIRED _____

NOTE: [ ] INDICATES INFORMATION TO BE COMPLETED BY MANUFACTURER

OPERATING DATA

VOLTAGE _____ FREQUENCY _____ AMBIENT TEMP (°C) _____
INSTALLATION ENVIRONMENT _____

CONSTRUCTION

CONDUCTORS

SIZE (AWG or KCMIL): _____
ARRANGEMENT: _____ SINGLE CONDUCTOR __ OTHER _____
_____ MULTI-CONDUCTOR _____ NO. OF CONDUCTORS
MATERIAL: _____ BARE COPPER _____ TIN-COATED COPPER
_____ SOLID _____ STRANDED
SINGLE CONDUCTOR: _____ JACKETED _____ NON-JACKETED
MULTI-CONDUCTOR (TRIPLEXED ONLY) _____ JACKETED _____ NON-JACKETED
_____ ARMORED _____ ARMORED W/OUTER JACKET
_____ GROUND WIRES IN INTERSTICES: _____ COPPER _____ ALUMINUM
CONDUCTOR CLASS PER _____ ASTM STANDARD
SPECIAL REQUIREMENTS: _____

INSULATION

TYPE: _____ CROSS LINKED POLYETHYLENE _____ CHLOROSULFONATED POLYETHYLENE
_____ POLYVINYL CHLORIDE _____ ETHYLENE-PROPYLENE RUBBER
_____ POLYETHYLENE _____ OTHER _____
THICKNESS (MILS OR MM) _____
COLOR: _____
TEMPERATURE RATING: _____ 60°C - 75°C (WET-DRY) _____75°C - 90°C (WET-DRY)
_____ 90°C (WET-DRY) _____ OTHER _____
DRAIN WIRE: SIZE _____ STRANDED ____ SOLID _ BARE COPPER _____TIN-COATED COPPER
SPECIAL REQUIREMENTS: _____

SHIELDING

TYPE SHIELDING: _____ BRAIDED _____ CONDUCTIVE PLASTIC
_____ CONDUCTIVE COTTON _____ SPIRAL-SERVED _____ CORRUGATED
_____ MYLAR FILM - ALUMINUM FOIL _____ POLYESTER FILM-ALUMINUM FOIL
_____ COPPER TAPE _____ OTHER _____
POLYESTER FILM-ALUMINUM LOCATION _____ INSIDE _____ OUTSIDE
_____ PAIR SHIELD ISOLATED
_____ SEPARATOR _____ FILLED

ITEM NO. _____

DATA SHEET 2 of 3

SHIELD COMBINATION

OVERSHIELD: _____ POLYESTER FILM ALUMINUM
_____ BRAID _____ SERVED _____ OTHER _____

BRAID SHIELD: _____ TYPE STRANDS _____ % COVERAGE _____ TINNED
_____ BARE _ COPPER _____ ALUMINUM
_____ OTHER _____

OVERALL TYPE: _____ POLYESTER _____ PAPER . OTHER: _____

JACKET

TYPE: _____ POLYVINYL CHLORIDE _____ POLYETHYLENE
_____ HEAVY DUTY NEOPRENE _____ CHLOROSULFONATED POLYETHYLENE
_____ NYLON _____ OTHER _____

THICKNESS (MILS OR MM) _____
COLOR: _____ BLACK _____ OTHER _____
SPECIAL REQUIREMENTS: _____

ARMORING

TYPE: _____ INTERLOCKED (POSITIVE) _____ OTHER _____
MATERIAL: _____ GALVANIZED STEEL _____ ALUMINUM
_____ OTHER _____
COVERING: _____ POLYVINYL CHLORIDE _____ OTHER _____
COLOR: _____ BLACK _____ OTHER _____
SPECIAL REQUIREMENTS: _____

MARKING

CONDUCTOR IDENTIFICATION

SINGLE CONDUCTOR: _____
MULTI-CONDUCTOR: _____

CABLE MARKING

REQUIRED: _____ MANUFACTURER _____ CONDUCTOR SIZE
_____ NO. OF CONDUCTORS _____ VOLTAGE RATING
_____ UL LABEL _____ NEC TYPE
_____ TEMPERATURE RATING _____ MONTH/YEAR OF MANUFACTURE
_____ INSULATION _____ FOOTAGE MARKERS
_____ OTHER _____

FACTORY TESTING/DOCUMENTATION

_____ PHYSICAL _____ _____ FLAME TESTS (PER IEEE 383 - 2.5)
_____ _____

_____ ELECTRICAL _____ OTHER TESTS _____
_____ MEGGER _____
_____ OTHER _____ _____
_____ _____
_____ _____

ITEM NO._____

DATA SHEET 3 of 3

QUALITY ASSURANCE

_____ NO ADDITIONAL REQUIREMENTS _____ ATTACHED SPECIFICATION _____

PACKAGING

_____ DOMESTIC _____ EXPORT

SHIPPING

REEL TYPE: _____ RETURNABLE _ NON-RETURNABLE _____ LENGTH PER REEL ____

ADDITIONAL REQUIREMENTS: _____

[ ] **MANUFACTURER DATA**

CABLE DIMENSION (O.D. IN.) _____ SHIPPING TIME _____
CABLE CROSS-SECTIONAL AREA _____ OTHER _____
CABLE WEIGHT (LBS/FT) _____
CABLE MIN BENDING RADIUS _____
TENSILE STRENGTH _____
GROSS WEIGHT/REEL (LBS) _____
TOTAL CUBIC FEET/REEL _____
SHORT CIRCUIT WITHSTAND CURVES _____
CABLE TESTING REQUIREMENTS _____

NOTES

ITEM NO. _____

Section 16122

600-VOLT POWER CABLE

PART 1 - G E N E R A L

1.01 SECTION INCLUDES

A. 600-volt power cable.

1.02 REFERENCES

A. 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.

3. ASTM B 33: 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. National Fire Protection Association (NFPA), No. 70 - National Electrical Code (NEC), Chapter No.3 - Wiring Methods and Materials.

F. City of Houston Electrical Code.

1.03 SUBMITTALS

A. Make submittals following Section 01330 - Submittal Procedures:

1. Completed engineer's data sheets
2. Completed manufacturer's data sheets
3. Manufacturer's cut sheets, catalog data
4. Installation, terminating and splicing procedure
5. Instruction for handling and storage
6. Dimensions and weight
7. Conformance certificate.

1.04 QUALITY ASSURANCE

A. Tests.

1. Cable shall be tested at the factory to confirm that the cable complies with requirements of Part 6 of ICEA S-61-402, S-66-524 or S-68-516. Refer to data sheet for additional test requirements.
2. 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

A. 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 ACCEPTABLE MANUFACTURERS

A. American Insulated Wire Company

B. Cablec Continental Cables Company

C. General Cable Company

D. Okonite Company

E. Pirelli Cable Corporation

F. Rome Cable Corporation

G. Triangle Wire and Cable, Inc.

2.02 MATERIALS AND EQUIPMENT

A. Design. Provide cable with the following design characteristic. Cable shall be UL 44 or UL 83 listed, rated 600 volts and certified for continuous operation at the temperature as specified on the 600 Volt Power Cable Data Sheets while installed in underground duct, conduit, or cable tray. Cables shall be single-conductor or multi-conductor (with ground) as specified on the data sheets.

B. Conductors. Provide conductors which are Class B, concentric stranded, annealed copper coated, unless otherwise specified on the data sheets, with physical and electrical properties conforming to ASTM B 3, ASTM B 8 or ASTM B 33 and Part 2 of ICEA S-61-402, S-66-524, or S-68-516. The number and size of conductors supplied in each cable shall correspond to the quantities specified on the data sheets.

C. Insulation. Insulate each conductor as specified on the 600 Volt Power Cable Data Sheets to meet the requirements of Part 3 of ICEA S-61-402, S-66-524 or S-68-516. The insulation thickness shall match the dimensions listed in Section 3.2, Table 3-1 of ICEA S-61-402, S-66-524 or S-68-516, as specified on the data sheets.

D. Jacket.

1. When power cables are to be enclosed in conduit, ducts or in other raceway systems, multiconductor power cables shall be of the non-metallic type and shall be covered by an overall nonmetallic jacket as specified on the Data Sheets, which complies with the requirements of Section 4.4 of ICEA S-66-524 or S-68-516, Section 4.3 of ICEA S-61-402, or Table 21-5 of Part 21 of UL 83.

2. Single-conductor cables shall have a jacket thickness which meets the requirements of Table 4-4 of Part 4 of ICEA S-66-524, Table 4-2 of Part 4 of ICEA S-68-516, or Table 4-2 or 4-6 of Part 4 of ICEA S-61-402. Multi-conductor cables shall have a jacket thickness which complies with Table 4-7 of Part 4 of ICEA S-66-524, Table 4-2 of Part 4 of ICEA S-68-516, Table 4-5 of Part 4 of ICEA S-68-516, or Table 4-6 of Part 4 of ICEA S-61-402, unless otherwise specified on the data sheets.

E. Armor. When power cables are to be exposed in a cable tray, cable channel or other cable support systems, the multiconductor power cables shall be protected by an interlocked metal armor 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 data sheets. An over-all jacket shall be provided as specified in the data sheets.

F. Cable Marking. Print cable marking information on the overall cable jacket at 2-foot intervals. Use a permanent printing method and color sharply contrasting with the jacket color. Identify individual conductors as specified on the data sheets in conformance with Part 5 of ICEA S-61-402, S-66-524, and S-68-516.

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 F.

3.02 INSTALLATION

A. Cable in Conduit and Ductbank.

1. Clean conduits of foreign matter before cables are pulled.

2. 2 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.

3. 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.

B. Cable in Tray.

1. Install medium voltage (5 kv and 15 kv) and 600V cables in separate trays or separated cables by a barrier in a single tray in accordance with NEC 318-6(f).

2. Install cables in trays in a neat and orderly manner. Tie cables to the tray rungs at approximate 15-foot intervals by use of cable ties.

3. Only one layer of 3-conductor No. 4/0 AWG and larger 600-volt power cables are allowed in a cable tray per NEC 318-9(a).

4. Using cable ties, make a triplex of single conductors used for 3-phase systems. Install in cable tray in accordance with NEC 318-10.

C. Preparation for Termination.

1. Make up 600-volt power cable terminations and splices with heat shrinkable sleeves and seals.

2. Use crimp-on terminal lugs and connectors for all sizes of conductors.

3. Use crimp-on lugs with long barrel and 2-hole tongues, except in places where terminations space is limited.

D. Tests.

1. Before connecting the cables, test insulation integrity.

2. Use a 500 VDC megohmmeter and perform the cable insulation test in accordance with the operating instructions.

E. Termination.

1. After the 600-volt cable has been tested with satisfactory results, terminate the cable at both ends to designated terminal points.

2. Tighten connection bolts with a torque wrench to specified torque levels.

END OF SECTION

DATA SHEET 1 of 3

1. **IDENTIFICATION**
2. CLIENT _____ MANUFACTURER _____
3. PROJECT _____ MODEL NO. _____
4. JOB NO. _____ SIZE _____
5. PLANT LOCATION _____ SERIAL NO. _____
6. ITEM NO. _____ INQUIRY NO. _____
7. SERVICE _____ P.O. NO. _____
8. QUANTITY REQUIRED _____
9. _____
10. _____
11. **OPERATING DATA**
12. VOLTAGE _____ FREQUENCY ____ AMBIENT TEMP (°C) _____
13. INSTALLATION ENVIRONMENT _____
14. _____
15. _____
16. **CONSTRUCTION**
17. **CONDUCTORS**
18. SIZE (AWG or MCM): _____
19. ARRANGEMENT: _____ SINGLE CONDUCTOR OTHER _____
20. _____ MULTI-CONDUCTOR _____ NO. OF CONDUCTORS
21. MATERIAL: _____ COPPER _____ ALUMINUM _____ TINNED COPPER
22. _____ JACKETED _____ NON-JACKETED
23. _____ GROUND WIRES IN INTERSTICES: __ COPPER ___ ALUMINUM
24. ASTM STANDARD: _____
25. SPECIAL REQUIREMENTS: _____
26. _____
27. _____
28. _____
29. **INSULATION**
30. TYPE: ___CROSS-LINKED-THERMOSETTING-POLYETHYLENE CHLOROSULFONATED POLYETHYLENE
31. ____ POLYVINYL CHLORIDE _____ ETHYLENE-PROPYLENE RUBBER
32. ____ POLYETHYLENE __OTHER _____
33. COLOR: _____
34. TEMPERATURE RATING: _____ 60°C - 75°C (WET-DRY) _____75°C - 90°C (WET-DRY)
35. _____ 90°C (WET-DRY) _____ OTHER ____
36. INSULATING RATING: ___ 100% __ 133% ___173%___ OTHER _____
37. ICEA STANDARD: _____
38. SPECIAL REQUIREMENTS: _____
39. _____
40. _____

41. **JACKET**
42. TYPE: _____ POLYVINYL CHLORIDE _____ POLYETHYLENE
43. _____ HEAVY DUTY NEOPRENE _____ CHLOROSULFONATED POLYETHYLENE
44. _____ NYLON _____ OTHER: ___
45. _____
46. COLOR: _____ BLACK _____ OTHER: _____
47. ICEA STANDARD: _____
48. SPECIAL REQUIREMENTS: _____
49. _____

ITEM NO. _____

DATA SHEET 2 of 3

ARMORING

TYPE: _____ INTERLOCKED (POSITIVE) _____ OTHER ____
MATERIAL: _____ GALVANIZED STEEL _____ ALUMINUM
_____ OTHER _____
COVERING: _____ POLYVINYL CHLORIDE _____ OTHER ___
COLOR: _____ BLACK ____ _____ OTHER ___
ICEA STANDARD: _____
SPECIAL REQUIREMENTS: _____

MARKING

CONDUCTOR IDENTIFICATION

SINGLE CONDUCTOR: _____
MULTI-CONDUCTOR: _____

CABLE MARKING

REQUIRED: _____ MANUFACTURER _____ CONDUCTOR SIZE
_____ NO. OF CONDUCTORS _____ VOLTAGE RATING
_____ UL LABEL _____ NEC TYPE
_____ TEMPERATURE RATING _____ MONTH/YEAR MANUFACTURE
_____ OTHER _____

TESTING

_____ PHYSICAL _____ ____ FLAME TESTS (PER IEEE 383 - 2.5)
_____ _____
_____ ELECTRICAL _____ OTHER TESTS _____
_____ MEGGER _____
_____ OTHER _____ _____
_____ _____
_____ _____

QUALITY ASSURANCE

_____ NO ADDITIONAL REQUIREMENTS _____ ATTACHED SPECIFICATION __

PACKAGING

_____ DOMESTIC _____ EXPORT

SHIPPING

REEL TYPE: _ RETURNABLE __ NON-RETURNABLE __ LENGTH PER REEL _

42. ADDITIONAL REQUIREMENTS:_____
43. _____
44. _____
45. _____
46. _____
47. _____
48. _____
49. _____
50. _____

ITEM NO. _____

DATA SHEET 3 of 3

1. **MANUFACTURER DATA**
2. CABLE DIMENSION (O.D. IN.) _____ SHIPPING TIME _____
3. CABLE CROSS-SECTIONAL AREA _____ OTHER _____
4. CABLE WEIGHT (LBS/FT) _____
5. CABLE MIN BENDING RADIUS _____
6. TENSILE STRENGTH _____
7. GROSS WEIGHT/REEL (LBS) _____
8. TOTAL CUBIC FEET/REEL _____
9. SHORT CIRCUIT WITHSTAND CURVES _____
10.
11. **NOTES**
12.
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ITEM NO. _____

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

1. 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.

2. 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

A. 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

1. Alpha Wire Corporation

2. Belden Division, Cooper Industries, Inc.

3. Cablec Continental Cables Company

4. General Cable Company

5. Manhattan Electric Cable Corporation

6. 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 EXECUTION

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

DATA SHEET 1 of 4

IDENTIFICATION

CLIENT _____ MANUFACTURER _____
PROJECT _____ MODEL NO. _____
JOB NO. _____ SIZE _____
PLANT/LOCATION _____ SERIAL NO. _____
ITEM NO. _____ INQUIRY NO. _____
SERVICE _____ P.O. NO. _____
QUANTITY REQUIRED _____

NOTE: [ ] INDICATES INFORMATION TO BE COMPLETED BY MANUFACTURER

ENVIRONMENTAL CONDITIONS

TEMPERATURE RANGE: MAX _____ °C, MIN _____ °C
INSTALLATION: _____ ENCLOSED _____ OUTDOORS _____ INDOORS _____
_____ UNDERGROUND _____ UNDERWATER _____
EXPOSURE: _____ MOISTURE _____ DIRT _____ OZONE _____
_____ RADIATION _____ CHEMICALS:(PLEASE LIST) _____
SOILS: (PLEASE LIST) _____ ELECTROSTATIC INTERFERENCE _____
ELECTROMAGNETIC INTERFERENCE DISTURBANCES _____ RODENTS _____
OTHER: _____

PHYSICAL REQUIREMENTS

FLEXIBILITY: _____ VERY FLEXIBLE _____ FLEXIBLE _____ NOT CRITICAL
RESISTANCE TO: _____ ABRASION _____ IMPACT _____ CRUSH
_____ DEFORMATION _____ CUT THROUGH . COLD FLOW
TERMINATION METHOD: _____

STRIPPABILITY: _____ MANUAL
_____ AUTOMATIC EQUIPMENT TYPE _____

ELECTRICAL REQUIREMENTS

_____ FREQUENCY (HZ) _____ CROSS TALK (ISOLATION IN DB AT FREQ)
_____ CURRENT (MILLIAMP) _____ DC RESISTANCE (OHMS/1000 FT)
_____ CAPACITANCE (PFD) _____ VOLTAGE BREAKDOWN (VOLTS/MILL)
_____ ATTENUATION (DB/100 FT) _____ INSULATION RESISTANCE (MEGOHMS/1000 FT)
ADDITIONAL REQUIREMENTS: _____

ITEM NO. _____

DATA SHEET 2 of 4

CONSTRUCTION

CONDUCTORS

SIZE (AWG): ____
_____ COPPER _____ STEEL _____ TINNED
_____ BARE _____ SOLID _____ COPPER COATED
_____ STRANDED _____ SILVER COATED
NUMBER OF CONDUCTORS: _____ NUMBER OF PAIRS _____
NUMBER OF TRIADS _____
ADDITIONAL REQUIREMENTS: _____

INSULATION

RUBBER: _____ SBR _____ NATURAL _____ SYNTHETIC _____ BUTYL POLYBUTADIENE
_____ NEOPRENE _____ NBR _____ EPR/EPT
_____ CHLORSULFONATED POLYETHYLENE _____ SILICONE
PLASTIC: _____ PVC ____ LOW-DENSITY POLYETHYLENE _____ CELLULAR POLYETHYLENE _____ TEFLON
_____ HIGH-DENSITY POLYETHYLENE _ POLYPROPYLENE _____ POLYURETHANE
_____ NYLON _ OTHER: _____
VOLTAGE RATING: _____ AC _____ DC WALL THICKNESS _____
LAY LENGTH PER INCH OF PAIRS: _____ LAY _____ TWIST
DRAIN WIRE: _____ SIZE _____ STRANDED __ SOLID _____ BARE COPPER _ TIN-COATED COPPER
COLOR _____
TEMPERATURE RATING: _____ 60° - 75°C (WET-DRY) __ 75°C - 90°C (WET-DRY)
_____ 90°C (WET-DRY) _____ OTHER: _____
SPECIAL REQUIREMENTS: _____

SHIELDING

TYPE SHIELDING: _____ BRAIDED _____ CONDUCTIVE PLASTIC
_____ CONDUCTIVE COTTON _____ SPIRAL-SERVED
_____ MYLAR FILM-ALUMINUM FOIL __ POLYESTER FILM-ALUMINUM FOIL
_____ OTHER: _____
POLYESTER FILM-ALUMINUM LOCATION: _____ INSIDE _ OUTSIDE _____ PAIR SHIELD ISOLATED
_____ SEPARATOR _____ FILTER

SHIELD COMBINATION

OVERSHIELD: _____ POLYESTER FILM-ALUMINUM __ BRAID _ SERVED
_____ OTHER: _____
BRAID SHIELD: _____ TYPE STRANDS _____% COVERAGE __ TINNED
_____ BARE _ COPPER _____ ALUMINUM
OVERALL TYPE: _____ POLYESTER _____ PAPER __ OTHER: ____
_____

JACKET

TYPE: _____ POLYVINYL CHLORIDE _____ POLYETHYLENE
_____ HEAVY DUTY NEOPRENE _____ CHLOROSULFONATED POLYETHYLENE
_____ NYLON _ OTHER: _____

ITEM NO. _____

DATA SHEET 3 of 4

JACKET (Cont)

THICKNESS (MILS OR MM) _____

COLOR: _____ BLACK _____ OTHER: _____

SPECIAL REQUIREMENTS: _____

ARMORING

TYPE: _____ INTERLOCKED (POSITIVE) OTHER: _____

MATERIAL: _____ GALVANIZED STEEL _____ ALUMINUM _____

_____ OTHER: _____

COVERING: _____ POLYVINYL CHLORIDE _____ OTHER: _____

COLOR: _____ BLACK _____ OTHER: _____

SPECIAL REQUIREMENTS: _____

MARKING

CONDUCTOR IDENTIFICATION

SINGLE-CONDUCTOR: _____

MULTI-CONDUCTOR: _____

CABLE MARKING

REQUIRED: _____ MANUFACTURER _____ CONDUCTOR SIZE

_____ NO. OF CONDUCTORS _____ VOLTAGE RATING

_____ UL LABEL _____ NEC TYPE

_____ TEMPERATURE RATING _____ MONTH/YEAR OF MANUFACTURE

_____ OTHER: _____

FACTORY TESTING/DOCUMENTATION

_____ PHYSICAL _____ _____ FLAME TESTS (SPECIFY STANDARDS) _____

_____ ELECTRICAL _____ OTHER TESTS: _____

_____ MEGGER

_____ OTHER: _____ _____

_____ _____

_____ _____

QUALITY ASSURANCE

_____ NO ADDITIONAL REQUIREMENTS _____ ATTACHED SPECIFICATION _____

PACKAGING

_____ DOMESTIC _____ EXPORT

SHIPPING

REEL TYPE: ____ RETURNABLE _ NON-RETURNABLE _____ LENGTH PER REEL _____

ADDITIONAL REQUIREMENTS: _____

ITEM NO. _____

DATA SHEET 4 of 4

1. [ ] **MANUFACTURER DATA**
2. CABLE DIMENSION (O.D. IN.) _____ SHIPPING TIME _____
3. CABLE CROSS-SECTIONAL AREA _____ OTHER _
4. CABLE WEIGHT (LBS/FT) _____
5. CABLE MIN BENDING RADIUS _____
6. TENSILE STRENGTH _____
7. GROSS WEIGHT/REEL (LBS) _____
8. TOTAL CUBIC FEET/REEL _____
9. SHORT CIRCUIT WITHSTAND CURVES _____
10. CABLE TESTING REQUIREMENTS _____
11.
12. **NOTES**
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ITEM NO. _____

Section 16131

DEVICE, PULL AND JUNCTION BOXES

PART 1 - G E N E R A L

1.01 SECTION INCLUDES

A. Specifications for device, pull, and junction boxes.

1.02 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA).

1. FB1 - Fittings and Support for Conduits and Cable Assemblies

2. 250 - Enclosures for Electrical Equipment (1000 volts maximum)

B. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA70 - National Electrical Code (NEC) - Article 314 - Outlet Device, Pull and Junction Boxes, Conduit Bodies and Fittings.

C. Underwriters Laboratories (UL):

1. 50 - Safety Cabinets and Boxes

2. 508 - Safety Industrial Control Equipment

3. 514B - Safety Fittings for Conduit and Outlet Boxes

4. 886 - Safety Outlet Boxes and Fittings for Use in Hazardous Areas

1.03 SUBMITTALS

A. Submit the following under provisions of Section 01330 – 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 PRODUCTS

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.

B. Cast Device Boxes

1. Appleton Electric Company
2. Crouse-Hinds, Division of Cooper Industries
3. Killark Electric Manufacturing Company

2.02 MATERIALS AND EQUIPMENT

A. Sheet Metal Boxes

1. Provide UL-approved junction boxes and pull boxes manufactured from stainless steel sheet metal and meeting requirements of NEMA 4X for corrosive and wet area, NEMA 250 and NEC Article 314.
2. Provide boxes with a stainless steel continuous hinge, closure hasps and all- stainless steel hardware. Junction boxes shall be mounted so the door opens to the right or to the left.
3. Furnish the door with neoprene gasket and provision for padlock.

B. Device Boxes

1. Provide UL-approved boxes designed and manufactured to house electrical devices like receptacles and switches, and in conformance with NEMA FB1 and NEC Article 314.

2. Supply boxes that are hot-dip galvanized on cast iron suitable for corrosive and wet atmosphere.

C. Hardware

1. Mounting Hardware: Stainless steel

2. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal.

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 314 in locations indicated on the Drawings. Junction boxes shall be mounted so the door opens to the right or to the left.

C. Install junction and pull boxes in readily accessible places to facilitate wire pulls, maintenance and repair. Junction boxes shall be sized for the number and size of conduits that enter the junction box.

D. Plug unused conduit openings.

E. Make conduit connections to sheet metal boxes with watertight conduit connectors.

F. Label boxes with phenolic nameplates as required in Section 16195.

END OF SECTION

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

A. Coordinate this specification with other specifications including the following related Sections.
Section 16111 - Conduit, Fittings and Bodies
Section 16140 - Wiring Devices
Section 16160 - Cabinets and Enclosures
Section 16170 - Grounding and Bonding

END OF NOTES

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 heavy duty plastic, gasketed with hinged covers that remain waterproof while still in use and stainless steel hardware.

2. All other plates: Type 302 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

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

A. Coordinate this specification with other specifications including the following related Sections.
Section 16131 - Device, Pull and Junction Boxes
Section 16170 - Grounding and Bonding

END OF NOTES

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 and motor controls.

1.02 REFERENCES

A. National Electrical Manufacturers Association (NEMA).

1. 250 - Enclosures for Electrical Equipment (1000 volts maximum).

a. NEMA 3 - Enclosures for outdoor use primarily to provide a degree of protection against wind-blown dust, rain, and sleet; undamaged by formation of ice on the enclosure.

b. NEMA 12 - Enclosures for indoor use primarily to provide a degree of protection against dust, falling dirt, and dripping non-corrosive liquids.

B. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA 70 - National Electrical Code (NEC), Article 312 - 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 01330 – 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.

H. Rittal

2.02 MATERIALS AND EQUIPMENT

A. Sheet Metal Boxes

1. Provide enclosures manufactured in accordance with NEMA 250 and NEC Article 312. Fabricate outdoor NEMA 3 panels from 0.125- inch thick type 5052 H32 aluminum or 14 gauge, 316 stainless steel for installation in areas that are not air conditioned. NEMA 12 indoor panels for installation in air conditioned areas shall be painted steel.

2. Dimensions and special features are shown on the Drawings.

3. Construct outdoor enclosures with continuously welded seams ground smooth.

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. Junction boxes shall be mounted so the door opens to the right or to the left.

6. Furnish the door with oil-resistant neoprene gasket attached with oil-resistant adhesive and held in place with aluminum retaining strips.

7. Use 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. Equip both NEMA 12 and NEMA 3 enclosures with thermostatically controlled space heaters and corrosion inhibitors. Provide heaters rated for 240V for 120V operation.

12. Weld mounting feet to the enclosure if called for on the Drawing.

13. Include a high impact plastic data pocket in the enclosure.

14. Provide ground connections on the enclosures to enable grounding of the enclosure with a No. 2 AWG conductor.

15. Equip free-standing outdoor cabinets with inner and outer door restraint bars to prevent door swing during windy conditions.

16. Supply indoor enclosures with filtered passive air intake and exhaust openings, 4-inch square in the side near the top and near the bottom of the adjacent side panel.

B. Hardware

1. Mounting Hardware: Stainless steel

2. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal.

2.03 TESTING

A. Test cabinets and enclosures in accordance with UL 50 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 NEC Article 312 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 as required in Section 16195.

G. Use pre-printed tubular heat-shrink type wire and cable markers to label each end of all conductors.

END OF SECTION

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

A. Coordinate this specification with other specifications including the following related Sections.
Section 16170 - Grounding and Bonding
Section 16195 - Electrical Identification
Section 16902 - Electric Controls and Relays

B. For pull boxes, junction boxes and terminal boxes, see Section 16131.

C. Paragraph 2.02A.11. A cooling fan package with filtered intake and exhaust may be provided for the NEMA 12 (indoor) enclosure only if heat build-up exceeds normal convection cooling.

END OF NOTES

Section 16161

PANELBOARDS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Specifications for panelboards.

1.02 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)

1. NEMA AB1: Molded Case Circuit Breakers

2. NEMA PB1: Panelboards

3. NEMA PB1.1: Instruction for Safe Installation Operation and Maintenance of Panelboards rated 600 volts or less.

4. NEMA PB1.2: Application Guide for Ground-fault Protective Devices for Equipment

B. Federal Specifications, FS W-C-375A: Circuit Breakers, Molded Case, Branch Circuit and Service.

C. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA No. 70 - National Electrical Code (NEC), Article 408 - Switchboards and Panelboards.

1.03 SUBMITTALS

A. Submit the following under provisions of Section 01330 – Submittal Procedures:

1. Manufacturer's cut sheets and catalog data

2. Breaker arrangement

3. Breaker characteristic curves

4. Instruction for handling and storage

5. Installation instructions

6. Dimensions and weights

1.04 DELIVERY, STORAGE AND HANDLING

A. Have panelboards 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. Sheet Metal Boxes

1. Cutler-Hammer Products

2. General Electric

3. Siemens Energy and Automation

4. Square D Company

5. Westinghouse Electric

2.02 MATERIALS AND EQUIPMENT

A. Basic Requirements

1. Use panelboards manufactured and tested in accordance with NEMA PB 1.

2. Provide circuit breakers of industrial grade, manufactured and tested in accordance with NEMA AB 1 and Federal Specification FS W-C-375.

3. Do not exceed 42 available single pole branch circuits in any one panelboard.

4. Perform a load analysis to assure the panel rating is not overloaded when new loads are added to existing panels.

B. Rating

1. Voltage rating, current rating, number of phases, number of wires and number of poles are indicated on Drawings.

2. Branch circuit breaker interrupting capacity shall be minimum 10,000 ampere RMS symmetrical for 208V; 25,000 ampere RMS symmetrical for 480V.

C. Circuit Breakers: Molded case, bolt-on thermal magnetic type with number of poles and trip ratings as shown on the Drawings. Provide ground fault interrupters with trip rating where shown on the Drawings.

D. Bus System

1. Bus Bars: 98 percent conductivity copper. Provide a solid neutral bar in 4-wire panelboards. Include ground bus in all panels. Provide split-bus panels where shown on Drawings.

2. Main: Circuit breaker or main lugs only as indicated on the Drawings or as required to meet the current interrupting ratings.

E. Box and Trim

1. Construction: Code grade steel, ample gutter space, flush door, flush snaplatch and lock.

2. Trim: Surface or flush as required. Enclose panelboards located outdoors, in other wet and corrosive areas, or in non air conditioned areas in NEMA 4X weatherproof stainless steel enclosures. Enclose indoor panelboards installed in air conditioned areas in a NEMA 1 enclosure with manufacturer's standard gray enamel finish.

3. Directory: Typed card, with glass cover in frame on back of door giving the circuit numbers and the area or equipment served.

F. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal.

PART 3 - E X E C U T I O N

3.01 PREPARATION

A. Review Drawings to verify that panelboards are correct for the application.

3.02 INSTALLATION

A. Install the panelboard in accordance with NEMA PB 1.1 and NEC Article 408.

B. Mount panelboards 6'-0" (to top of cabinet) above finished floor or grade. In wet and corrosive areas, including outdoor locations, install panel

enclosures on spacers to provide approximately 1/4-inch between back of cabinet and mounting surface. Mounting hardware shall be type 316 stainless steel.

C. In wet and corrosive areas, including outdoor locations, connect conduit to the bottom of enclosure and to the lower 30 percent of the sides using watertight connectors.

END OF SECTION

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:
****

A. Coordinate this specification with other specifications including the following related Sections.
Section 16111 - Conduit, Fittings and Bodies
Section 16160 - Cabinets and Enclosures
Section 16170 - Grounding and Bonding

B. Paragraph 2.02B.2. Verify the adequacy of breaker interrupting capacities stipulated at each point of application.
****

END OF NOTES

Section 16165

DISCONNECT SWITCHES

PART 1 - G E N E R A L

1.01 SECTION INCLUDES

A. Specifications for disconnect switches including:

1. Fusible disconnect switches
2. Non-fusible disconnect switches
3. Circuit breaker type disconnect switches
4. Fuses
5. Circuit breakers

1.02 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)

1. NEMA AB1: Molded Case Circuit Breakers
2. NEMA KS1: Enclosed Switches

B. Underwriters Laboratories (UL)

1. UL 98: Standard for safety enclosed switches and Dead Front Switches
2. UL 198C: High Interrupting Capacity Fuses, Current Limiting type
3. UL 198E: Class R Fuses

C. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA No. 70 - National Electrical Code (NEC), Chapter 4.

1.03 SUBMITTALS

A. Submit the following under provisions of Section 01330 – Submittal Procedures:

1. Manufacturer's cut sheets and catalog data

2. Switch internal arrangement

3. Breaker or fuse characteristic curves

4. Instructions for handling and storage

5. Installation instructions

6. Dimensions and weights

1.04 DELIVERY, STORAGE AND HANDLING

A. Have disconnect switches 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. Disconnect Switches and Circuit Breakers:

1. Cutler-Hammer Products

2. General Electric

3. Siemens Energy and Automation

4. Square D Company

5. Westinghouse Electric

B. Fuses

1. Bussman Division, Cooper Industries

2. Gould Shawmut

3. Littelfuse Incorporated

2.02 MATERIALS AND EQUIPMENT

A. Disconnect Switches

1. Characteristics: Horsepower rated, 600-volt, heavy-duty type with an interlocked door, positive quick-make, quick-break mechanism and visible blades.

2. Use switches and components designed, manufactured and tested in accordance with NEMA AB1, NEMA KS1, UL 98, and NEC Chapter 4.

3. Enclose switch in a NEMA 12 type enclosure for indoor, air-conditioned applications and NEMA 4X (type 316 stainless steel) in outdoor locations, non air-conditioned areas, or other wet or corrosive areas.

4. Provide switches with provisions for padlocking the operating lever in OFF position and door in closed position.

5. Select switches having the number of poles and general size conforming to the Drawings.

6. Conform to fusible, non-fusible or circuit breaker type switch requirements as shown on Drawings and required by the NEC, or one-line diagrams.

7. Provide an auxiliary contact, shown on the Drawings.

8. Select fuses or circuit breakers with current interrupting duty as calculated for the points of switch application or as indicated on the Drawings or one-line diagrams.

B. Fuses. Unless otherwise noted on Drawings, for fuses used in disconnect switches, provide the dual-element, time-delay type with the maximum interrupting rating of 200,000 amperes, conforming to the NEC.

C. Circuit Breakers. When circuit breakers are used in disconnect switches, provide the thermal-magnetic type with current interruption ratings as required at the point of application.

D. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal.

PART 3 - E X E C U T I O N

3.01 PREPARATION

A. Review the Drawings and verify that the disconnect switches are correct for the applications.

B. Make sure that the correct fuses or breakers are being used regarding size and short circuit interrupting capability.

C. Prepare adhesive labels on the inside door of each switch indicating UL fuse class and size or breaker type and size for replacement.

3.02 INSTALLATION

A. Install the disconnect switches in accordance with and NEC Chapter 4. Disconnect switches shall be mounted in sight of or within 25' of motors and rotating equipment.

B. Mount switches 6'-6" (to top of cabinet) above finished floor or grade.

C. In wet and corrosive areas, including outdoor locations, install switches on spacers to provide a space of approximate 1/4-inch between the back of cabinet and the mounting surface.

D. In wet and corrosive areas, including outdoor locations, connect conduit to the bottom of enclosure and to the lower 30 percent of the sides using watertight connectors.

E. Disconnect shall be labeled as required in Section 16195.

END OF SECTION

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

A. Coordinate this specification with other specifications including the following related Sections.
Section 16111 - Conduit, Fittings and Bodies
Section 16160 - Cabinets and Enclosures
Section 16170 - Grounding and Bonding

END OF NOTES

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 01330 – 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 or insulated, 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 or green tape marking.

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. Electrical equipment, buildings, tanks, and other structures and equipment shall be grounded as indicated on the Drawings. 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. Ground wells will be provided for all driven rods.

C. Local pushbutton and selector switch stations, two-wire control devices, disconnect switches, lighting transformers, panelboards, operator panels, benchboards, and the enclosures of other electrical apparatus shall be grounded through and equipment grounding conductor run with the power supply or control circuit conductors or shall be grounded as shown on the Drawings.

D. Ground medium voltage motors, in addition to the grounding conductors in the motor feeder cable, with a separate No. 4/0 AWG cable to motor frame.

E. Motors having power supplied by multiconductor 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.

F. Do not ground the insulated bearing pedestals of large motors.

G. Connect ladder-type cable trays to the grounding electrode system.

H. Install a warning ribbon approximately 12 inches below finished grade directly above the ground grid.

I. Connect fence posts of chain link and metal fences to the main ground loop at least every 50 feet. Install bonding straps to gates.

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 a grounding conductor is 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 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 or through an impedance. See Drawings for 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 jumpering 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 ground test well using a "fall of potential" test method. Each ground test well shall not exceed a maximum resistance of 5 ohms. Where measured values exceed this figure, install additional ground rods as required to reduce the resistance to the specified limit.

H. Inspection. Inspection of the grounding system by the Project Manager and the local Code Inspector must take place before the grid trenches are backfilled.

END OF SECTION

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

A. Coordinate this specification with other specifications including the following related Sections.
Section 16111 - Conduit, Fittings and Bodies
Section 16120 - 600-Volt Building Wire and Cable
Section 16670 - Lightning Protection System

B. Paragraph 2.02 The design is based on a grounding grid completely surrounding the project site with laterals picking up grounding of equipment, steel structures, power systems grounding, and metal fence grounding.
The material and systems requirements shall be based on soil resistivity and associated calculations.
The ground resistance to earth shall be 5 ohms maximum. Maximum resistance between equipment and ground system shall be 1 ohm.
CAUTION: If cathodic protection is applied to the underground sewer pipe, the pipe must not be tied in with the general grounding system, either directly through grounding cable or indirectly through grounded electrical devices connected to the pipe. Electrical devices must, in this case, be electrically isolated from the sewer pipe.

END NOTES

SECTION 16171

LOW VOLTAGE MOTORS

PART 1: GENERAL

1.01 SECTION INCLUDES

A. Specification for low voltage motors.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be provided for work performed under this Section. Include the cost for this work in the lump sum base bid.

B. Refer to Section 01270 – Measurement and Payment.

1.03 REFERENCES

A. American National Standards Institute/Anti-Friction Bearing Manufacturers Association (ANSI/AFBMA): Load Ratings and Fatigue Life for Ball Bearings.

B. American National Standards Institute/national Electrical Manufacturers Association (ANSI/NEMA): MG 1 - Motors and Generators.

C. American National Standards Institute/National Fire Protection Association (ANSI/NFPA): NFPA 70 - National Electrical Code (NEC).

D. American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

1. IEEE112 – Standard Test Procedure for Polyphase Induction Motors and Generators

2. IEEE114 – Standard Test Procedure for Single-Phase Induction Motors

E. American National Standards Institute/Underwriters Laboratories, Inc. (ANSI/UL)

1. UL547 – Thermal Protectors for Motors

2. UL674 – Electric Motors and Generators for Use in Hazardous Locations, Class I Groups C and D, Class II Groups E, F and G

F. Institute of Electrical and Electronics Engineers (IEEE)

1. 85 – Test Procedure for Airborne Sound Measurements on Rotating Electric Machinery

2. 43 – Recommended Practice for Testing Insulation Resistance of Rotating Machinery

G. American Society of Heating, Refrigerating, and Air-conditioning Engineers, Inc./ Illumination Engineering Society of North America (ASHRAE / IES): 90.1-1989, Table 5.1 – Minimum Acceptable Nominal Full-load Motor Efficiencies for Single Speed Polyphase Motors.

1.04 SUBMITTALS

A. Submit the following under the provisions of Section 01330 – Submittals:

1. Outline drawings

2. Completed motor data sheets

3. Assembly drawings

4. Anchor bolt location drawings

5. Electrical schematics and wiring diagrams

6. Equipment performance curves and data

7. Bill of installation/assembly materials

8. Equipment weights

9. Catalog data

10. Operating instructions

11. Maintenance and lubrication recommendations

12. Recommended spare parts for startup including prices

13. Recommended spare parts list for one year operation

14. Quality control procedures

15. Surface preparation and painting procedure per manufacturers standard

16. Shipping, handling, and storage procedures

17. Installation/erection procedure

18. Code compliance certificate

19. Electrical equipment heat run test records

20. Nameplate data

21. Performance/acceptance test report (unwitnessed)

22. Size of the largest three phase power factor correction capacitor unit which can be connected to three phase motors.

1.05 QUALITY ASSURANCE

A. Tests

1. Inspect and test motors in accordance with specified NEMA standards. Test polyphase motors to the requirements of ANSI/IEEE 112. Test single phase motors to the requirements of ANSI/IEEE 114. See data sheets for other standard test requirements that may be specified.

1.06 DELIVERY, STORAGE AND HANDLING

A. Prepare each unit for the type and mode of shipment specified. The preparation shall be suitable for at least six months of outdoor storage from time of shipment requiring no disassembly prior to operation (except for bearing and seal inspections).

B. Provide instructions as necessary to preserve the integrity of the storage preparation after the equipment arrives at the jobsite.

C. Coat exterior machined surfaces with a suitable rust preventative.

D. After drained and cleaned, coat internal areas of bearings and auxiliary equipment in oil lubrication systems fabricated from carbon steel with a suitable oil-soluble rust preventative.

E. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic plugs or caps.

F. When sleeve bearings are furnished, block the rotor to prevent axial and radial movement.

G. When space heaters are furnished, make heater leads accessible without disturbing the shipping package. Tag the leads for identification.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. General Electric.

B. Reliance Electric.

C. Siemens.

D. Toshiba.

E. U.S. Motors.

F. TECO-Westinghouse Motor Company

2.02 DESIGN

A. This specification defines the minimum requirements for low-voltage, random-wound, squirrel-cage, induction motors in the NEMA frame sizes for nonclassified electrical area service.

B. Use this specification for the selection and purchase of induction motors purchased separately or furnished with driven equipment as a package.

C. This specification, along with the reference documents make up the requirements for motors up to and including 300 hp. Use driven equipment specifications to supplement this specification and identify special project requirements.

D. Motors purchased with this specification will drive vertical pumps. Motors will be installed in a plant environment that may include high humidity, storms, salt-laden air, insects, plant life, fungus, rodents as well as traces of petroleum and/or chemicals.

E. Motors shall perform satisfactorily for the application and unusual conditions specified herein.

F. Make motors suitable for operation in an outdoor corrosive and wet environment.

G. When motors are furnished with the driven equipment as a package, motors shall also meet the requirements of the driven equipment specification.

H. Design motors for operation at a temperature of up to 40 degrees C/104 degrees F ambient and at an elevation of up to 1000 m/3300 ft above sea level.

2.03 PERFORMANCE REQUIREMENTS

A. Confirm motors have ample capacity to supply the maximum output demanded by the driven equipment and have a speed-torque-current characteristic appropriate to the driven equipment. Where new motors are provided for existing pumps, match new motor characteristics to pumps.

B. Confirm motors ability to overcome starting load inertia and accelerate the load to rated speed within 15 seconds at 80 percent of rated nameplate voltage, without exceeding the motor time-temperature damage curve.

C. Design and construct motors for continuous full load duty. Motors may also operate intermittently.

D. Three-phase induction motors shall be ANSI/NEMA MG 1 Design B. Motors driving high-torque loads may be NEMA Design C or D.

E. Single-phase fractional horsepower motors shall be NEMA Design N.

F. The single speed, polyphase motors shall have efficiencies which exceed those shown in ASHRAE/IES Standard 90.1 - 1989, Table 5-1 and ANSI/NEMA MG-1-1998 Table 12-10. Provide motors commonly referred to as "NEMA Premium Efficiency" in the industry.

2.04 ENCLOSURES AND FRAMES

A. Motors shall be provided with NEMA Type TEFC enclosures.

B. Motors frames, enclosures, terminal boxes, fan cover guards and air passages shall be cast iron or heavy fabricated steel of such design or proportions as to hold all motor components rigidly in proper position, and shall meet all NEMA requirements for the type of enclosure employed.

End bells shall be cast iron. Steel sheet or plate used shall have a thickness of at least 1/8 in. Fans, breathers, drains, screens, covers and hardware shall be corrosion-resistant materials. Fractional horsepower motors may have rolled steel stator frame and cast iron brackets with integral mounting feet.

C. Make motor enclosure fans low inertia, nonsparking type, and suitable for bidirectional rotation and mount on hub with stainless steel bolts.

D. Furnish each enclosure with a stainless steel automatic breather/drain located at the low point of the enclosure.

E. Motor frame and enclosure shall have provisions for grounding to the main grounding system. Drill and tap rear foot on horizontal motors and the flange base on vertical motors on the junction box side for a service post ground connector.

F. Provide motors weighing more than 300 lbs. with lifting eyebolts, rings or lugs capable of supporting the weight of the motor.

2.05 ELECTRICAL REQUIREMENTS

A. Motors shall be rated as follows:

1. 460 volts, three phase, 60 Hz.

2. 230 volts, three phase, 60 Hz.

3. 230 volts, single phase, 60 Hz.

4. 115 volts, single phase, 60 Hz.

B. Induction motors shall be random-wound, squirrel-cage rated for continuous duty and suitable for across-the-line starting, at rated voltage.

C. Determine motor speed, torque and special operating requirements from the requirements of the driven equipment.

D. Use copper for motor windings and terminal leads. Aluminum is not an allowable material for any portion of the motor other than die-cast rotor (fabricated aluminum rotors are not acceptable). Copper rotors shall not be fabricated using brazing maler and any copper alloy must contain less than two percent phosphorous.

E. Three-phase single speed AC motors shall be provided with three leads.

F. Motors shall have a 1.15 service factor (SF) rating unless specified otherwise.

G. Motor insulation shall be a minimum of Class F epoxy nonhygroscopic material with temperature rise limited to Class B design rise of 90 degrees C by resistance method at 1.15 SF. Inverter Duty Motors shall have the highest voltage rated insulation system available for application on the output of VFD's (Variable Frequency Drives). As a minimum, inverter duty motors shall use Phelps–Dodge type QS magnet wire which is pulse resistant, in combination with the motor manufacturer's insulation system.

H. Motors shall operate successfully under running conditions at rated load with variation in voltage and frequency up to the limits set by ANSI/NEMA MG 1-12.44.

I. Unless specified otherwise, motors shall be suitable for the number of full-voltage starts as required by ANSI/NEMA MG 1-12.50 as a minimum.

J. Locked rotor kVA/HP shall not exceed 5.0

K. Motors operated on VFD's shall be rated as inverter duty.

2.06 TERMINAL BOXES

A. Make motor terminal boxes weatherproof and with threaded conduit entrances with water-resistant seals between boxes and motor frame. Design the line-terminal box to allow box to be rotated in four 90 degree steps for bottom, side or top entry of conduit or cable. The line terminal box shall match the location indicated on project drawings. Locate a separate terminal box for space heaters adjacent to the line terminal box. Provide a separate terminal box for RTD's.

B. Size the line terminal box so that feeder cables can be connected to motor leads for terminals without damage to the cable or the leads. Oversize the terminal box to exceed the minimum volumes shown in the NEC Section 430-12 and provide adequate space to mount and enclose all devices mounted within.

C. Furnish the line terminal box with suitable compression ring-type, permanently numbered, cable connectors for incoming bolted-cable connections and one clamp-type ground terminal lug of sufficient size to contain a conductor the same size as motor leads.

D. Wire accessory leads to a terminal board in a terminal box or boxes separate from the line leads. Supply separate terminal boxes for the leads

for space heaters, and temperature detectors, current transformers, and other similar accessories, when supplied.

2.07 ELECTRICAL ACCESSORIES

A. For motors 25 Hp and larger, provide space heaters for optimum uniform heating of the stator winding and prevent condensation in the motor at ambient temperature when motor is not in operation. Space heaters shall be rated 240 V but shall be connected for operation at 115V. Space heaters shall have maximum sheath temperature of 150 degrees C and shall be approved for the specified hazardous area classification, if so classified.

B. Provide motors larger than 200 horsepower with a minimum of six, three-wire, 100 ohm, platinum RTDs, two per phase, spaced equally around the circumference of the stator. Include three additional spare RTD's, one per phase, as spares and label as spares.

C. Provide motors larger than 200 horsepower with three-wire, 100 ohm, platinum RTDs, one per bearing.

2.08 BEARINGS AND LUBRICATION

A. Provide oil-lubricated anti-friction ball or roller bearings for motors 200 Hp and larger. Provide grease lubricated bearings for motors less than 200 Hp.

B. Motors shall have proper bearing insulation to prevent circulation of shaft currents and resulting damage. Provide also insulating means for any oil-supply connections and monitoring equipment to prevent electrical bypassing of the bearing insulation.

C. Unless specified otherwise, oil lubricated bearings shall have an L10 rating life in accordance with ANSI/AFBMA 9, of at least 100,000 hours. Grease lubricated bearings shall have a rating life of at least 40,000 hours.

D. For oil lubricated motors, provide oil-lubricated bearing housings and a reservoir of sufficient depth, to serve as a settling chamber for foreign materials, with a drain plug, and vents as required, accessible from the exterior of the motor. Furnish oil-lubricated motors with a constant oil-level sight gauge mounted on the motor housing and marked with running- and stopped-oil levels.

E. Provide motors with suitable seals to prevent moisture from entering through the shaft openings. For applications where hoses and water are

used for cleanup, provide an Inpro/Seal isolator (labyrinth seal) on the shaft end of the motor.

F. For in-line pumps, special high thrust bearings are required for drive motors, except for pumps where the thrust bearings are provided as an integral part of the pump.

2.09 ADDITIONAL REQUIREMENTS FOR VERTICAL MOTORS

A. Solid shaft vertical motors are acceptable for all applications except when the connection to the driven equipment consists of sectional driven shaft which may unscrew and lengthen in the event of reversal of direction.

B. Design vertical motor thrust bearings conservatively to carry maximum axial thrusts (up and down) imposed by driven equipment.

C. Vertical motors shall have oil-lubricated, top and bottom bearings.

D. Vertical motor bases shall be NEMA Type P.

E. Provide vertical motors with a positive, nonreversing, corrosion-resistant ("anti-ratchet") mechanism.

F. Provide vertical motors with fan-end splash shields.

G. Where new motors are being provided for existing pumps, motor mounting must match the existing pump, and new shaft couplings shall be provided to couple the pump to the new motor.

2.10 SLIDING BASE AND SOLE PLATE REQUIREMENTS – Not Used

2.11 ROTOR BALANCING AND VIBRATION

A. Balance motor rotors dynamically according to NEMA standards. Depositing weld metal, solder and the like on the rotor to effect a balance will not be acceptable. Remove parent metal to achieve balance without affecting the structural strength of the rotor. Chiseling or sawing parent metal is prohibited.

B. Measure vibration in all directions with the motor running uncoupled at no load, normal voltage and frequency, and at each speed of the operating range. Motor vibration shall not exceed the total amplitude, peak-to-peak values given in ANSI/NEMA MG 1-Part 7 as measured in accordance with ANSI/NEMA MG 1-Part 7. Perform a second test and measure vibration in all directions with the motor running coupled to the load with normal load, normal voltage, normal frequency, and typical speed.

2.12 NAMEPLATES

A. Fasten motor stainless steel nameplates securely to the motor with stainless steel screws. Nameplates shall include as a minimum the information required by ANSI/NEMA MG 1-16.61.

2.13 FINISH

A. Motors shall be primed and finished using the motor manufacturer's standard epoxy painting system unless specified otherwise.

B. Cover internal surfaces, e.g., shaft, rotor, stator, and other similar components, with a corrosion-resistant coating of epoxy or equal material for increased life.

2.14 NOISE LEVELS

A. Determine motor noise level in accordance with IEEE 85. Levels or noise generated by a motor shall not exceed 85 dbA at a distance of 1 m/3.3 ft unless specified otherwise on the data sheet.

B. Noise level requirements may be also covered by a separate noise requirements specification included with the driven equipment specification.

PART 3: EXECUTION

3.01 PREPARATION

A. Verify motor and motor base match mounting provisions for the driven equipment.

3.02 INSTALLATION

A. Install the motor in accordance with the Manufacturer's published instructions using the necessary tools and instrument to ensure proper fit and alignment with the driven machine.

B. Install overload relay heaters sized for motor full load current.

C. Before coupling up with the driven machine, the following work should be performed.

1. Test the motor winding insulation resistance in accordance with IEEE 43.

2. Terminate cables to the motor leads.

3. Energize motor momentarily to check rotation.

4. Check shaft of driven machine to ensure free movement.

D. Couple motor up with driven machine.

E. Record motor nameplate data.

END OF SECTION

Section 16175

LOW VOLTAGE VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section covers AC voltage source, Pulse Width Modulated (PWM) type Variable Frequency Drives (VFDs) for general or high performance constant or variable torque loads as shown on the project drawings or noted in project motor list.

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.

1.03 REFERENCES STANDARDS

A. Each variable frequency drive shall be designed, constructed, and tested in accordance with the applicable standards listed below.

1. Institute of Electrical and Electronic Engineering (IEEE). Standard 51-1992, IEEE Guide for Harmonic Content and Control.

2. Underwriters Laboratories (UL). UL508

3. National Electrical Manufacture's Association (NEMA). ISC 6, Enclosures for Industrial Controls and Systems.

4. International Electrotechnical Commission (IEC). IEC 801-2, 801-4, 255-4.

5. National Fire Protection Association (NFPA 70), National Electrical Code (NEC).

1.04 RELATED DOCUMENTS.

A. Project motor list to contain application description, environmental descriptions for variable frequency drive, and motor information (if

available). Refer to specification 11311 Submersible Wastewater Pumps.

1.05 SUBMITTALS

A. Submit product data, shop drawings and samples (if samples are requested by the City Engineer) under provisions of Section 01330 - Submittal Procedures.

1. Submit in complete packages grouped to permit review of related items as outlined in these specifications including but not limited to the pump monitoring and protection system.

2. Bind submittals in three-ring binders with complete indexing and tab dividers. Completely tag and label equipment information to correspond with Drawings.

3. Review of Submittals will be for conformance to Contract Documents and for application to specified functions.

B. Product Data: Submit descriptive product literature including manufacturer's specifications for each component specified.

C. Drawings

1. Name of manufacturer.

2. Types and model numbers.

3. Rated drive power.

4. Percent efficiency at 100 percent speed and 100 percent load.

5. Front and side views with overall dimensions and weights shown; and nameplate legends.

6. Schematics, including interlocks.

7. Parameter list.

8. Minimum operating speed per motor.

9. Wiring diagrams, including all internal and external devices and terminal blocks.

10. List of diagnostic indicators.

11. List of spare drives and/or parts to be furnished.

D. Quality Control Submittals

1. Factory Test Reports: Drives supplier to provide typical factory test description. Drives are to be 100% tested at the factory prior to shipment. All drives are to be powered with a motor load.

2. Field Reports: Drives commissioned in the field by the contractor manufacturers are to include start-up report. The report will include installation overview, application description, drive wiring description, and parameter settings as programmed for the application. Comments on drive performance as commissioned shall be also noted in the field report.

E. Operations and Maintenance (O&M) Data.

1. Submit operation and maintenance data notebook in accordance with Section 01782 - Operations and Maintenance Data.

2. Information and drawings submitted must reflect the final installed condition. Revise documents requiring updates following testing and start-up.

3. In addition to the content specified in Section 01782 - Operation and Maintenance Data, provide the following information:

a. Name, address and telephone number of the VFD supplier's local service representative.

b. Complete list of supplied system hardware parts with full model numbers referred to system part designations, including spare parts and test equipment provided.

c. Copy of approved submittal information and system shop drawings as specified in Paragraph 1.3, Submittals, with corrections made to reflect actual system as tested, delivered and installed at the site. Provide half-size blackline reproductions of all shop drawings larger than 11 inches x 17 inches.

d. Start-up software.

e. Parameter list and drive software configuration file.

f. Manufacturer's hardware, software, installation, assembly and operations manuals for the VFD. Provide all manuals in PDF format DVD-RW.

F. Project Record Documents

1. Submit record documents under provisions of Section 01785 - Project Record Documents.

2. Insert half-size blackline prints of wiring diagrams and parameter lists applicable to each drive unit in a clear plastic envelope and store in a suitable print pocket or holder inside each drive panel.

1.06 QUALITY ASSURANCE

A. Manufacturer's Qualifications: The VFD shall be designed and manufactured to a quality management system in according with ISO 9001 and ISO 14001. The VFD shall be supplied by a manufacturer who has considerable experience in the design and manufacturing of VFD of the ratings specified for a period of at least ten (10) years.

1.07 DELIVERY, STORAGE AND HANDLING

A. The construction/installation manager is to protect the inverter against physical shocks and vibration during transport or storage. The equipment shall also be protected against water (rainfall) and excessive temperatures. Installation after a prolonged period of storage may require reform of the capacitors in the inverter. Consult manufacturer for details.

B. Check for damage upon receiving products on site.

C. Store products in a clean, dry area; maintain temperature in accordance with NEMA ICS 1.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Maintain area free of dirt and dust during and after installation of products.

B. Provide temporary heating and air conditioning units and equipment required to maintain environmental conditions specified for VFDs.

PART 2 PRODUCTS

2.01 VARIABLE FREQUENCY DRIVE (VFD)

A. Manufacturer and Model: Siemens Energy & Automation model MicroMaster MM440; ABB model ACS550, or approved substitute.

B. Service Ratings: Provide variable frequency controllers suitable for operating variable or constant torque loads. Controllers shall be sized for at least 10% larger than the motor. Controllers shall meet or exceed the ratings listed below:

1. Rated input voltage: 200 – 240 volts, 400-500, or 500-600 volts plus or minus 10 percent, three phase. Rated frequency: 60 hertz plus or minus 2 percent.

2. Drives must comply with IEEE 519 by means of active front end and output technology and output technology filters or use of multiphase 18 pulse technology.

3. VFD power range to be available from 1 to 600HP where VFD shares common programming, human interface, and options. Product family to be available in 8 mechanical sizes as follows:

4. Motor nameplate voltage: 230, 460, or 575 volts, three phase 60 hertz (as specified on motor list).

5. Displacement power factor: between 1.0 and 0.95, lagging, over entire range of operating speed and load.

6. Operating ambient temperature: 32 to 122 degrees F or 0 to 50 degrees Provide HVAC system to keep drives functional within the listed temperature ranges.

7. Minimum efficiency at full load: 96 - 97 percent.

C. Configuration

1. Variable frequency drive to have modular construction to allow for maximum configuration flexibility.

2. Inputs and outputs for the VFD to shall be a minimum of six programmable digital inputs. Two fully programmable analog outputs, and three fully programmable relay outputs.

3. Drive shall be capable of switching frequencies of 4, 8 and 12 kHz."

4. Complete inverter and motor protection. Include pump monitoring and protection system.

5. Product to provide simple commissioning macro to program the VFD for the application, motor data, and control information. In addition, the drive to provide automatic calibrate routine to optimize motor electrical characteristics within the VFD.

D. Features and Performance

1. Latest IGBT technology and Digital microprocessor control.

2. PID control loop for process control shall be provided with automatic tuning routine.

3. Fast, repeatable digital input response time with NPN/PNP Source-Sink control adaptability. As a minimum, the drive shall provide at least three programmable digital inputs for control of these typical inverter functions:

   a. On Fwd

   b. Fault reset

   c. Direction

4. As a minimum, the drive shall provide three digital outputs for signal indication of any one of these functions:

   a. Inverter running

   b. Inverter frequency 0.0 hertz.

   c. Motor direction in reverse

   d. Fault indication

5. PC interface port with all required hardware and software for configuration and monitoring.

6. Programmable acceleration/ deceleration, 0 s to 650s with Multi-curve, adjustable ramp smoothing.

7. Flying restart.

8. Automatic restart following power failure or fault.

9. Fast current limit (FCL) for trip free operation.

10. Provide the following short circuit and input protective features:

    a. Solid-state instantaneous over-current trip set at minimum 265 percent.

    b. Under voltage protection.

    c. Transient surge protection.

    d. Transistor over temperature and over current protection.

    e. Current limit circuit to automatically phase back output current and frequency to prevent excessive currents from damaging motor insulation (frequency output rollback).

    f. Microprocessor fault/memory chip error.

    g. DC bus over voltage trip.

11. Provide the following output protective features:

    a. Inverse time motor overload protection, UL approved for motor protection, (I squared T trip).

    b. Thermal sensor detection, thermistor or thermostat for motor overtemperature.

    c. Protection against opening or shorting of motor leads.

    d. Critical frequency avoidance circuit. Minimum three (3) set points selective from 0 to maximum frequency. Bandwidth of set points to be adjustable.

12. RS485 communications interface is to provide monitoring and setting of all operating and fault parameters within the VFD. In addition, the RS485 interface shall be capable of monitoring digital input status of the VFD while providing direct access to the relay

outputs and the analog outputs of the drive.

13. The following conditions shall cause an orderly drive shutdown and lockout:

    a. Overcurrent at start-up

    b. Instantaneous over current

    c. Over temperature of VFD or external fault

    d. Motor over temperature

    e. Ground fault in motor output circuit
    f. Over voltage during shut down

    g. Motor I squared T trip

14. The drive shall record and display the last four (4) faults that occurred in the drive. The drive shall also display the last warning message experienced by the inverter.

15. The drive shall provide two 0 to 20-milliamp analog output signals proportional to the output frequency, output current, frequency setpoint, motor RPM, bus voltage.

16. The drive shall have the capability to perform an automatic motor calibration test and adjust its internal settings automatically without any special tools or instruments.

17. The drive shall have the capability to be reset to factory conditions via parameter change.

2.02 Advanced Operator Panel

A. Manufacturer and Model: Siemens Energy & Automation MicroMaster AOP; or approved substitute.

B. The manufacturer of the VFD to provide digital keypad/display capable of controlling the drive and setting the drive parameters. The digital display will have a minimum of 4 line by 16-character LCD panel that is backlit for easy readability. The LCD device for the VFD will be capable of bus master operation with multiple AC drives of the same family. Broadcast messages shall be possible. The operator panel shall have the capability to store up to 3 different parameter sets. A minimum of 5 languages to

include English as one of option that will be available in the device. The panel can normally display:

1. Frequency in hertz.
2. Drive status
3. Output voltage.
4. Motor speed.
5. Output current.

C. The digital keypad shall allow operators to enter exact numerical settings in English engineering units. These parameters shall be adjustable for specific project application requirements on site. All setup operations and adjustments will be digital, stored in non-volatile (EEPROM) memory. As a standard feature, these variables shall be protected from unauthorized tampering, revision, or adjustment by password code. The digital keyboard shall have six keys to provide easy programming of the drive. These keys shall include:

1. Up and down arrow keys to increase or decrease output frequency or data values.
2. Run and stop keys for starting and stopping in the manual mode.
3. Program key to enter the program mode and adjust parameters.
4. Programmable Maintenance Assist Application
5. Protocol Assist Application

D. Include Operator Panel Door Mounting Kit if door mounting is specified.

2.03 Networking Interfaces

A. Profibus-DP Network Communication Module to be mounted on front of VFD.

B. Ethernet Network Communication Module to mounted on front of VFD.

2.04 Programming Interface

A. PC connection kit with drive module and communication cable to be provided.

PART 3 EXECUTION

3.01 INSTALLATION

B. Verify that mounting surface is suitable for controller installation.

C. Do not install controller until building environment can be maintained within the service conditions required by the manufacturer.

3.02 RELATED INSTALLATION REQUIREMENTS

A. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.

B. The manufacturer shall have the capability and personnel to assist in the start-up, training, service and maintenance of the equipment.

C. Provide bypass contactor to perform emergency operation when dive is not functional.

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 Houston 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 01330 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 and instrumentation 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 and instrumentation equipment, devices, or enclosures, such as MCC's, panelboards, 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 panelboard 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 panelboards (i.e., lighting, instrument or receptacle panels). State the panelboard name, the drawing number on which the panelboard schedule shows, and the main breaker feeding the panel (MCC No. and compartment).

8. Type panelboard directories and insert them inside the panelboard doors.

9. Place a large nameplate no less than 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 braided wire.

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. Warning Labels

3. Place OSHA safety labels on enclosures and boxes 100 cubic inches

or more containing electrical equipment or terminations.

4. Provide OSHA color codes for the labels. Use labels made from 4 mil vinyl with pressure sensitive adhesive backing.

5. The warning label caption is DANGER - 480 VOLTS or as indicated on the drawings

6. 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, panelboards, 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

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

A. Coordinate this specification with other specifications including the following related Sections.
Section 16111 - Conduit, Fittings and Bodies
Section 16120 - 600-Volt Building Wire and Cable
Section 16121 - 600-Volt Control Cable
Section 16126 - Instrumentation Cable
Section 16160 - Cabinets and Enclosures
Section 16170 - Grounding and Bonding
Section 16402 - Underground Duct banks

END OF NOTES

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.

D. All 90 degree elbows in an electrical/instrumentation duct banks shall be PVC Coated RGS conduit.

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 Project Manager, Wastewater Inspectors 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 as detailed on the Drawings.

R. Where multiple conduits are grouped together in an electrical/instrumentation duct bank, the concrete shall be vibrated.

END OF SECTION

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

A. Coordinate this specification with other specifications including the following related Sections:
Section 02220 - Structural Excavation, Fill Backfill
Section 03100 - Concrete Formwork
Section 16111 - Conduit, Fittings and Bodies

END OF NOTES

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 01330 – 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. When called for on the one-line diagrams, provide the power factor correction by an automatic capacitor bank.

9. Connect the capacitor bank to the main power supply bus immediately down-stream from the ammeter and voltmeter in the motor control center.

10. Select individual capacitors as described for the individual motor power factor correction capacitor.

11. Use a capacitor bank with a modular design to allow for expansion by adding capacitor units and control devices.

12. Mount capacitors and control system in an enclosure suitable for the environment and as specified in Section 16160 - Cabinets and Enclosures.

a. If installed outside, provide a NEMA 3 gasketed enclosure.

b. If installed inside a building, provide a NEMA 12 enclosure.

c. Mount capacitors on wall above indoor motor control centers.

If a motor control center is part of the plant design, install controls for the automatic power factor correction capacitors in a motor control center section.

B. Automatic Power Factor Control: Where specified, provide controls to permit an operator to select a target power factor adjustable to any value between 0.95 leading and 0.80 lagging. The controls continuously sense the power factor on the circuit being corrected and, when it differs from the target setting for more than 10 seconds, operate a contactor to switch a capacitor bank into or out of the circuit. Contactors are opened or closed as required to bring the corrected circuit power factor closer to the target setting. Only one capacitor bank is switched at a time.

C. Controls. The controls for the automatic power factor correction shall comply with NEMA ICS-2 with quantities, ratings, mounting provisions and sensing, and power connections as shown on the one-line diagrams. System features and components shall include:

1. Basic control system: solid-state microprocessor-based.
2. Three-pole 600-volt rated contactors for repetitive high-inrush-switching duty presented by capacitor loading.
3. Fuses or circuit breakers for protection of wiring, contactors and capacitors.
4. Air-core-type inductors mechanically braced to withstand the maximum fault current available at the point of application may be installed in the capacitor circuit to limit switching surges to within contactor ratings.
5. Indicating lights designating energized capacitor banks.
6. The power bus, when required, shall be tin plated copper and braced for available fault current.
7. Interlock enclosure doors to deenergize capacitors when doors are opened.
8. A switchboard type power factor meter with 0.5 lagging to 0.5 leading and plus or minus one percent accuracy.
9. A main circuit breaker operable from outside the enclosure which can deenergize the entire system inside the enclosure. Arrange breaker for pad-locking.
10. Capacitor failure alarm relay with one form C contact for connection by City.

PART 3 EXECUTION

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 Motor Control Center - 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 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

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

A. Coordinate this specification with other specifications including the following related Sections.
Section 16111 - Conduit, Fittings and Bodies
Section 16170 - Grounding and Bonding
Section 16195 - Electrical Identification

END OF NOTES

Section 16480

MOTOR CONTROL CENTER

PART 1 - G E N E R A L

1.01 SECTION INCLUDES

A. Specification for low voltage motor control center (MCC).

1.02 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)
   1. ICS 1: General Standards for Industrial Control and Systems
   2. ICS 2: Industrial Control Devices, Controllers and Assemblies
   3. ICS 4: Terminal Blocks for Industrial Use

B. American National Standards Institute/Underwriters Laboratories, Inc. (ANSI/UL)

   1. 467: UL Standard for Safety, Grounding and Bonding Equipment

   2. 489: UL Standard for Safety, Molded-Case Circuit Breakers and Circuit-Breaker Enclosures

   3. 506: UL Standard for Safety, Specialty Transformers

   4. 845: UL Standard for Safety, Motor Control Centers

C. American National Standards Institute/National Fire Protection Association (ANSI/NFPA): 70 National Electrical Code (NEC).

1.03 SUBMITTALS

A. Submit the following under the provisions of Section 01330 – Submittal Procedures:

   1. Outline drawings with elevations

   2. Equipment arrangement drawings

   3. Anchor bolt location drawings

   4. Electrical schematics and wiring diagrams

   5. Current, potential, and power transformer curves

6. Electrical fuse/circuit breaker characteristic
7. Equipment performance curves and data
8. Bill of installation/assembly materials
9. Equipment weights
10. Completed manufacturer's data sheets
11. Catalog data
12. Assembly/disassembly sizes and weights
13. Nameplate data
14. Performance/acceptance test report
15. Operation and maintenance data

1.04 QUALITY ASSURANCE

A. Tests. Perform tests in accordance with ANSI/NEMA ICS 2-322.22. Test each MCC as described in ANSI/UL 845. Make available upon request certified temperature and short-circuit test data, and a certificate of circuit breaker conformance with ANSI C37.16. Have tests and inspections performed and evaluated by qualified personnel. Document and correct deficiencies observed during the testing process prior to shipment.

1.05 ELIVERY, STORAGE AND HANDLING

A. Upon completion of the manufacture and assembly of the MCC and before crating for shipment, have parts that are disassembled match marked to facilitate installation in the field. Pack and crate parts in such a way to permit ease of handling.

B. Equip MCC shipping sections with lifting facilities so that may be easily unloaded and handled, either by crane or forklift.

C. Do not exceed 120 inches in length for shipping sections. Have equipment packed, crated, and rigidly braced to protect it from damage during shipment, handling, and outdoor storage. Make provision to energize the space heater of each shipping section during storage at the jobsite. Make a connection point readily available without uncrating the equipment and clearly tag each shipping section to locate the connection and identify the electrical service required.

PART 2 - P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Allen-Bradley

B. Cutler-Hammer/Westinghouse

C. General Electric

D. Powell Electrical Manufacturing Company

E. Siemens Energy and Automation, Inc.

F. Square D Company

G. Toshiba

2.02 MATERIALS AND EQUIPMENT

A. Design. Provide an MCC with the following design characteristics:

1. The MCC construction and wiring shall be NEMA Class I, Type B as specified in ANSI/NEMA ICS-2-322.08 and ICS-2-322.10. Provide an MCC designed for 3-phase, 60 Hz, 480-Volt service with main horizontal and vertical bus ampacities and short circuit bracing as specified on the one-line diagram.

2. Furnish an MCC designed to operate in service conditions described in NEMA ICS 1 and as shown on the one-line diagram.

3. Supply motor starters suitable for full voltage starting unless otherwise noted on the one-line diagram.

4. Construct the MCC of one or more vertical sections bolted together to form a free standing assembly, designed to permit future additions, changes, or regrouping of units.

5. Provide motor control units of the combination type, consisting of a motor circuit protector (MCP), a magnetic starter and a control power transformer. Size the MCP and starter in accordance with manufacturer's recommendation for the starter and motor size indicated on the one-line diagram.

6. When power factor correction capacitor is called for, connect its wiring to the line side of the overload relay with a set of fuses, a circuit breaker, or other acceptable means to serve as overload protection for the wiring and capacitor.

7. Manufacture main breaker (if used) and feeder breakers of the molded case, thermal-magnetic type to be mounted and wired in accordance with ANSI/UL 489.

8. If called for on the one-line-diagram, locate the lighting panelboard, transformer and transformer feeder breaker in the same vertical section. Supply a transformer with 115 degrees C temperature rise, installed in accordance with ANSI/UL 506.

B. Construction. Construct the MCC of self-supporting and fully enclosed metal clad section for mounting of motor starters, circuit breakers and necessary accessories including bus bars, control transformers, control switches, ground bus, and control wiring, as specified in this section and shown on the one-line diagram.

C. Enclosures

1. Construct each MCC enclosure to be fully metal enclosed, dead front, free standing, and NEMA 12 suitable for indoor service as defined in ANSI/UL 845 or NEMA 3R suitable for outdoor installation when indicated on the one-line diagram. Fabricate enclosure of sheet steel not less than 14 gauge with rear and end covers not less than 16 gauge; with adequate strength to withstand stresses imposed by short circuit current, shipping, handling, installation, and operation, without distortion or damage.

2. Construct frames of the enclosure structure with continuous steel barriers, extending from the front to the rear of each compartment for the controller units, buses and power cables.

3. Provide enclosures of suitable size for reduced voltage starting auto transformers and associated wiring, if required.

D. Vertical Sections

1. Make the structure 20 inches deep. Nominal vertical section dimensions are 20 inches wide by 90 inches high. Design each vertical section to accommodate not more than six NEMA Size 1 combination motor control units mounted one above the other in front-mounted arrangement.

2. Provided horizontal wiring space at the top and the bottom of each vertical section, which will line up with adjacent sections to form continuous raceways through the entire length of the MCC. In addition, in standard sections include vertical wireways with hinged doors for unit wiring. Provide grommets at points wiring must cross cut-outs.

3. Use section structure designed for top or bottom cable entry as indicated on the one-line diagram. Provide adequate ventilation and heating facilities for each section to keep the maximum temperature rise and humidity within the acceptable limits.

E. Incoming Feed

1. Terminate incoming feeder cables in a main breaker or main lugs. Use top feed to main breakers whether either top or bottom MCC cable entry is specified.

2. The MCC will be fed from one 480V source, unless otherwise stated. Provide the necessary space for adequate bending radius and spreading room to properly train and terminate the cables specified on the Drawings. Where large (350 MCM and above) or parallel cables are used as feeders, provide a separate termination compartment along side the main breaker for cable entry.

3. Provide a separate compartment with a hinged front access door and suitable space for terminations for incoming cables. Provide compression type lugs in the quantity shown on the diagram. Allow space for a cable bending radius not less than ten times the diameter of the cable. The cable size is shown on the one-line diagram. Install current transformers and phase monitor coils in this compartment on fixed horizontal mounting brackets. Do not loosely place coils around feeder cables.

4. Furnish surge arresters as specified in Section 13446 - Primary Instrumentation Devices, located downstream from the main breaker or lugs. Mount surge arresters in an isolated, completely enclosed cubicle.

5. When shown on the one-line diagram, install a voltmeter and an ampere-meter with switches in the incoming feed section. Provide meters of the switchboard type with one percent accuracy, 4-1/2 inch diameter face with a minimum of 240 degree direct reading scale.

F. Combination Starter Unit

1. Provide a standard combination motor starter unit which consists of a motor circuit protector (MCP), a magnetic motor starter, and an overload relay. Install starter and circuit protective device and control power transformer in a plug-in unit. The ratings of the components are shown on the one-line diagram.

2. Provide motor starters conforming to NEMA standards for the horsepower of the motors with which they are to be used and which are suitable for full voltage, across-the-line starting. Select starters with pickup and dropout voltages of not greater than 85 percent and 60 percent of rated voltage, respectively. Do not use a starter smaller than NEMA Size 1.

3. For NEMA size 4 and larger, provide vacuum-type contactors.

4. Select overload relays designed so that any attempt for reset immediately after operation cannot result in damage to the unit. Provide running protection for the motor and all other series components, based upon the tripping characteristics of the overload relay.

5. Utilize motor overload relays of the solid state type with adjustable overload, phase unbalance and phase failure sensitivity.

6. Starters shall have a minimum of one NC and one NO auxiliary contacts in addition to the seal-in contact.

7. Have reversing contactors and 2-speed starters both mechanically and electrically interlocked to prevent both contactors from being engaged at one time.

8. Provide an MCP of the magnetic type with a fault interrupting capability suitable for the complete starter unit.

9. Provide each combination starter unit with its own control power transformer with Class B insulation and 120 volt secondary.

10. Place fuses on the secondary side of control power transformers with one dual element fuse. Have control transformers separately fused on the primary side with two dual element fuses.

11. Unless otherwise called for on the one-line diagram, the minimum rating of the control power transformer, for the various sizes of starters, shall be as follows:

NEMA Size 1	75 VA
NEMA Size 2	150 VA
NEMA Size 3	250 VA
NEMA Size 4	500 VA

12. Connect the control power transformer so that it is de-energized when the circuit breaker is opened.

G. Reduced Voltage Starters

1. If reduced voltage starters are specified, provide the closed transition auto-transformer type.

2. Construct each reduced voltage auto-transformer starter unit with a molded-case circuit breaker in combination with a closed transition type auto-transformer starter with 50 percent, 65 percent, and 80 percent taps. Set the starter on the 65 percent tap. The starter shall have three phase overload relays and shall be ambient temperature compensated with manual reset. Include a thermal switch wired to protect the auto-transformer from overheating. Control timing of the starting period by an adjustable accelerating relay.

3. Provide heavy duty, NEMA type, autotransformers sized for a minimum of 125 percent of the motor load.

H. Terminal Blocks

1. Provide terminal blocks conforming to NEMA/ANSI ICS 4 type rated 600 volts, with screw type terminals to accommodate non-insulated ring tongue wire lugs for No. 18 through No. 10 size wire for field connection.

2. Use a sufficient number of terminal blocks so circuits for 480-volt and 120-volt service can be wired to a separate group of terminal blocks, making power and control circuit readily identified for safety during maintenance.

3. Wire auxiliary contacts to terminal blocks.

I. Units

1. Equip each unit compartment with barriers to isolate it from adjacent devices in the control center and prevent communication of faults from one compartment to another.

2. Provide draw-out type units. Provide means in the vertical section for supporting and aligning units during their removal or replacement.

3. Install an individual front door on each unit compartment. Make each door interlocking with the circuit disconnect so that the door may not be opened while the circuit disconnect is in a closed position. Provide a means for overriding this interlock.

4. Use padlocking arrangements that permit locking circuit disconnect in the open position with a minimum of three padlocks when the door is closed.

5. Arrange components so that removal of a starter or breaker unit does not require removal of its door, or the removal of an adjacent unit.

6. Place unit wiring diagrams in the print pocket on the inside of each unit door.

7. Furnish units designated as future or spare complete with guide rails, separator bars, doors, and operating hardware required to permit completion of the unit by the addition of a combination starter or feeder breaker unit.

8. For any unused space that is not suitable for the addition of a plug-in unit, fabricate and install a plain bolted sheet metal cover.

9. Identify electrical components, such as relays, breakers, terminal strips, and starters, with laminated nameplates as required in Section 16195.

10. Each motor starter door shall have a laminated nameplate duplicating the motor's nameplate rating information. At a minimum the motor nameplate information should include: HP, Phase, Hertz, Enclosure type, frame, code, RPM, volts, Amps, insulation class, max amb., duty cont., service factor, bearings, serial or ID number, P/N or Model number, and manufacturer.

J. Buses and Connections

1. Extend the main horizontal copper bus across the assembly to form a complete continuous bus. Support it in at least two places in each vertical section using glass-reinforced, polyester-type insulators

which are impervious to moisture and adverse atmospheric conditions.

2. Fabricate buses from tin plated copper bars. Use buses designed to operate at individual rate full load current without exceeding a 50 degrees C temperature rise at 40 degrees C ambient temperature as defined in ANSI/UL 845. The continuous current rating of the main and branch buses shall be as stated on the one-line diagram.

3. Bolt connections to main and branch buses. Make joints and contact surfaces free of burrs and irregularities.

4. Provide tin-plated, compression-type cable connectors (NEMA 2-hole) for each bus bar in the main feed cubicle. Select connectors of adequate size and quantity for the feeder cables.

5. Make provision for extension in both directions for future sections.

6. Install both main and branch buses so they are phased in the order A-B-C from front-to-rear, top-to-bottom, and left-to-right as viewed from the front of the MCC.

7. Have a copper ground bus extend the full length of the MCC near the bottom, with provision for extension into future sections. It shall be amp rated at a minimum of 25 percent of horizontal power bus. Provide compression lugs on each end of the ground bus for connection of the grounding copper conductor. Permanently ground the non-current carrying metal parts of equipment within each MCC through the ground bus in accordance with ANSI/UL 467. Terminate ground cables to the ground bus by means of the connectors.

K. Wireways

1. Provide each section with horizontal wiring space at both the top and bottom. Make wiring spaces line up with adjacent sections to form a continuous wireway for the entire length of the MCC.

2. In addition, provide each section with a wireway space at least 4 inches wide between the units and side unit wiring. Secure the wireway with a tight fitting hinged access door of formed sheet metal. Furnish wire straps in the vertical wireway to group individual conductors. Tie wires securely in place for a neat, orderly installation.

3. Completely enclose both horizontal and vertical wireways and isolate them from exposure to any live parts.

4. Use control wiring that is a minimum No. 14-AWG copper, 600 volts, Type TA, TBS or SIS as defined in ANSI C37.30.6.

5. For current transformer wiring, use No. 10 AWG copper which is otherwise, the same as control wiring.

6. Power and control cables may enter the MCC only at bottom. Provide suitable opening in bottom of MCC for cable entry. Collect power and control cables neatly in separate bundles.

7. Make wires continuous between terminals and other connections, without splices.

8. Identify wiring at both ends with same number, machine printed on heat shrink type sleeves as specified in Section 16195 - Electrical Identification.

L. Control Devices

1. Provide pushbuttons, selector switches and indicating lights which are of the oil tight, heavy duty type with industrial application quality.

2. Provide indicating lights which are push-to-test LED type with transformer and 100,000 hour lamp life.

M. Space Heaters: Install thermostat controlled electric space heaters to prevent condensation of moisture in the control centers. The rated voltage of these heaters shall be double the voltage applied. Make thermostats adjustable, and set to cut out when the temperature rises to an ambient of 30 degrees C (240 volt rated space heaters operated on 120 volt which power is derived from a local panelboard).

N. Nameplates

1. Use engraved phenolic with black lettering and white background for nameplates on individual units as well as the main nameplate for the assembly.

2. Make MCC compartment nameplates 1" x 3" with approximately 1/4 inch high lettering. Make MCC main nameplates 8" x 2" with 1 inch high lettering. Secure nameplates with self tapping stainless steel metal screws.

3. Provide a blank nameplate for spare compartments.

4. Word nameplate captions as indicated on the one-line diagram.

5. Label all components in the MCC with phenolic nameplates as required in Section 16195.

O. Finish

1. Thoroughly clean the inside and outside of the MCC of foreign matter, excessive oxide, scale, weld spatter, and flux. Repair fabricating scars and rough edges by welding and grinding before painting, followed by heat treatment, if required by the governing code or standard.

2. Give a finish coat of manufacturer's standard enamel for compartment doors, cover plates, and structural parts of the MCC. Do not apply paint or filler until repairs, tests, and final shop inspection are completed.

PART 3 - E X E C U T I O N

3.01 PREPARATION

A. Verify dimension of the housekeeping pad and the embedded leveling channels and conduit stub-ups.

3.02 INSTALLATION

A. Install the motor control center in accordance with the manufacturer's published instructions.

B. Torque bus bar bolts to manufacturer's recommendations and tighten nuts and bolts on the steel structure to ensure structural integrity.

C. Adjust the magnetic setting on motor circuit protectors in accordance with motor inrush currents (nameplate data).

D. Select and install motor starter overload relay heater coils based on motor nameplate data.

E. Touch up scratches and verify data on nameplates.

F. Install warning labels on Motor Control Centers as required in Section 16195, 2.02, F.

END OF SECTION

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

A. Coordinate this specification with other specifications including the following related Sections.
Section 03300 - Concrete: Housekeeping Pads
Section 13446 - Primary Instrumentation Devices
Section 15170 - Motors
Section 16425 - Low Voltage, Metal Enclosed Switchgear

END OF NOTES

Section 16510

LIGHTING FIXTURES

PART 1 - G E N E R A L

1.01 SECTION INCLUDES

A. Specification for:

1. Fluorescent lighting fixtures
2. High intensity discharge (HID) lighting fixtures
3. Emergency lighting fixtures
4. Exit fixtures
5. Incandescent lighting fixtures
6. Photo cells

1.02 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.

1.03 SUBMITTALS

A. Submit the following under the provisions of Section 01330 – 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.

1.04 QUALITY ASSURANCE

A. Tests. Run manufacturer's tests on lighting fixtures in accordance with applicable Underwriters Laboratories (U.L.) Standards 1570, 1571 and 1572.

1.05 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

2.1 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

2.2 REQUIREMENTS

A. Provide lighting fixtures in accordance with the lighting plan Drawings, Lighting Fixture Schedules and this specification.

B. Fluorescent Lighting Fixtures

1. Fixtures

a. Select fixtures designed for operation on rapid start ballast circuit with medium bipin T8 bases.

b. Use ballasts with high power factor rapid start electromagnetic type in accordance with ANSI C82.1.

c. Use fixtures tested and approved under UL 1570 for damp locations as a minimum.

d. Provide heavy duty industrial type fixtures with baked white finish, spring loaded metal clad lamp holders and heavy duty apertured reflector, unless indicated otherwise on the Drawings.

2. Ballasts

a. Ballasts shall be UL listed with a Class P thermal rating, a Class A sound rating conforming to Part 18 of CRF 47 of the Federal Communications Commission Rules and Regulations.

b. Ballasts shall comply with ANSI C62.1-1984 (IEEE 587) for line transients and ANSI C78-1 for maximum starting voltage for each type of fluorescent lamp.

c. Ballasts shall be for minimum starting temperature of 0 degree F, unless otherwise specified and shall have a power factor greater than 0.90 and shall not contain PCB (Polychlorinated biphenyls).

d. Ballasts shall maintain constant light output for line voltage fluctuations of plus or minus 10 percent and be able to operate properly with plus or minus 15 percent voltage fluctuations.

e. Ballast factor: Ballasts shall comply with ANSI C82.1 and shall have a high ballast factor (.88 or greater) when firing the number of lamps wired to the ballast.

f. Crest factor: Ballasts shall have a lamp current crest factor, CCF, of 1.65 or less, and shall be furnished by the manufacturer.

g. Electronic ballasts shall have an output frequency of 20 Khz or higher with less than 2 percent lamp flicker. The average ballast life shall be rated at 60,000 hours or greater based on 3 hour average burn cycles. Total Harmonic Distortion (THD) shall not exceed 10 percent and third Harmonic Distortion shall be less than 6 percent.

h. For lamp types for which none of the acceptable manufacturers produces an electronic ballast, the ballast shall be energy-saving magnetic type.

i. Ballast and T8-lamp compatibility: Ballasts for use with T8 lamps shall be compatible with T8 lamps only. The ballast shall not adjust current if T12 lamps are inserted.

j. Ballast and T12-lamp compatibility: Electronic ballasts for use with T12 lamps shall be T12 compatible only.

k. Ballast for Compact Fluorescent Lamps: Ballasts shall be High Power Factor (HFP) type.

l. Warranty: Ballast shall carry a manufacturer's warranty against failure due to defects in material or workmanship for 5 years.

3. Lamps

a. Fluorescent lamps shall meet the following specifications unless otherwise specified for a particular lamp.

b. Lamp Type: Lamps shall be T8 tri-phosphor type.

c. Lamp Correlated Color Temperature, CCT: Lamps shall have a manufacturer's Correlated Color Temperature, CCT, of 4100K.

d. Lamp Color Rendering Index, CRI: Lamps shall have a Color Rendering Index, CRI, of greater than 75.

e. 4-foot Fluorescent Lamp type: Lamps shall be 4-foot Phillips F32T8/TL741, or equal. Initial lumen output shall be 2850 lumens or greater with a design lumen output of 2600 lumens or greater at 40 percent of rated lamp life. Lamps shall have an average rated life at 20,000 hours or greater, based on 3-hour burn cycles.

f. 8-foot Fluorescent Lamp type: Lamps shall be 8-foot Phillips F96T8/TL741, or equal. Initial lumen output shall be 4500 lumens or greater with a design lumen output of 4050 lumens or greater at 40 percent of rated lamp life. Lamps shall have an average rated life at 15,000 hours or greater, based on 3-hour burn cycles.

g. U-lamp type: U-lamps shall be Phillips FB31T8/TL741, or equal. Initial lumen output shall be 2600 lumens or greater with a design lumen output of 2370 lumens or greater at 40 percent of rated lamp life. Lamps shall have an average rated life at 20,000 hours or greater, based on 3-hour burn cycles.

h. Compact Fluorescent Lamps Short: Lamps shall be Phillips PL-S 13W/41, or equal. Initial lumen output shall be 900

lumens or greater. Lamps shall have an average rated life at 10,000 hours or greater, based on 3-hour burn cycles.

i. Compact Fluorescent Lamps Long; Lamps shall be Phillips PL-L 40W/2G11/RS/41, or equal. Initial lumen output shall be 3150 lumens or greater with a design lumen output of 2835 lumens or greater at 40 percent of rated lamp life. Lamps shall have an average rated life at 20,000 hours or greater, based on 3-hour burn cycles.

C. 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.

D. Emergency Fixtures / Exit Fixtures

1. In working areas such as dry wells, or valve vaults with two or more levels, rooms which do not exit directly outside, or rooms with multiple means of egress, exit signs and lighting are required for safe evacuation of workers.

2. Provide Dual Light AS-160-BCI wall-mounted, sealed beam, battery powered packs with dual heads where emergency illumination is required.

3. In areas where exit signs and emergency lighting is needed, utilize Dual Light ESRWW-RGI packs to provide both.

E. Incandescent Lighting Fixtures

1. Provide incandescent lighting fixtures with a maximum 150W design and vandal-proof construction.

2. Fixtures shall be made for wall, ceiling or pendant mount in accordance with the Drawings or fixture schedules.

3. Fixtures shall be designed for single incandescent lamp, medium base for maximum 150 watts with cast aluminum base and vandal-resistant polycarbonate lens or globe.

4. For outdoor application the fixtures shall be of vaporproof NEMA 4X construction with globe, guard and stainless steel hardware.

5. In hazardous areas the fixtures shall be approved under standard UL844 for Class 1, Division 1, Group D environment and shall be equipped with globe, guard and stainless steel hardware.

F. 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

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

A. Coordinate this specification with other specifications including the following related Sections:
Section 16111 - Conduit, Fitting and Bodies
Section 16120 - Building Wire and Cable
Section 16161 - Panelboards
Section 16461 - Dry-type Transformers

B. Paragraph 2.02. The lighting shall be designed in accordance with the IES Handbook and the applicable sections of the National Electrical Code. The selection of lamps and ballasts for fluorescent fixtures shall be in compliance with the National Energy Policy Act and the EPA Green Lights Program.

END OF NOTES

Section 16670

LIGHTNING PROTECTION SYSTEM

PART 1 - G E N E R A L

1.01 SECTION INCLUDES

A. Lightning protection system, including design, installation and materials.

1.02 REFERENCES

A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

1. NFPA No: 780 - Lightning Protection Code

2. NFPA No: 70 - National Electrical Code

a. Section 250-46 - Spacing from Lightning Rods

b. Section 250-86 - Use of Lightning Rods

B. American National Standards Institute/Underwriters Laboratories (ANSI/UL)

1. UL 96 - Lightning Protection Components

2. UL 96A - Safety Installation Requirements for Lightning Protection System

3. Lightning Protection Institute (LPI) - LPI 175 - Installation Standards

1.03 SUBMITTALS

C. The following Section 01330 - Submittal Procedures.

1. Outline dimensions and weightsInstallation and maintenance manual

2. Catalog data

3. Complete design and construction drawings

4. Underwriters Laboratories, Inc. Master Label Certification

5. Lightning protection institute certified system certification.

1.04 QUALITY ASSURANCE

D. See Part 3.02 – INSTALLATION

1.05 PREPARATION FOR SHIPPING

A. Pack and crate materials to permit ease of handling and provide protection from damage during shipping, handling and storage.

PART 2 - P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Advanced Lightning Technology

B. East Coast Lightning Equipment

C. Harger Lightning Protection

D. Thompson Lightning Protection

2.02 DESIGN, CONSTRUCTION AND MATERIALS

A. System Design: Provide a functional and unobtrusive lightning protection system. Departures from the Drawings or submittals shall be submitted to the City Engineer for approval.

B. Lightning Protection Equipment: Materials shall be copper and bronze and of the size, weight, and construction to suit the application and used in accordance with PLI, UL, and NFPA code requirements. Use bolt type connectors and splicers Class I and Class II structures. Pressure squeeze clamps are not acceptable. Use stainless steel mounting hardware to prevent corrosion.

C. Aluminum Components: Aluminum materials may not be used except on roofs that utilize aluminum roofing components. On aluminum roofs or where aluminum parapet caps are used, utilize aluminum components for roof lightning protection equipment to ensure compatibility. However, use copper down leads and grounding with the bimetal transition occurring at the through roof assembly with an approved bimetal through roof assembly.

D. Use equipment which is UL listed and properly UL labeled. Equipment shall be new, and of a design and construction to suit the application in

accordance with accepted industry standards and LPI, UL, NFPA, and NEC code requirements.

PART 3 - E X E C U T I O N

3.01 PREPARATION

A. The Contractor is responsible for the following coordination with the building contractors:

1. The lightning protection installer shall install a correct, neat and unobtrusive installation in cooperation with other trades.

2. The roofing contractor shall seal and flash protection roof lightning penetrations conforming to the roof manufacturer's recommendations. However, the lightning protection contractor shall designate locations of through roofs and submit details of through roof penetrations, as required.

3. Should the roofing manufacturer require any special walk pads, membrane patches or pavers under the components of the lightning protection system, the lightning protection installer shall install such items with the roofing materials (patches, pads, pavers, adhesive) supplied by the roofing manufacturer at no additional cost to the lightning protection installer.

4. The roofing contractor shall instruct the lightning protection installer of the proper installation procedures of the roof pads, patches, and pavers, if required.

3.02 INSTALLATION

A. Have the system installed by an experienced installation company that is UL listed, a member of the Lightning Protection Institute and an employer of Certified Master Installers of lightning protection systems.

B. A Certified Master Installer shall directly supervise the work. Provide and install a complete conductor network at the roof and include air terminals, connectors, splicers, bonds, copper down leads, and proper ground terminals.

C. Use copper down lead conductors even when aluminum is required on the roof. Do not bring down lead conductors in conduit directly through the roof. Use through roof assemblies with solid brass or stainless steel rods for this purpose. Structural steel may be utilized in the installation as outlined by UL, NFPA, and LPI.

D. Upon completion of the installation, the lightning protection installer shall secure and deliver to the Contractor for submittal to the City Engineer, the Underwriters Laboratories, Inc., Master Label certification and the Lightning Protection Institute Certified System certification. The system will not be accepted without the UL Master Label plate and the LPI certification certificate.
Notes to Specifier. Provide Class I sized components, Class I sized components are utilized on roof levels 75 feet and below in height. Class II sized components are required for roof levels over 75 feet in height.

END OF SECTION

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

RELATED SECTIONS - For use by Specifier. Do not include list in Project Specifications.
Section 16050 - Basic Electrical Requirements
Section 16170 - Grounding and Bonding

END OF NOTES

SECTION 16900

OVERCURRENT PROTECTIVE DEVICE COORDINATION AND ARC FLASH STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Follow and comply with the COH Electrical Standards.

1.2 SUMMARY

A. This Section includes computer-based, fault-current, overcurrent protective device coordination selective studies, and arc flash study. Protective devices shall be set based on results of the protective device coordination selective study.

1. Coordination of series-rated devices is permitted where indicated on Drawings.

2. Retain a qualified professional/engineering firm to assist in the development and implementation of the arc flash and protection coordination selective study.

1.3 SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

C. Qualification Data: For coordination- selective study specialist.

D. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals may be in digital form.

1. Coordination- selective study input data, including completed computer

program input data sheets.
2. Study and Equipment Evaluation Reports.
3. Coordination- Selective Study Report.
4. Electrical One-line diagram

1.4 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination- Selective Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision, owner representative, Commissioning Agent and control of engineer.

C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

E. The entity shall have an employee that is certified, train and skilled to perform this type of test and be able to interpret the curve and settings.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:

B. Computer Software Developers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. CGI CYME.
2. EDSA Micro Corporation.
3. ESA Inc.

4. Operation Technology, Inc.
5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination selective study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:

a. Circuit-breaker and fuse-current ratings and types.
b. Relays and associated power and current transformer ratings and ratios.
c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
d. Generator kilovolt amperes, size, voltage, and source impedance.
e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
f. Busway ampacity and impedance.
g. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

a. Special load considerations, including starting inrush currents and frequent starting and stopping.
b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
d. Generator thermal-damage curve.
e. Ratings, types, and settings of utility company's overcurrent protective devices.
f. Special overcurrent protective device settings or types stipulated by utility company.
g. Time-current-characteristic curves of devices indicated to be coordinated.
h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:

1. Switchgear and switchboard bus.
2. Medium-voltage controller.
3. Motor-control center.
4. Distribution panelboard.
5. Branch circuit panelboard.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141, IEEE 241 and IEEE 242.

1. Transformers:

   a. ANSI C57.12.10.
   b. ANSI C57.12.22.
   c. ANSI C57.12.40.
   d. IEEE C57.12.00.
   e. IEEE C57.96.

2. Medium-Voltage Circuit Breakers: IEEE C37.010.
3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
4. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium and high voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.

F. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents.

Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION SELECTIVE STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
3. Calculate the maximum and minimum ground-fault currents.

B. Comply with IEEE 141 recommendations for fault currents and time intervals.

C. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

   a. Inrush current when first energized.
   b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
   c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

E. Coordination-Selective Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:

   a. Device tag.
   b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
   c. Circuit-breaker sensor rating; and long-time, short-time, and

instantaneous settings.

d. Fuse-current rating and type.

e. Ground-fault relay-pickup and time-delay settings.

2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

   a. Device tag.
   b. Voltage and current ratio for curves.
   c. Three-phase and single-phase damage points for each transformer.
   d. No damage, melting, and clearing curves for fuses.
   e. Cable damage curves.
   f. Transformer inrush points.
   g. Maximum fault-current cutoff point.

F. Completed data sheets for setting of overcurrent protective devices.

3.5 ARC FLASH STUDY

A. A detailed arc flash study shall be performed to determine potential arc flash incident energies, arc flash boundaries, shock hazard boundaries and proper personal protective equipment (PPE) for all energized electrical system equipment tasks for the electrical systems studied. The calculations shall comply with NFPA-70E 2009, and IEEE-1584. Bolted short circuit calculations used in the above standards shall comply with ANSI C37.010, C37.13, C37.5, IEEE-141, and IEEE-399. The purpose of this study is to determine arc flash hazards in conformance with NFPA-70E and to provide a comprehensive software model of the electrical distribution system, which provides integral work permits and arc flash calculations in compliance with NFPA 70E Articles 130.1 and 130.3 for all equipment in the facility. The software program used in this study shall comply with the above standards. No substitutions in calculation methods will be allowed.

B. The arc flash study shall determine the following results for each system mode of operation developed in Section 1.3E (Modeling). The results shall be provided in spreadsheet format for each mode and electrical system location to provide easy viewing and comparison. Worst-case arc flash energy levels shall be flagged and the spreadsheet comparison table shall be capable of providing its output directly to high quality vinyl label printers. The calculations shall, as a minimum, include a comparison of both 100% and 85% arcing currents for low

voltage equipment for each electrical system configuration or operating mode, indicating worst-case arc flash hazards. The spreadsheet results shall include:

1. Equipment name and voltage
2. Upstream equipment device name and ANSI function, i.e. 51/50, etc
3. Equipment type, i.e. switchgear, MCC, Panel, VFD, etc
4. Equipment arc gap
5. Bolted and estimated arcing fault current at the fault point (equipment) in symmetrical amperes. The estimated arcing current should be based on the arcing current equations used.
6. Trip time, opening time, and total clearing time (total Arc time) of the protective device
7. Worst-case arc flash boundary for each bus/equipment in the model
8. Worst-case arc flash hazard incident energy in cal/cm2 for each bus/equipment in the model
9. Worst-case personal protective equipment (PPE) for each bus/equipment in the model
10. Working distances for up to five different distances showing items 7, 8, and 9 for each distance
11. Indicate "Danger/Hazardous" areas where incident energy is greater than 40 cal/cm2 and provide recommendations to reduced arc flash energy levels for these areas
12. Flag results where 85% arcing current provided worst-case results

C. Each mode of operation shall include a detailed write-up indicating areas where incident energy calculations and PPE requirements are higher than calculated in the normal operating mode.

D. Contractor shall provide a detailed arc flash analysis report including as a minimum:

1. Introduction
2. Methodology
3. Information Sources
4. Assumptions including generic substitutions when data cannot be field verified. This type of assumptions shall be documented in the report.
5. Arc Flash Energy and other consideration for various System Modes of Operation (maintenance mode, bus-tie, co-gen on/off, etc)
6. Arc Energy at 100% and reduced currents
7. IEEE 1584-2002 Considerations.
8. Overcurrent Protective Device Changes, Replacements or Setting Changes implemented in study to reduce arc flash hazard exposure.
9. Explanation of Data in Arc Flash Hazard Report Tables
10. NFPA 70E Information

    a. Shock Hazards with covers removed.

b. Shock Hazard Approach Boundaries.

1) Limited Approach Boundary
2) Restricted Approach Boundary
3) Prohibited Approach Boundary

c. Arc Flash Hazard Boundaries

11. Results of Arc Flash Hazard Analysis for high voltage, medium voltage and low voltage systems, including:

a. Working distances.
b. Energy Levels
c. PPE Requirements
d. Recommendations to reduce arc flash hazard energy and exposure.

12. Arc Flash Hazard Report

a. 3 Hard Copies
b. 1 Electronic Copy in WORD or Excel format and PDF (5.0 or later)
c. 1 Electronic copy in latest version of SKM format or its native software

13. Electronic file for Power System Modeling Software as developed and utilized for this analysis.

E. Contractor shall provide print labels for for all equipment in the system from the project study file. Assume two (2) labels per equipment/bus in your estimate using 4" x 6" labels. The labels shall be UV resistant vinyl labels (white with orange warning strip and black letters) conforming to ANSI-Z 535. The labels shall be printable directly from the power system software utilized for the study.

F. The software shall provide complete integration of the one-line, database, short circuit and PDC and Arc flash functions. Software using separate short circuit, PDC, TCC or arc flash programs is not allowed. Spreadsheet calculations are not allowed. The purpose of this section is to ensure that the arc flash hazard calculations comply with NFPA-70E and IEEE-1584, and that the calculations are programmed with necessary requirements to help eliminate possible errors in the arc flash calculations. The additional purpose is to establish a detailed software model of the compliance with the OSHA requirements and NFPA 70E mandates. This model will serve as an integral part of owner safety program by providing integral work permits and arc flash calculations in compliance with NFPA-70E Article 130.1(A)(2) for each electrical equipment in the facility.

1. Arc flash calculations shall be performed with enhanced IEEE-1584 equations, which eliminate voltage discontinuities and the non-conservative/average results of the standard equations. The purpose of this requirement is to ensure that the calculated incident energies

are closer to actual test results insuring a conservative calculation minimizing personnel risk.

2. Arc flash calculations shall be based on the fastest clearing upstream protective device protecting the equipment for single sources and the slowest upstream protective device for multiple sources. The calculations shall automatically compare all series and parallel upstream protective devices in the system to determine the fastest series device or a conservative parallel clearing time.
3. The arc flash calculations shall include arc flash boundary, incident energy, PPE requirements, and working distances.
4. The arc flash calculations shall include calculations for all operating modes to ensure the worse arc flash magnitude.
5. The arc flash calculations shall provide integral "Work Tasks" for the listed equipment types. The tasks shall be derived from 70E Table 130.7(C)(9)(a) and be specific to the equipment type. Listed equipment types shall include:

    a. Switchgear, Switchboards, Panelboards, MCC, VFD, UPS, ATS, Interrupting Switch, NEMA E2 Contactor, Conductor, Open Air for 100-200 volt equipment.
    b. Switchgear, Switchboards, Panelboards, MCC, VFD, UPS, ATS, Interrupting Switch, NEMA E2 Contactor, Conductor, Open Air for 200-1000 volt equipment.
    c. Switchgear, MCC, VFD, UPS, ATS, Interrupting Switch, NEMA E2 Contactor, Conductor, Open Air for 1.0-5.0 kV equipment.
    d. Switchgear, MCC, VFD, ATS, Interrupting Switch, NEMA E2 Contactor, Conductor, Open Air for 5.0-15.0 kV equipment.
    e. Interrupting Switch, Conductor, and Open Air for 138 kV equipment.

6. Work Tasks shall have a user-defined library that provides the following customizable features for each work task:

    a. Work Tasks for each specific equipment type and voltage range
    b. Working distance units English or Metric
    c. Work distance for each task
    d. V-rated gloves and tool requirements
    e. Job description and procedures
    f. Safe work practices description
    g. Hazard Risk Category (HRC) reduction - HRC reduction can only be used based on a documented risk assessment as an integral part of a safety program.

END OF SECTION