Unitec Wastewater Treatment Plant – Phase I Expansion – FY 2020
SEAL SHEET

The following specifications were prepared under my direction:

Technical Specifications – Civil/Mechanical, 01 75 60, 09 90 20, 11 00 02, 15 10 20, 15 10 30, 15 43 00, 15 95 60, 22 32 19, 33 32 16, 40 00 00, 40 71 13, 46 01 00, 46 02 01, and 46 51 46.

Dan S. Leyendecker, P.E.
LNV, LLC
Texas Registered
Engineering Firm F-366
Unitec Wastewater Treatment Plant – Phase I Expansion – FY 2020

SEAL SHEET

The following specifications were prepared under my direction:

Technical Specifications – Structural, 03 10 00, 03 20 00, 03 30 00, 05 12 00, 05 50 00, 05 72 10, 07 90 00, 31 23 16, and 31 23 23.

Jennifer D. Scheffler, P.E.
LNV, LLC
Texas Registered
Engineering Firm F-366

March 2020
Unitec Wastewater Treatment Plant – Phase I Expansion – FY 2020

SEAL SHEET

The following specifications were prepared under my direction:

Technical Specifications – Electrical, 16000, 16030, 16060, 16070, 16075, 16123, 16134, 16140, 16272, 16285, 16411, 16444, 16600, 16610, 16620 and 16630.

Juan Pablo Cantu, P.E.
Square E Engineering
Texas Registered Engineering Firm F-12247
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SECTION A-1
NOTICE TO BIDDERS

Sealed bids will be received at City Secretary’s Office, 1110 Houston Street, Laredo, Texas until 4:00 P.M., on Thursday, April 23, 2020 and publicly opened at 10:00 A.M. on Friday, April 24, 2020 read and taken under advisement for the furnishing of all necessary materials, machinery, equipment, labor, superintendence, and all other services and appurtenances required for the Unitec Wastewater Treatment Plant – Phase I Expansion Project – FY 2020. Said bid shall be marked,

“Unitec Wastewater Treatment Plant – Phase I Expansion Project – FY 2020”

The facility improvements and expansion of the Unitec Wastewater Treatment Plant include, but are not limited to: New headworks, additional aeration, upgrades to the disinfection system, a new clarifier, associated piping, and other necessary appurtenances.

Bids shall be based on Lump Sum Basis and shall include dollar amount for improvements including those items listed as alternatives as per the Schedule of Values included in the specifications of this project. Submit completed Schedule of Values form with the Lump Sum Bid.

Each proposal and the proposal guaranty must be originals and must be sealed in an envelope plainly marked with the name of the project as shown above, and the name and address of the Bidder. When submitted by mail, this envelope shall be placed in another envelope addressed as indicated in this Notice to Bidders.

Only proposals and proposal guaranties actually in the hands of the designated official at the time set in this Notice to Bidders shall be considered. Proposals submitted by telephone, telegraph, or fax, will not be considered.

Bidders are expressly advised to review Section C-3.10 of the General Conditions of the proposed Contract as to the causes which may lead to the disqualification of a bidder and/or the rejection of a bid proposal. Unless all bids rejected, Owner agrees to give Notice of Award of Contract to the successful bidder within sixty (60) days from the date of the bid opening.

Bidders are expected to inspect the site of the work and inform themselves regarding all local conditions.

A Pre-bid meeting is scheduled for Thursday, April 2, 2020 at 10:00 A.M. at the City of Laredo Utilities Department, 5816 Daugherty Ave., Laredo, Texas 78041

Copies of the plans and specifications may be reviewed and downloaded from City website at: www.cityoflaredo.com/bids-and-rfps.html

Signed

Jose A. Valdez, Jr.
City Secretary

Publication Dates:
March 15, 2020
March 22, 2020
SECTION A-2
INFORMATION TO BIDDERS

Sealed bids will be received at City Secretary’s Office, 1110 Houston Street, Laredo, Texas until 4:00 P.M., on Thursday, April 23, 2020 and publicly opened at 10:00 A.M. on Friday, April 24, 2020 read and taken under advisement for the furnishing of all necessary materials, machinery, equipment, labor, superintendence, and all other services and appurtenances required for the Unitec Wastewater Treatment Plant – Phase I Expansion Project – FY 2020. Said bid shall be marked,

“Unitec Wastewater Treatment Plant – Phase I Expansion Project – FY 2020”

The facility improvements and expansion of the Unitec Wastewater Treatment Plant include, but are not limited to: New headworks, additional aeration, upgrades to the disinfection system, a new clarifier, associated piping, and other necessary appurtenances.

Bids shall be based on Lump Sum Basis and shall include dollar amount for improvements including those items listed as alternatives as per the Schedule of Values included in the specifications of this project. Submit completed Schedule of Values form with the Lump Sum Bid.

Each proposal and the proposal guaranty must be originals and must be sealed in an envelope plainly marked with the name of the project as shown above, and the name and address of the Bidder. When submitted by mail, this envelope shall be placed in another envelope addressed as indicated in this Notice to Bidders.

Only proposals and proposal guaranties actually in the hands of the designated official at the time set in this Notice to Bidders shall be considered. Proposals submitted by telephone, telegraph, or fax, will not be considered.

The City reserves the right to award the contract on the basis of the alternative which appears most advantageous to the City, to reject any or all bids, to waive objections based on failure to comply with formalities and to allow the correction of obvious or patent errors. Bidders are expressly advised to review Section C-3 of the General Conditions of the proposed contract as to the causes which may lead to the disqualification of a bidder and/or the rejection of a bid proposal. Unless all bids are rejected, Owner agrees to give Notice of Award of contract to the successful bidder within sixty (60) days from the date of the bid opening.

Bidders for the construction work must submit a satisfactory cashier’s or certified check, or bidder’s bond, payable without recourse to the order of the City of Laredo, Texas, in an amount not less than five percent (5%) of the total bid based on the bid which check or bond shall be submitted as a guarantee that the bidder will enter into a contract and executed performance and payment bonds within ten (10) days after Notice of Award of contract to him for contracts in excess of $25,000.00. Bids without the required check or bond will NOT be considered.

Successful bidder for the construction of the improvements must furnish a satisfactory Performance Bond in the amount of 100% of the total contract price, and a satisfactory Payment Bond in such amount, both duly executed by such bidder as principal and by a corporate surety duly authorized so to act under the laws of the State of Texas. The successful bidder will be required to provide Performance and Payment Bonds issued by an insurance company which meets the minimum State requirements and is licensed in the State of Texas, and has a Best’s Key Rating as follows:

<table>
<thead>
<tr>
<th>Construction Contract</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>25,001 - 250,000</td>
<td>None</td>
</tr>
<tr>
<td>250,000 - 1,000,000</td>
<td>B</td>
</tr>
<tr>
<td>Over 1,000,000</td>
<td>A</td>
</tr>
</tbody>
</table>

All lump sum and unit prices must be stated in both script and figures.

Bidders are expected to inspect the site of the work and to inform themselves regarding all local conditions.
The Instructions to Bidders, Forms of Bid, Form of Contract, Plans, Specifications, Form of Bid Bond, Performance and Payment Bonds and other contractual documents may be examined free of charge at the City of Laredo Utilities Department, 5816 Daugherty Ave., Laredo, Texas 78041.

Copies of the plans and specifications may be reviewed free of charge at the office of the City Utilities Dept., 5816 Daugherty Ave., Laredo, Texas. Digital Copies (CD’s) containing the complete set of bid document will also be made available at no charge.

In the event the base bid amount is LESS than $25,000.00, a Payment Bond and Performance Bond will NOT BE REQUIRED. A Bid Guarantee in the form of a Cashier’s or Certified Check or Bid Bond and the Certificate of Insurance however, WILL BE REQUIRED. Under these conditions, the successful bidder for the Unitec Wastewater Treatment Plant Improvements Project – Phase I Expansion Project - 2020 is hereby advised that the total contract price will be paid in MULTIPLE PAYMENTS upon completion and acceptance of the project by the City of Laredo.

Any other division or section of this project’s specifications having reference to Bid Guarantee, Cashier’s or Certified Check, Bid Bond, Payment Bond, or Performance Bond, or having mention at all, to the requirements of bonds, is hereby amended to concur with the above conditions ONLY when the base bid is LESS THAN $25,000.00.

Bidders are advised to contact the City of Laredo Utilities Department at 5816 Daugherty Ave., Laredo, Texas, 78041, telephone number (956) 721-2000, for any additional information required on the project.

Contractor’s attention is directed to Special Provision 000-6233, “Important Notice to Contractors” and “Statement of Materials and Other Charges” which will be included in all projects, beginning with the September 1991 letting. These establish the procedures whereby the Contractor will be permitted to obtain an exemption from the sales tax on certain materials. See Comptroller’s Rule 2.291 and Texas Tax Code Chapter 151, as amended by House Bill Number 11, Acts 1991, 72nd Legislature, First called Session. The Contractor will be required to separate the charges for materials from all other charges and will be furnished an Exemption Certificate of each contract. Also, the Contractor must issue resale certificates to suppliers. Sales tax permit applications and information regarding resale certificates may also be obtained by calling the State Comptroller’s toll free number 1-800-252-5555.

A Pre-bid meeting is scheduled for Wednesday, March 25, 2020 at 10:00 A.M. at the City of Laredo Utilities Department, 5816 Daugherty Ave., Laredo, Texas 78041.
SECTION A-2.1
SUMMARY OF WORK

1.1 DESCRIPTION

NOTE: Project will have Base Bid and 2 Alternates – Alt #1 New Aeration Basin
– Alt #2 Re-Purpose Existing Package Plant

A. Base Bid

1. Provide Factory-built stainless steel Headworks with Screening and Degritter System:
   a. Provide new Inclined Screen and Degritter system rated at 0.5 mgd average daily flow/2.0 mgd peak. Tank and equipment to be 316 (L) stainless steel.
   b. Screen inlet to receive piped/pumped wastewater from off-site lift station (8” diameter PVC); Contractor to tie-in piping from the 8” and 4” PVC influent to the new headworks.
   c. Provide a passive screen bypass system (peak – 2 mgd) with weir.
   d. Provide screenings washer/compactor with discharge to dumpster and bagging system.
   e. Provide aerated grit chamber with collector screw.
   f. Provide inclined grit removal spiral screw with discharge chute to dumpster.
   g. Provide all electrical and controls for a complete operating system and meet all TCEQ requirements.
   h. Provide non-potable water piping and tie-ins. Provide air compressor for grit chamber.
   i. Provide walkways, stairs, concrete foundation, access driveway, and splitter box foundation; foundation to be certified and sealed by a State of Texas licensed Professional Engineer.

2. Provide concrete or 316 (L) Stainless Steel Splitter Box to control flows by gravity to existing and proposed aeration basins; provide weir gates with belt operator.

3. Provide 12” PVC piping from the flow splitter to Train A as shown in the drawings.

4. Provide piping to the clarifier as shown in the drawings.

5. Provide new concrete clarifier with a bridge supported sludge collector with mechanical surface skimming and spray bar.

6. Provide scum and supernatant lift station including all valves, equipment, and piping including submersible pumps two (2) each with slot for future 3rd pump in an 8’ diameter FRP wet well as shown in the drawings.

7. Provide 12” PVC effluent piping from new clarifier to existing chlorine contact basin.

8. Provide piping from clarifier to RAS pump, including drain.

9. Provide one each RAS pump and Blower at existing concrete pad, including controls, electrical, meters, piping, and Air Relief Valves.

10. Remove existing plant chlorine disinfection equipment and replace with new equipment including scales, gas regulator, automatic switch-over, vacuum injector, room heater including all necessary appurtenances, piping and tie-ins to existing and proposed process units and meeting all TCEQ requirements, including ventilation/safety.

11. Provide a non-contact ultrasonic level meter/totalizer/transmitter for combined final effluent flow measurement at the existing V-Notch weir box and install chart recorder in existing ofc.

12. Provide Stainless Steel piping and aeration diffuser disks at existing Chlorine Contact Chamber.

13. Provide New NPW Supply Station, flow meter, strainers, bypass piping, air bladder tank and all piping connections to the headworks, clarifier, thickener, clarifier basin, and disinfection; also other piping to various locations, as shown in the drawings.

14. Provide a new two-channel chart recorder with required underground conduit to existing plant office and tie-in flow meter signals from combined effluent and NPW meters, including all required conduit/wiring.

15. Provide Dissolved Oxygen (DO) sensors and controls for existing basins to include all required conduit/wiring.
16. Provide all yard piping, drains, connections, concrete structures, foundations, sidewalk, flat-work, lighting, electrical, access roads, and other items not listed but required to provide a complete and functional installation per contract documents, plans, specifications and meeting all TECQ and OSHA requirements and regulations.

B. Alternate #1
1. Provide New 0.18 MGD Aeration and Digester Concrete Basin (TRAIN B) with Fine-Bubble Diffuser System including all equipment and schedule 10 – 316 (L) stainless steel piping; access stairs, landings, concrete walkways and handrails and a new Aerated Sludge Digester Holding Basin with a Coarse Bubble Diffuser System and Telescoping Valves, including drain piping to both basins.
2. Provide all RAS/WAS and MLSS piping and tie-ins.
4. Provide all valves and fittings.
5. Provide all drains and connections to lift station.
6. Provide NPW and Blower/RAS Pump piping connections.
7. Provide D.O. equipment, controls, tie-ins and electrical.
8. Provide all required yard piping and connections to splitter box.

C. Alternate #2
1. Upgrade existing 0.11 MGD concrete Package Plant including demolition of all existing mechanical equipment, access stairs, landings, handrails and air piping to re-purpose the Existing Package Plant with Coarse Bubble System.
2. Provide Aerated Sludge Holding Tank discharge and overflow piping.
3. Provide concrete repair and total interior coating system to all of Existing Package Plant – 40 mils min. DFT.
4. Provide 316 (L) stainless steel headers with air drops and all tie-ins to Blower.
5. Provide all yard piping/valves/fittings/ connections to splitter box.
6. Provide NPW Station and Blower/RAS pump piping and complete tie-in.
7. Provide new MLSS Lift Station in old CCC chamber including two (2) pumps and weir with piping connection to MLSS Lift Station.
8. Provide new access stairs, handrails, and landings as shown in the drawings.
SECTION A-3
ADVICE TO BIDDERS

PROJECT: Unitec Wastewater Treatment Plant Improvements – Phase I Expansion Project – FY 2020

The Contractor’s attention is directed to the State of Texas Comptroller of Public Accounts Limited Sales Excise and Use Tax Rules and Regulations, Paragraph 3 of Ruling No. 9. Repairmen and Contractors (amended April 3, 1972). Reference Article 20.01 (T). Upon compliance with certain conditions, this ruling provides for exemption from this tax of materials incorporated into work done for an exempt agency under a Contract. The City is an exempt agency.

Any Bidder may elect to exclude this sales tax from his bid. If the Bidder submitting the lowest acceptable bid for performing the work on this project elects to comply with the above ruling on any bid item included in this Contract by obtaining any necessary permit or permits from the State Comptroller allowing the purchase of material for incorporation into this project without having to pay the Limited Sales, Excise and Use Tax at the time of purchase, he shall upon Award of Contract submit a statement in satisfactory form in which his bid prices to the City for materials are listed separately from all other charges, either by bid item or by total as required by the comptroller. This statement shall be included in and made part of the Contract.

The City will make no further allowance for and will make no price adjustment above or below the originally bid unit price on account of this tax. It shall be the Contractor’s sole responsibility, if he elects to exclude the sales tax from his bid, to comply with the aforementioned Ruling No. 9 and with any other applicable rules, regulation, or laws pertaining to the Texas Limited Sales, Excise and Use Tax which may now or at any time during the performance of this Contract be in effect, and the City shall have no responsibility for any sales or use tax which the Contractor may be required to pass as a result of his failure or the City’s failure to comply with said rules, regulations or laws, or as the result of the performance of the Contract or any part thereof by the Contractor.

Bidders are cautioned that materials which are not permanently incorporated into the work are not eligible for exemption and are not to be included in the statements as “Materials” (example: fuel, lubricants, tools, forming materials, etc.).
SECTION A-4
INFORMATION TO CONTRACTORS

PROJECT: Unitec Wastewater Treatment Plant – Phase I Expansion Project – FY 2020

The Contractor’s attention is directed to Special Provision 000-6233, “Important Notice to Contractors”, and “Statement of Materials and Other Charges” which will be included in all projects, beginning with the September, 1991 letting. These establish the procedures whereby the Contractor will be permitted to obtain an exemption from the sales tax on certain materials. See Comptroller’s Rule 3.291 and Texas Tax Code, Chapter 151, as amended by House Bill Number 11, acts 1991, 72nd Legislature, First Called Session. The Contractor will be required to separate the charges for materials from all other charges. Also the Contractor must issue resale certificates to suppliers. Sales tax permit applications and information regarding resale certificates may be obtained by calling the State Comptrollers’ toll fee number 1-800-252-5555.
SPECIAL PROVISION
No. 000-6233
IMPORTANT NOTICE TO CONTRACTORS

The Contractor’s attention is directed to Rule 3.291, paragraphs (a) (1), defining separated contracts, subsection (b) (3) discussing separated contracts, and subsection (c) discussing exempt contracts. Reference: Texas Tax Code, Chapter 151.

Contractors should note those organizations in subsection (c) that the rule shows as being exempt no longer qualify for the exemption. The rule states that contractors improving realty for organizations listed in Texas Tax Code 151.309 and 151.310 are exempt from tax. THIS IS NO LONGER TRUE EFFECTIVE WITH CONTRACTS SIGNED ON OR AFTER AUGUST 15, 1991.

Only those contracts with school districts and nonprofit hospitals qualify for the exemption discussed in subsection (c) of Rule 3.291.

The Comptroller is amending the rule to reflect this change.

If the low bidder elects to operate under a separated contract as defined by Rule 3.291, by obtaining the necessary permits from the State Comptroller’s office allowing the purchase of materials for incorporation in this project without having to pay the Limited Sales and Use Tax at the time of purchase, the low bidder shall identify separately from all other charges the total agreed contract price for materials incorporated into the project. This form shall be filled out by the low bidder in each of the two bound copies of the contract. Total materials shall only include materials physically incorporated into the realty.

In order to comply with the requirements of Rule 3.291, as mentioned above, it will be necessary for the Contractor to obtain a sales tax permit.

It will also be necessary that the contractor issue resale certificates to his suppliers.

Sales tax application for a sales tax permit and information regarding resale certificates may be obtained by writing to:

Comptroller of Public Accounts
Capital Station
Austin, Texas 78774

The Contractor may also receive information or request sales tax permit applications by calling the State Comptrollers’ toll free number 1-800-252-5555.
Subcontractors are eligible for sales tax exemption if the subcontract is made in such manner that the charges for materials is separated from all other charges. The procedure described above will effect a satisfactory separation. When subcontractors are handled in this manner, the Contractor must issue a resale certificate to the subcontractor and the subcontractor, in turn, must issue a resale certificate to his supplier.
STATEMENT OF MATERIALS AND OTHER CHARGES

PROJECT: Unitec Wastewater Treatment Plant Improvements – Phase I Expansion - 2020

MATERIALS INCORPORATED INTO THE PROJECT: $__________

ALL OTHER CHARGES: $__________

*TOTAL: $__________

*This total must agree with the total figure shown in the Item and Quantity Sheets in the bound contract.

For purposes of complying with the Texas Tax Code, the Contractor agrees that the charges for any material incorporated into the project in excess of the estimated quantity provided for herein will be no less than the invoice price for such material to the Contractor.

NOTE: ONLY THE COPY OF THIS FORM IN THE BOUND CONTRACTS IS TO BE FILLED OUT.
BID PROPOSAL

To: The City of Laredo, Texas

Honorable Pete Saenz, Mayor

From: Contractor

Address: ____________________________
Phone: ____________________________
Fax: ____________________________

Project: Unitec Wastewater Treatment Plant – Phase I Expansion Project – FY 2020

Pursuant to Notice to Bidders, the undersigned bidder hereby proposes to furnish the labor, materials, and equipment in accordance with the plans and specifications, general conditions of the agreement, special provisions of the Agreement, and Addenda, if any. The bidder binds himself upon acceptance of his proposal to execute a contract and bonds accompanying form of performing and completing the said work within the time stated as required by the detailed specifications at the following unit prices. The quantities shown below are based on the Engineer’s estimate of quantities and it is agreed that the quantities may be increased or diminished, and may be considered necessary in the opinion of the City of Laredo, Texas to complete the work fully as planned and contemplated, and that all quantities of work, either increased or decreased, are to be performed at the unit prices set forth below (except as provided in the General Conditions of the Agreement or the specifications, the contract documents).

Acknowledgment of Addenda: (Please initial and date):

Addendum No. 1: ____________________________
Addendum No. 2: ____________________________
Addendum No. 3: ____________________________
Addendum No. 4: ____________________________
Addendum No. 5: ____________________________

Acknowledgment of other documents: (Please initial and date):

Wage Determination: ____________________________
Labor Provisions: ____________________________
Affirmative Action Program: ____________________________
Project: Unitec Wastewater Treatment Plant – Phase I Expansion – FY 2020

Form of Non-Collusive Affidavit

AFFIDAVIT

STATE OF TEXAS {}
COUNTY OF WEBB {}

being first duly sworn, deposes and says

That he is

(a Partner of Officer of the firm of, etc.)

the party making the foregoing proposal or bid, that such proposal or bid is genuine and not collusive or sham; that said Bidder has not colluded, conspired, connived or agreed, directly or indirectly, with any Bidder or Person, to put in a sham bid or to refrain from bidding, and has not in any manner, directly or indirectly, sought by agreement or collusion, or communication or conference, with any person, to fix the bid price or affiant or of any other Bidder or to fix any overhead, profit or cost element of said bid price, or of that of any other Bidder, or to secure any advantage against the City of Laredo or any person interested in the proposed Contract; and that all statements in said proposal or bid are true.

______________________________
Signature of

Bidder, if the Bidder is an individual
Partner, if the Bidder is a Partnership
Officer, if the Bidder is a Corporation

Subscribed and sworn before me this _____ day of ____________, 20___.

______________________________
Notary Public

My Commission expires

______________________________
STATEMENT OF MATERIALS AND OTHER CHARGES

PROJECT: Unitec Wastewater Treatment Plant – Phase I Expansion Project – FY 2020

MATERIALS INCORPORATED INTO THE PROJECT - BASE BID: $______________

MATERIALS INCORPORATED INTO THE PROJECT - ALT. # 1: $______________

MATERIALS INCORPORATED INTO THE PROJECT - ALT. # 2: $______________

ALL OTHER CHARGES: $______________

*TOTAL: $______________

*This total must agree with the total figure shown in the Item and Quantity Sheets in the bound contract.

For purposes of complying with the Texas Tax Code, the Contractor agrees that the charges for any material incorporated into the project in excess of the estimated quantity provided for herein will be no less than the invoice price for such material to the Contractor.

NOTE: ONLY THE COPY OF THIS FORM IN THE BOUND CONTRACTS IS TO BE FILLED OUT.
INFORMATION FROM BIDDERS
MUST BE COMPLETED AND SUBMITTED WITH BID PROPOSAL

Project: Unitec Wastewater Treatment Plant – Phase I Expansion Project – FY 2020

Statement of Qualifications:  (Similar Projects Completed by Bidder)

1. Name of Project:  
   Value of Contract:  
   Date Completed:  

2. Name of Project:  
   Value of Contract:  
   Date Completed:  

3. Name of Project:  
   Value of Contract:  
   Date Completed:  

Experience Data:  (Include name and experience record of the Superintendent)

Financial Status:  A confidential financial statement will be submitted by the apparent successful low Bidder only if the Owner deems it necessary.

NOTE:  TO BE SUBMITTED UPON REQUEST

IS NOT AN ACCEPTABLE ANSWER.

Project: Unitec Wastewater Treatment Plant – Phase I Expansion Project – FY 2020
Proposed Progress Schedules:

Data on Equipment to be used on the Work: (Include the number of machines, the type, capacity, age and conditions and location)

Subcontractors: (Submit a list of proposed Subcontractors. List sources, types and manufacturers of proposed materials)

NOTE: TO BE SUBMITTED UPON REQUEST

IS NOT AN ACCEPTABLE ANSWER.
PROJECT: Unitec Wastewater Treatment Plant – Phase I Expansion Project – FY 2020

### BASE BID

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description of item with Lump Sum Price Written in Words</th>
<th>Unit</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mobilization, Bonds, Storm Water Pollution Prevention Plan (SWPPP) and Compliance with National Pollutant Discharge Elimination System (NPDES) Permit; complete, in place, ready to use for the lump sum of: ____________________________________dollars and __________________________________cents.</td>
<td>LS</td>
<td>$</td>
</tr>
<tr>
<td>2</td>
<td>Miscellaneous site civil work including all clearing, grubbing, concrete flatwork, sidewalks, steps, handrails, access road improvements, trench safety protection, subsurface utility excavation (SUE), all yard piping; complete, in place, tested, ready to use for the lump sum of: ____________________________________dollars and __________________________________cents.</td>
<td>LS</td>
<td>$</td>
</tr>
<tr>
<td>3</td>
<td>Installation of new factory-built Headworks. Structure to be welded 316 (L) Stainless Steel, 3/8” wall thickness (min.); all required equipment including concrete foundation, mechanical bar screen with passive bypass system, compactor-bagger/classifier/de-gritter; concrete or 316 (L) S.S. splitter box, all piping, fittings, reducers, measuring devices, electrical, controls, metering, restraints, tie-ins to existing 8” diameter force main (FM) and existing Aeration basin A; meeting all TCEQ requirements; all work complete, in place, tested, ready to use for the lump sum of: ____________________________________dollars and __________________________________cents.</td>
<td>LS</td>
<td>$</td>
</tr>
</tbody>
</table>
## BASE BID

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description of item with Lump Sum Price Written in Words</th>
<th>Unit</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Installation of 3HP RAS pump and 60 HP Blower; including all equipment for a complete Pump and Blower Header Piping Assembly; all work to include all, appurtenances, fittings, reducers, headers, valves, electrical and controls, air relief valves, VFDs, meters, and all other items for a complete installation; all work complete, in-place, tested; ready to use for lump sum of</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>__________________________________________________________________________ dollars and __________________________________________________________________________ cents.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Construction and installation of New Bridge Supported Concrete Clarifier including all equipment, access stairs/walkway; spray bar; bridge and structure assembly; electrical and controls, all piping and tie-ins; all work complete, in-place, tested, and ready to use per lump sum of:</td>
<td>LS</td>
<td>$</td>
</tr>
<tr>
<td></td>
<td>__________________________________________________________________________ dollars and __________________________________________________________________________ cents.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Construction and installation of New Lift Station with two (2) pumps; 8’ diameter FRP wetwell; all connections, valves, fittings; controls; Air release valves, alarms, electrical; all work complete, in place, tested, and ready to use per lump sum cost of:</td>
<td>LS</td>
<td>$</td>
</tr>
<tr>
<td></td>
<td>__________________________________________________________________________ dollars and __________________________________________________________________________ cents.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Construction and installation of New Non-Potable Plant Water Supply (NPW) with two (2) pumps; including concrete foundation, strainers, pneumatic tank, valves, all piping/connections, reducers, metering, controls, fittings and appurtenances; complete, in-place, tested, and ready to use per lump sum of:</td>
<td>LS</td>
<td>$</td>
</tr>
<tr>
<td></td>
<td>__________________________________________________________________________ dollars and __________________________________________________________________________ cents.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Complete upgrade of the existing Gas Chlorine Disinfection System in existing building; all required demolition and new equipment, improvements, all piping/connections, all connections to chlorine contact chamber (CCC); meeting TCEQ and OSHA requirements for disinfection and safety; all work complete in-place, tested, and ready to use per lump sum of:</td>
<td>LS</td>
<td>$</td>
</tr>
<tr>
<td></td>
<td>__________________________________________________________________________ dollars and __________________________________________________________________________ cents.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### BASE BID

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description of item with Lump Sum Price Written in Words</th>
<th>Unit</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>All Electrical items and materials for a complete and working electrical system. For the installation of, but not limited to, Headworks, Clarifier, Blower, Lift Station, Non-Potable Water Supply, Control Panels, Dissolved Oxygen Sensors and Controls, Flow Meters, Chart Recorder and area lighting, required conduits/piping, and other items detailed in the plans and specifications. All complete and in place for the lump sum of: ___________________________________________ dollars and ___________________________________________ cents.</td>
<td>LS</td>
<td>$</td>
</tr>
<tr>
<td>10</td>
<td>Utility Allowance. This allowance is to be used at the Owner’s discretion for unanticipated adjustment of a utility or unknown structure, which warrants the use of the Allowance. Should use of the Allowance become necessary, the Owner will provide written authorization at a cost to be negotiated between the Owner and the Contractor and based on the Contractor’s actual cost. No work is to be performed under this Item without written approval and authorization from the Owner. Work performed without written authorization will not be paid. There is no guarantee that any of these funds will be used. If approved, an authorization shall be measured by complete and functioning adjustment of the unanticipated work. Payment shall be made for work complete, in place, tested, and ready to use. All complete and in place for the lump sum of: ___________________________________________ dollars and ___________________________________________ cents.</td>
<td>LS</td>
<td>$ 200,000.00</td>
</tr>
</tbody>
</table>

TOTAL BASE BID AMOUNT (Bid Items No. 1-10) $______________________________

TOTAL BASE BID WRITTEN IN WORDS: ________________________________________
<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description of item with Lump Sum Price Written in Words</th>
<th>Unit</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alt# 1</td>
<td>Construction and installation of New 0.18 MGD Aeration and Digester Concrete Basin (TRAIN B) including all equipment; access stairs, landings, concrete walkways and handrails; all RAS/WAS and MLSS piping and tie-ins; all stainless steel Aeration piping; including all Header/Fine Bubble Aeration and Digester Coarse Bubble air drops; valves and fittings; all drains and connections to lift station; NPW piping and connections; telescoping valves; D.O. equipment; provide yard piping/valves/fittings/connections to splitter box, NPW Station and Blower/RAS pump; concrete flatwork; work to be complete, in place, tested, and ready to use for the lump sum of: ________________________ dollars and __________________ cents.</td>
<td>LS</td>
<td>$</td>
</tr>
</tbody>
</table>

TOTAL ALTERNATE #1 AMOUNT
$______________________________

TOTAL BASE BID WRITTEN IN WORDS: __________________________________________

________________________________________
<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description of item with Lump Sum Price Written in Words</th>
<th>Unit</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alt# 2</td>
<td>Upgrade existing 0.11 MGD concrete Package Plant including demolition of all existing mechanical equipment, access stairs, landings, handrails and air piping; provide concrete repair and interior coating system; provide New Coarse Bubble Air Diffuser System to existing Aeration Basins; provide stainless steel headers with air drops and all tie-ins to Blower; provide yard piping/valves/fittings/connections to splitter box, NPW Station and Blower/RAS pump; provide new MLSS Lift Station including two (2) pumps and weir with piping connection to MLSS Lift Station; new access stairs, handrails, and landings; all work complete, in place, tested, and ready to use for the lump sum of:</td>
<td>LS</td>
<td>$</td>
</tr>
</tbody>
</table>

TOTAL ALTERNATE #2 AMOUNT $__________________________________________

TOTAL BASE BID WRITTEN IN WORDS: ____________________________________
NOTE:
1) Items of work or requirements not shown nor specifically listed for payment in the Bid Proposal and for work, scope, requirements in the plans, contract documents or specifications, if not listed, shall be considered necessary and subsidiary to the other items in the Bid Schedule and shall be required under the Contract.

Meet All Local, State, Federal, AWWA, TCEQ, and OSHA Codes and Regulations; complete, in-place, tested, and ready to use.

2) All Bid Items listed are approximate and are for reference only. See plans and specifications.

3) Manufacturer’s Authorized Factory Representative(s) shall be present for equipment, installation, testing, and start-up to successful operation and acceptance by the City. Manufacturer shall supply a written Certification when equipment installation is complete meets all manufacturer’s requirements and is ready for operation.

Note: For any conflict for measurement and payment items shown in the plans, standard or technical specifications, or drawings of this project the items shown in the “Bid Proposal/Schedule of Values” will prevail and be the only items to be used for project payment; complete, tested, in place and ready to use.

________________________________________
Contractor

________________________________________
Signature

___________________________
Title

___________________________
Address

___________________________
City/State

___________________________
Zip Code

___________________________
Telephone Number:(__)

___________________________
Fax Number:(__)

___________________________
Date:

NOTE: FINAL PAYMENT FOR BID ITEMS SHOWN IN BID PROPOSAL/SCHEDULE WILL BE PAID FOR WHEN COMPLETE IN PLACE, TESTED, AND ACCEPTED BY THE OWNER.
BID BOND

Project: Unitec Wastewater Treatment Plant – Phase I Expansion Project – FY 2020

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned

________________________________________

as Principal, and __________________________ as
Surety, are hereby held and firmly bound unto

________________________________________

as Owner in the penal sum of 5% of greatest amount bid for payment of which, well and
truly to be made, we hereby jointly an severally bid ourselves, our heirs, executors,
administrations, successors and assigns.

Signed, this ______ day of ____________________, 20__.

The condition of the above obligation is such that whereas the Principal has submitted to

________________________________________

a certain Bid, attached hereto and hereby made a part hereof to enter into a Contract in writing for the

________________________________________

NOW, THEREFORE,

(a) If said Bid shall be rejected, or in the alternate,
(b) If said Bid shall be accepted and the Principal shall execute and deliver a
Contract in the Form of Contract attached hereto (properly completed in
accordance with said Bid) and shall furnish a bond for his faithful
performance of said Contract, and for the payment of all persons
performing labor or furnishing materials in connection therewith, and shall
in all other respects perform the Agreement created by the acceptance of
said Bid,

then this obligation shall be void, otherwise the same shall remain in force and
effect; it being expressly understood and agreed that the liability of the Surety for any and
all claims hereunder shall, in no event, exceed the penal amount of this obligation as
herein stated.

The Surety, for value received, hereby stipulates and agrees that he obligations of
said Surety, and its bonds shall be in no way impaired or affected by any extension of the
time within which the Owner may accept such Bid; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth herein.

__________________________ (L.S.)
Principal

__________________________
Surety

By: _________________________
**CITY OF LAREDO**  
**PURCHASING DIVISION**

### CERTIFICATE OF INTERESTED PARTIES

FORM 1295

Complete Nos. 1 - 4 and 6 if there are interested parties.  
Complete Nos. 1, 2, 3, 5, and 6 if there are no interested parties.

| 1 | Name of business entity filing form, and the city, state and country of the business entity’s place of business. |

| 2 | Name of governmental entity or state agency that is a party to the contract for which the form is being filed. |

| 3 | Provide the identification number used by the governmental entity or state agency to track or identify the contract, and provide a description of the goods or services to be provided under the contract. |

<table>
<thead>
<tr>
<th>4</th>
<th>Name of Interested Party</th>
<th>City, State, Country (place of business)</th>
<th>Nature of Interest (check applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Controlling</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Intermediary</td>
</tr>
</tbody>
</table>

| 5 | Check only if there is NO Interested Party. |

| 6 | AFFIDAVIT  
I swear, or affirm, under penalty of perjury, that the above disclosure is true and correct. |

Signature of authorized agent of contracting business entity

Sworn to and subscribed before me, by the said ____________________________, this the ________ day of ____________, 20______, to certify which, witness my hand and seal of office.

Signature of officer administering oath  
Printed name of officer administering oath  
Title of officer administering oath

**ADD ADDITIONAL PAGES AS NECESSARY**
SECTION A-6
CHECKLIST FOR BIDDERS

All information required by the terms of the Bid Documents must be furnished. MISTAKES OR OMISSIONS CAN BE COSTLY AND CAN RESULT IN THE REJECTION OF YOUR BID. Important items for you to check are included in but not limited to, those listed below. This checklist is furnished only to assist you in submitting a proper bid. Check as you read. **DO NOT INCLUDE THIS CHECKLIST WITH YOUR BID.**

[ ] Have you acknowledged receipt of all addenda to the plans and specifications?

[ ] Is your bid properly signed? (Refer to Bid Documents)

[ ] If a bid guarantee is required, is it included in your bid? (A late bid guarantee is treated the same as a late bid)

[ ] Is your bid guarantee in the proper amount? (5% of total bid price)

[ ] Your bid guarantee must be in the form of a Bidder’s Bond, a Certified Check or Cashier’s Check.

[ ] If your bid guarantee is in the form of a Bidder’s Bond, is the bond properly signed by both the bidder and surety and are all required seals affixed?

[ ] Is the surety company qualified and licensed by the State of Texas as required by the provisions of the bid documents?

[ ] Is the name in which you submitted the bid the same on your bid proposal as on the Bidder’s Bond?

[ ] If required have you entered a unit price for each bid item?

[ ] If required have you entered the unit price or lump sum price in both words and figures? (Unit Price or Lump Sum price in words govern)

[ ] Are decimals in unit prices in the proper places? Are your figures legible?

[ ] Are the extensions of your unit prices, and your total bid price correct?

[ ] Proposals are required to be submitted in duplicate. Are they identical? The duplicate proposal may be a reproduced copy.

[ ] Are all erasures or corrections initialized by the person signing the bid or by an authorized representative of the person signing the bid.
[ ] Do not restrict your bid by altering any provisions of the Bid Document or by attaching any documents to the Proposal that takes exception to the Bid Documents.

[ ] Have you included all pages of the Proposal with your bid? Are all blanks in the Proposal properly completed (equipment brands, alternate materials, etc.)?

[ ] Is the envelope containing your bid properly identified that it is a sealed bid and does it contain the correct project name and bid opening date?

[ ] Will your bid arrive on time? Late bids will not be considered. Bids must be received by the City Secretary, City Hall before the specified bid time on the date specified in the Notice to Bidders, or as modified by addenda issued by the City (Other times or dates will be clearly specified in the Notice).
SECTION A-7
CONSTRUCTION CONTRACT

PROJECT: **Unitec Wastewater Treatment Plant – Phase I Expansion Project – FY 2020**

STATE OF TEXAS {}

COUNTY OF WEBB {}

THIS AGREEMENT, made this ___ day of _______________ by and between the City of Laredo, Texas, acting by and through its duly authorized City Manager hereinafter termed the Owner, and ______________ of the City of ______, County of ______, State of __________, his/their executors, administration, heirs, successors, or assigns, hereinafter termed the Contractor.

WHEREAS, the Owner desired to enter into Contract for **Unitec Wastewater Treatment Plant – Phase I Expansion Project - FY 2020** in accordance with the provisions of the Invitation for Bids, the Specifications and Plans title as above, and published by City of Laredo, Texas, 5816 Daugherty Ave., (mailing address: P.O. Box 2950), Laredo, Texas 78041 all of which are a part thereof; and,

WHEREAS, the Contractor has been engaged in and now does such work and represents that he is fully equipped, competent and capable to perform the above desired and outlined work, and is ready and willing to perform the work in accordance with the provisions of the Invitation for Bids, the Specifications and Plans, titled, **Unitec Wastewater Treatment Plant – Phase I Expansion Project - FY 2020**.

WITNESS:

THAT for and in consideration of the payments and agreements hereinafter mentioned to be made and performed by the Owner, the Contractor hereby agrees at the unit price set forth in his Bid, made a part thereof totaling the sum of ___________________ ($________________) based on the Engineer’s estimate of quantities, payable in the manner set out in Division C, Section 9, General Provisions of the contractual Documents to commence and complete the construction of **Unitec Wastewater Treatment Plant – Phase I Expansion Project - FY 2020** in the City of Laredo, Texas, in accordance with Instruction to Bidders, Special Provisions, General Provisions, Technical Provisions, and all other requirements of the contractual Documents, and in accordance with the Specifications and Plans (including all maps, plats, blueprints, and other drawings and printed or written explanatory matter thereof) prepared by the Owner’s Engineer, a part thereof and collectively, together with this Agreement constitute the entire Contract; and the Contractor agrees to furnish all the materials, supplies, machinery, equipment, tools, superintendence, labor, insurance, and other accessories and services, and whatever else may be necessary to complete the said construction in accordance with said specifications, plans, and other contractual documents including such proposal.

Said Contractor further agrees to begin the work on or before the tenth day following the date set by the Owner in the written notice to proceed and to complete the work within **300 Working days**.

The Contractor further agrees to pay, as liquidated damages, the sum of $___________ for each consecutive working day there-in-after as herein provided in Division B, Section 1.
And the Owner in consideration of the full and true performance of the said work by said Contractor hereby agrees to and binds itself to pay the said Contractor the unit price set forth in the attached Bid, and in the manner provided in the Specifications.

IN WITNESS WHEREOF, the OWNER AND THE CONTRACTOR have hereunto set their hand this __________ day of ________________________.

WITNESS:

_________________________  ________________  ________________
Contractor/Firm (Typed)  Name  Signature

_________________________  ________________  ________________
Name  Signature  Signature (Typed)

_________________________  ________________  ________________
Address  Signature (Typed)  Title

_________________________  ________________
Address  Address

_________________________
City/State/Zip Code

_________________________
Telephone Number

_________________________
Fax Number

ATTEST:

_________________________
CITY OF LAREDO, TEXAS

_________________________
Robert A. Eads, ICMA-CM  City Manager

_________________________
Jose A. Valdez, Jr.  City Secretary

APPROVED AS TO FORM:

_________________________
Kristina Laurel Hale, City Attorney
SECTION A-8
PERFORMANCE BOND
(To be Used in Texas under V.A.T.S. 5160)

THE STATE OF {}
COUNTY OF {}

KNOW ALL MEN BY THESE PRESENTS: That we (1) ____________________________
_________________________________________ a (2) ____________________________
_________________________________________ of hereafter called Principal and (3) _______
_________________________________________ of __________________________, State of _______
_________________________________________, hereinafter called the Surety, are held and firmly bound unto (4) __________
_________________________________________ of __________________________, hereinafter called Owner, in the penal sum of ____________________________
_________________________________________ ($__________ )

Dollars in lawful money of the United Stated, to be paid in (5)

WEBB COUNTY, TEXAS

_______________ for the payment of which sum well and truly to be made, we bind
ourselves, our heirs, executors, administrators and successors, jointly and severally,
firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION is such that Whereas, the Principal entered
into a certain Contract with (6) ____________________________
the Owner, dated the ________________ day of ________________ a copy
of which is hereto attached and made a part hereof for the Construction of:

_________________________________________

_________________________________________

(hereinafter called the “Work”)

These notes refer to the numbers in body of Contract above:

Date of Bond must not be prior to Date of Contract.

(1) Correct name of Contractor.
(2) A Corporation, or Partnership or an Individual, as case may be.
(3) Correct name of Surety.
(4) Correct name of Owner.
(5) County and State.
(6) Owner.

NOW THEREFORE, if the Principals shall well, truly and faithfully perform the work in accordance with the Plans, Specifications and Contract Documents during the original term thereof, and any extensions thereof which may be granted by the Owner with or without notice to the Surety, and if he shall satisfy all claims and demands incurred under such Contract, and shall fully indemnify and save harmless the Owner from all costs and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the owner all outlay and expense which the Owner may incur in making good any default, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED FURTHER, that if any legal action be filed upon this Bond, venue shall lie WEBB County, State of Texas, and that the said surety, for value received hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract or to the work to be performed thereunder or the Specifications accompanying the same shall in any wise affect its obligation on this Bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract or to the work or to the Specifications.

IN WITNESS WHEREOF, this Instrument is executed in six counterparts, each one of which shall be deemed an original, this the ______ day of ____________________.

ATTEST:

(Principal) Secretary ____________________________
PRINCIPAL

By: ____________________________

(SEAL) ____________________________
Address (State and Zip Code) ____________________________

Witness as to Principal ____________________________
Telephone Number ____________________________

Address (State and Zip Code) ____________________________
ATTEST:

__________________________________________  SURETY: (Surety)
Secretary

By: ______________________________

(SEAL)

(Surety) Secretary  Address (State and Zip Code)

__________________________
Telephone No. (Area Code)

(SEAL)

Witness as to Surety

__________________________
Address (State and Zip Code)
PAYMENT BOND
(To be Used in Texas under V.A.T.S. 5160)

THE STATE OF {}
COUNTY OF {}

KNOW ALL MEN BY THESE PRESENTS: That we (1) __________________________ (2) __________________________
of __________________________, hereinafter called Principal and (3) __________________________
of __________________________, State of __________, hereinafter called the Surety, are held and firmly bound unto (4) __________________________ of __________________________ hereinafter called Owner, and unto all Persons, Firms, and Corporations who may furnish materials for, or perform labor upon the building or improvements hereinafter referred to in the penal sum of __________________________ ($___________)

Dollars in lawful money of the United States, to be paid in (5) WEBB COUNTY, TEXAS for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION is such that Whereas, the Principal entered into a certain Contract with (6) ______ the Owner, dated the ________________ day of ________________ a copy of which is hereto attached and made a part hereof for the construction of:

________________________________________

(herinafter called the “Work”)

These footnotes refer to the numbers in body of contract above:

Date of Bond must not be prior to Date of Contract.

(1) Correct name of Contractor.
(2) A Corporation, or Partnership or an Individual, as case may be.
(3) Correct name of Surety.
(4) Correct name of Owner.
(5) County and State.
(6) Owner.
NOW THEREFORE, if the Principals shall well, truly and faithfully perform the work in accordance with the Plans, Specifications and Contract Documents during the original term thereof, and any extensions thereof which may be granted by the Owner with or without notice to the Surety, and if he shall satisfy all claims and demands incurred under such Contract, then this obligation shall be null and void; otherwise to remain in full force and effect.

This Bond is made and entered into solely for the prosecution of all claimants supplying labor and material in the prosecution of the work provided for in said Contract, and all such claimants shall have a direct right of action under the Bond as provided in Article 5160, Revised Civil Statues 1925, as amended by House Bill 344, Acts 46 Legislature, Regular Session, 1959.

PROVIDED FURTHER, that if any legal action be filed upon this Bond, venue shall lie WEBB County, State of Texas, and that no change, extension of time, alteration or addition to the terms of the Contract or to the work to be performed thereunder or the Specifications accompanying the same shall in any wise affect its obligation on this Bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract or to the work or to the Specifications.

PROVIDED FURTHER, that no final settlement between the Owner and the Contractor shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in six counterparts, each one of which shall be deemed an original, this the ______ day of ___________.

ATTEST:

______________________________  ______________________________
(Principal) Secretary  PRINCIPAL

By: ___________________________

______________________________  ______________________________
(SEAL)  Address (State and Zip Code)

______________________________  ______________________________
Witness as to Principal  Telephone Number

______________________________
(SEAL)  

______________________________  
Surety
ATTEST:

(Surety Secretary)     By:__________________________

(SEAL) 

__________________________
Address (State and Zip Code)

__________________________
Telephone Number

NOTE: If Contractor is Partnership, all Partners should execute Bond.
PERFORMANCE - PAYMENT BOND FORM
M-24, 25, Attach. Sa

______________________________________________  (SEAL)
Individual Principal

______________________________________________
Address (State and Zip Code)

______________________________________________
Business Address

______________________________________________
Telephone Number (Area Code)

______________________________________________
Telephone Number (Area Code)

ATTEST:

______________________________________________
Corporate Principal

______________________________________________
(State and Zip Code)

______________________________________________
Business Address Name

______________________________________________
Telephone Number (Area Code)

______________________________________________
(Affix Corporate Seal)

By: ______________________________

______________________________________________
Address (State and Zip Code)

______________________________________________
Corporate

______________________________________________
Business Address

______________________________________________
(Affix Corporate Seal)

______________________________________________
Telephone:

______________________________________________
CERTIFICATE AS TO CORPORATE PRINCIPAL

I, ________________________________, certify that I am the ______________________.
Secretary of the Corporation named as Principal in the within Bond; that ________________
______________________________, who signed the said Bond on behalf of the Principal was
then ______________________________, of said Corporation; that I know his signature thereof is genuine; and that said Bond was duly signed, sealed, attested for and in behalf of said Corporation by authority of its governing body.

Title

________________________________________________________________________

Date: __________________________________ (Affix Corporate Seal)

Telephone No.

The rate of premium on this Bond is __________ per thousand. Total of premium charge

$_ __________

NOTE: The above must be filled in by Corporate Surety. Power-of-Attorney of person signed for Surety company must be attached.
Contractor shall provide and continuously maintain the minimum insurance coverages set forth below during the term of its agreement with the City of Laredo; and Contractor shall require its subcontractors to purchase the same types and amounts of insurance, at a minimum, as set forth below with respect to statutory workers’ compensation and liability insurance.

1. Standard ISO commercial general liability insurance at minimum combined single limits of $1,000,000 per-occurrence and $2,000,000 general aggregate for bodily injury and property damage, which coverage shall include: products/completed operations ($2,000,000 products/completed operations aggregate); XCU (explosion, collapse, underground) hazards; and contractual liability. Without limitation, the commercial general liability coverage must cover all operations required in the contract, as well as contractual liability for the indemnity obligations assumed by the Contractor in the contract. Coverage must be written on an occurrence form.

2. Workers’ compensation insurance at statutory limits, including employers liability coverage at minimum limits of $1,000,000 each-occurrence, each accident/$1,000,000 by disease each-occurrence/$1,000,000 by disease aggregate.

3. Commercial automobile liability insurance at a minimum combined single limit of $1,000,000 per-occurrence for bodily injury and property damage, including non-owned and hired car coverage and owned vehicles if any are owned.

4. Umbrella liability or following-form excess liability at minimum limits of $_________________ each-occurrence/$_________________ aggregate where applicable in any underlying coverage. Coverage must be at least as broad as the underlying commercial general liability, auto liability, and employer’s liability.

5. Pollution Legal Liability—
   a) Project costs of $1,000,000 to $10,000,000 and over $10,000,000
   b) Contractors Pollution Liability:
      - $___________ per-claim/ $_____________ aggregate (applies to operations that include the use, application, or consumption of pollutants)
      - Retro date shall not be later than the inception date of contract
      - Contractual liability coverage to be included in contractor’s pollution liability coverage
   c) Environmental Liability (Asbestos and removal of other hazardous materials and/or repair, maintenance, installation, construction operations that are high hazard)
      - $5,000,000 per-claim/$10,000,000 aggregate minimum
      - Retro date shall not be later than the inception date of contract
      - Contractual liability coverage to be included in contractor’s pollution liability coverage
      - At a minimum, coverage must apply to on-premises and transit operations
6. Professional liability for design build contractors, engineers, and architects at minimum limits of $_______________ per-claim/$_______________ aggregate. The retro date shall not be later than the inception date of the contract.

7. Builders Risk—
   a) “All-risk” including collapse, flood, and earthquake, to be written on completed value form.
   b) Coverage to include limits of at least $250,000 for off-premises storage and transit of construction materials. Soft costs to be included at a minimum limit of $500,000.
   c) Thirty (30)-day occupancy clause to apply.
   d) No testing exclusion should apply.

City of Laredo reserves the right to purchase the builder's risk coverage at its sole discretion.

With reference to the foregoing insurance requirements, Contractor shall specifically endorse applicable insurance policies as follows:

1. City of Laredo shall be named as an additional insured on a primary and non-contributory basis, regardless of the application of other insurance, with respect to all liability coverages, except for the professional liability and workers' compensation.

2. All liability policies shall contain no cross-liability exclusions or insured versus insured restrictions.

3. A waiver of subrogation in favor of City of Laredo shall be contained in all policies.

4. All insurance policies shall be endorsed to require the insurer to immediately notify City of Laredo of any material change in the insurance coverage.

5. All insurance policies shall be endorsed to the effect that City of Laredo will receive at least thirty (30) days’ notice prior to cancellation or non-renewal of the insurance.

6. The additional insured coverage in the CGL policy in favor of City of Laredo must apply to the ongoing operations of Contractor for contract costs or up to $1,000,000 and expanded to include products/completed operation for contract costs in excess of $1,000,000.

7. Required limits may be satisfied by any combination of primary and umbrella/excess liability insurances.

8. Contractor may maintain reasonable and customary deductibles, subject to approval by City of Laredo.

9. Insurance must be purchased from insurers that are financially acceptable to City of Laredo with a minimum A.M. *Best* financial rating of A-:VII.

10. Coverage for commercial general liability, professional liability, and pollution legal liability must be maintained for at least one (1) to two (2) years after the project is completed.

11. For projects in excess of $10,000,000 in cost, a per-project aggregate limit must be included in the commercial general liability.
All insurance must be written on standard ISO or equivalent forms. Certificates of insurance shall be prepared and executed by the insurance company, or its authorized agent, shall be furnished to City of Laredo within five (5) business days of being notified of the award of the contract, and shall contain provisions representing and warranting the following:

➢ Shall set forth all endorsements and insurance coverages according to requirements and instructions contained herein.

➢ Shall specifically set forth the notice-of-cancellation or termination provisions to City of Laredo.

➢ Copies of all required endorsements must be attached to the certificate of insurance. The certificates of insurance must be updated and resubmitted to the City of Laredo to show renewal coverages, as applicable, at least thirty (30) days prior to expiration of any one or more policies.

Upon request, Contractor shall furnish City of Laredo with certified copies of all insurance policies.

**BONDS**
(APPLIES TO MAJOR CONSTRUCTION CONTRACTS)

Bonds are required for public works contracts under the following circumstance:

1. Payment and Performance Bond and Labor and Material Payment Bond, each in a personal sum equal to 100% of the contract cost.
2. A Bid Bond is also required in the amount of the bid submitted to the City of Laredo.

**All of the above requirements are minimum, as referenced, and may be modified at the sole discretion of the City of Laredo.**
# CITY OF LAREDO
## RECOMMENDED INSURANCE PROVISIONS FOR CONSTRUCTION, REPAIR, INSTALLATION AND MAINTENANCE CONTRACTORS

<table>
<thead>
<tr>
<th>CONTRACT COST</th>
<th>TYPE OF INSURANCE</th>
<th>LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than $1,000,000</td>
<td>Umbrella Liability</td>
<td>Not Required</td>
</tr>
<tr>
<td></td>
<td>Professional Liability</td>
<td>$1,000,000 Per-Claim/ $2,000,000 Aggregate</td>
</tr>
<tr>
<td>$1,000,000 to $5,000,000</td>
<td>Umbrella Liability</td>
<td>$4,000,000 Per-Occ/</td>
</tr>
<tr>
<td></td>
<td>Professional Liability</td>
<td>$1,500,000 Per-Claim/ $3,000,000 Aggregate</td>
</tr>
<tr>
<td>$5,000,000 to $10,000,000</td>
<td>Umbrella Liability</td>
<td>$9,000,000 to $10,000,000 Per-Occ</td>
</tr>
<tr>
<td></td>
<td>Professional Liability</td>
<td>$1,500,000 Per-Claim/ $3,000,000 Aggregate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>to $2,000,000 Per-Claim/$4,000,000 Aggregate</td>
</tr>
<tr>
<td>Over $10,000,000</td>
<td>Umbrella Liability</td>
<td>$10,000,000 or Higher</td>
</tr>
<tr>
<td></td>
<td>Professional Liability</td>
<td>$2,000,000 Per-Claim/ $4,000,000 Aggregate</td>
</tr>
<tr>
<td>$1,000,000 to $10,000,000</td>
<td>Contractor's Pollution Liability</td>
<td>$1,000,000 Per-Claim/ $2,000,000 Aggregate</td>
</tr>
<tr>
<td>Over $10,000,000</td>
<td>Contractor's Pollution Liability</td>
<td>$2,000,000 Per-Claim/ $4,000,000 Aggregate</td>
</tr>
</tbody>
</table>

## TAIL COVERAGE

<table>
<thead>
<tr>
<th>CONTRACT SIZE</th>
<th>INSURANCE</th>
<th>DURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1,000,000 to $5,000,000</td>
<td>CGL, PL, and PLL</td>
<td>One (1) Year</td>
</tr>
<tr>
<td>Over $5,000,000</td>
<td>CGL, PL and PLL</td>
<td>Two (2) Years</td>
</tr>
<tr>
<td>Any Contract Size</td>
<td>Hazardous Environmental Work</td>
<td>Two (2) Years</td>
</tr>
</tbody>
</table>
SECTION A-10
NOTICE OF AWARD

To:

Project: Unitec Wastewater Treatment Plant – Phase I Expansion Project – FY 2020

The City of Laredo has considered the bids submitted for the above described project in response to its advertisement for bids dated ________________________________ and related information to Bidders.

You are hereby notified that your bid in the amount of $________, has been approved by the City Council at its regular council meeting on __________.

Pursuant to the Information to Bidders you are asked to sign the proposed Contract (in five duplicate originals) and to return the same, along with the required Certificate of Insurance and Payment Bond and Performance Bond within ten (10) days of your receipt of this Notice, for the approval and signature of the City Manager.

For the purpose of effective date of the Performance and Payment Bond, and the required Certificate of Insurance, the date of __________ may be considered the date of the Contract, if the Documents are approved by the City Manager.

If you fail to submit the proposed Contract and the Performance and Payment Bonds and the Certificates of Insurance within ten (10) days from your receipt of this Notice, your bid will be considered as withdrawn and your bid bond will be forfeited.

You are asked to acknowledge receipt of this Notice by signing in the appropriate place below.

Dated this __________ day of __________

CITY OF LAREDO UTILITIES DEPT.

Riazul I. Mia, P.E., CFM
Utilities Director

ACKNOWLEDGMENT:

Receipt of this Notice is hereby acknowledged

Dated this __________ day of __________

Authorized Signature

Title: __________________________
SECTION A-11
NOTICE TO PROCEED

Date: ________________________________

To: ________________________________

Project: Unitec Wastewater Treatment Plant – Phase I Expansion Project – FY 2020

In accordance with the construction contract dated ______________________ you are hereby notified to commence work on ______________________. Contract time is 300 working days including material handling and inventory.

CITY OF LAREDO UTILITIES DEPT.

______________________________
Riazul I. Mia, P.E., CFM
Utilities Director

The above NOTICE TO PROCEED is hereby acknowledged by

______________________________
on this the ____________ day of ____________.

______________________________
Authorized Signature

______________________________
Typed Name:

Title: ________________________________
SECTION A-12
CERTIFICATE OF OWNER’S ATTORNEY

Project Description: Unitec Wastewater Treatment Plant – Phase I Expansion Project – FY 2020

Awarded by the City Council: __________________________________________

I, the undersigned, Kristina Laurel Hale, City Attorney the duly authorized and acting legal representative of THE CITY OF LAREDO, do hereby certify as follows:

I have examined the attached Contract(s) and Surety bonds and the manner of execution thereof, and I am of the opinion that each of the aforesaid Agreements has been duly executed by the proper parties thereto acting through their duly authorized representatives; that said representatives have full power and authority to execute said Agreements on behalf of the respective parties named thereon; and that the foregoing Agreements constitute valid and legally binding obligations upon the parties executing the same in accordance with terms, conditions, and provisions thereof.

____________________________________
Kristina Laurel Hale, City Attorney

Date: __________________________________
NOTICE FROM THE
TEXAS ETHICS COMMISSION

OVERVIEW

In 2015, the Texas Legislature adopted House Bill 1295, which added Section 2252.908 of the Government Code. The law states that a governmental entity or state agency may not enter into certain contracts with a business entity unless the business entity submits a disclosure of interested parties to the governmental entity or state agency at the time the business entity submits the signed contract to the governmental entity or state agency. The law applies only to a contract of a governmental entity or state agency that either (1) requires an action or vote by the governing body of the entity or agency before the contract may be signed or (2) has a value of at least $1 million. The disclosure requirement applies to a contract entered into on or after January 1, 2016.

The Texas Ethics Commission was required to adopt rules necessary to implement that law, prescribe the disclosure of interested parties form, and post a copy of the form on the Commission’s website. (See attached Rules.) The Commission adopted the Certificate of Interested Parties form (Form 1295) on October 5, 2015. The Commission also adopted new rules (Chapter 46) on November 30, 2015, to implement the law.

Filing Process:

By January 1, 2016, the commission will make available on its website a new filing application that must be used to file Form 1295. A business entity must use the application to enter the required information on Form 1295 and print a copy of the completed form, which will include a certification of filing that will contain a unique certification number. An authorized agent of the business entity must sign the printed copy of the form and have the form notarized. The completed Form 1295 with the certification of filing must be filed with the governmental body or state agency with which the business entity is entering into the contract.

The governmental entity or state agency must notify the commission, using the commission’s filing application, of the receipt of the filed Form 1295 with the certification of filing not later than the 30th day after the date the contract binds all parties to the contract. The commission will post the completed Form 1295 to its website within seven business days after receiving notice from the governmental entity or state agency.

Information regarding how to use the filing application will be available on this site by January 1, 2016.

FREQUENTLY ASKED QUESTIONS FOR DISCLOSURE OF INTERESTED PARTIES (FORM 1295)

1. WHO IS REQUIRED TO FILE FORM 1295?

In 2015, the Texas Legislature adopted House Bill 1295, which added section 2252.908 of the Government Code. The law states that a governmental entity or state agency may not enter into certain
contracts with a business entity unless the business entity submits a disclosure of interested parties (Form 1295) to the governmental entity or state agency at the time the business entity submits the signed contract to the governmental entity or state agency. The Texas Ethics Commission has adopted rules requiring the business entity to file Form 1295 electronically with the Commission.

2. WHAT CONTRACTS DOES FORM 1295 APPLY TO?

The law applies only to a contract of a governmental entity or state agency that either:

(1) requires an action or vote by the governing body of the entity or agency before the contract may be signed; or

(2) has a value of at least $1 million.

Gov’t Code § 2252.908. The disclosure requirement applies to a contract entered into on or after January 1, 2016.

A contract does not require an action or vote by the governing body of a governmental entity or state agency if:

(1) the governing body has legal authority to delegate to its staff the authority to execute the contract;

(2) the governing body has delegated to its staff the authority to execute the contract; and

(3) the governing body does not participate in the selection of the business entity with which the contract is entered into.

1 T.A.C. § 46.1(c).

3. CAN I FILE FORM 1295 ON PAPER?

No. A business entity must file Form 1295 electronically with the Texas Ethics Commission using the online filing application. See Question #4 for information about logging in to the online filing application.

4. HOW DO I LOGIN TO THE FILING APPLICATION?

If this is your first time logging in, you will need to create an account in order to register and receive a password. Once you have registered, you will receive an email containing a password setup link. Click on the link to set your password. After you have established an account, you will use your email address, password, and user type (either “Business Entity” or “Governmental Entity/State Agency”) to log in to the filing application. Watch our short videos on "Logging In The First Time" on the Form 1295 File Reports Electronically web page.

5. IS THERE A MOBILE VERSION?

The mobile version is not complete at this time, but will be available soon.

6. HELP! I FORGOT MY PASSWORD.

If you forgot your password, you can reset your password by clicking the “Forgot Password?” link on the filing application login screen. Once you enter your email address and filer type and successfully answer
the security questions, you will receive an email containing a password reset link. If you cannot successfully answer your security questions, you will need to call the Texas Ethics Commission at (512)463-5800.

7. CAN I HAVE MULTIPLE ACCOUNTS?

You can have a separate account associated with each unique email address. However, once an account is established, there is no way to combine it with another account. You can only view those certificates created under your own unique email address. If you want to view all your certificates together in one account, we highly encourage you to setup a specific email address to register your account and use that email address each time you login to the filing application.

8. HOW MUCH TIME DO I HAVE TO ACKNOWLEDGE A FORM 1295?

A state agency or other governmental entity must acknowledge the receipt of the filed Form 1295 not later than the 30th day after the date the contract binds all parties to the contract. Once a Form 1295 is acknowledged, it will be posted to the Texas Ethics Commission’s website within seven business days.

9. DO I SEND A COPY OF THE NOTARIZED FORM 1295 TO THE TEXAS ETHICS COMMISSION?

No. Do not send a paper copy of the notarized Form 1295 to the Texas Ethics Commission. If you are with a state agency or other governmental entity, you will login to the filing application and acknowledge receipt of Form 1295 electronically. See Question #4 for more information about logging into the filing application.

10. WHAT IF I ACCIDENTALLY ACKNOWLEDGE THE WRONG FORM 1295?

Before you acknowledge a Form 1295, you should double check that you are acknowledging the correct one. If you acknowledge a Form 1295 in error, you cannot undo the certification. Contact the Texas Ethics Commission at 512-463-5800 and ask to speak with Technical Support.

11. THE FILING APPLICATION SAYS THIS FORM 1295 HAS ALREADY BEEN ACKNOWLEDGED. WHAT DO I DO NOW?

First, you should double check that you are entering the correct certification number. If you still receive an error, contact the Texas Ethics Commission at 512-463-5800 and ask to speak to technical support.

12. I SUBMITTED A FORM 1295 AND REALIZED THERE IS AN ERROR. CAN I STILL EDIT IT?

No. Once a Form 1295 has been submitted by the business entity, it can no longer be edited. If you found an error, you will need to start a new certificate and re-enter all the required information.

13. WHAT IF THE CONTRACT ASSOCIATED WITH THE FORM 1295 IS NEVER FULFILLED?

All certificates that are filed with the Texas Ethics Commission and acknowledged by a governmental entity will be posted to the Commission’s website regardless of the eventual outcome of the contract associated with the certificate.

14. WHY AM I NOT RECEIVING EMAIL MESSAGES FROM THE TEXAS ETHICS COMMISSION?
All password reset links will be sent to the email address you provided when you registered. This should be an email address that is current and that you check often. You can verify and update your email address right after you log in. Also, be sure to “whitelist” or mark as “safe” emails that come from “do-not-reply@ethics.state.tx.us” and be sure to check your Spam or Junk folder for any missing messages.
DIVISION B

Supplementary Conditions
SECTION B-1
CONTRACT TIME & LIQUIDATED DAMAGES

PROJECT: Unitec Wastewater Treatment Plant – Phase I Expansion Project – FY 2020

The Contract Performance for this project shall be **300 Working Days** as defined in the Specifications under General Provisions, Division C, Section 1.

The time set forth in the proposal for the completion of the work is an essential element of the Contract. For each working day under the conditions described in the preceding Paragraph that any work shall remain uncompleted after the expiration of the working days specified in the Contract, together with any additional working days allowed, the amount per day given in the following schedule will be deducted from the money due or to become due the Contractor, not as a penalty but as liquidated damages.

<table>
<thead>
<tr>
<th>For Amount of Contract</th>
<th>From More Than</th>
<th>To and Including</th>
<th>Amount of Liquidated Damages Per Working Days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$0</td>
<td>$100,000</td>
<td>$200</td>
</tr>
<tr>
<td></td>
<td>100,000</td>
<td>500,000</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td>500,000</td>
<td>1,000,000</td>
<td>550</td>
</tr>
<tr>
<td></td>
<td>1,000,000</td>
<td>2,000,000</td>
<td>700</td>
</tr>
<tr>
<td></td>
<td>2,000,000</td>
<td>5,000,000</td>
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</tr>
<tr>
<td></td>
<td>20,000,000</td>
<td>Over 20,000,000</td>
<td>2,500</td>
</tr>
</tbody>
</table>
SECTION B-2
EQUAL OPPORTUNITY CLAUSE

PROJECT: Unitec Wastewater Treatment Plant – Phase I Expansion Project – FY 2020

1. The Contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex or natural origin. The Contractor will take Affirmative action to insure that applicants are employed, and that employees are treated during employment, without regard to their race, creed, color or national origin. Such action shall include, but not limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection of training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of the non-discrimination clause.

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

3. The Contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency contracting officer, advising the labor union or worker’s representative of the Contractor’s commitments under Section 202 of Executive Order No. 11246, as amended (3CFR 169 (1974) and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

4. The Contractor will comply with all provisions of Executive Order No. 11246, as amended, and of the rules, regulations and relevant orders of the Secretary of Labor.

5. The Contractor will furnish all information and reports required by Executive Order No. 11246, as amended, and by the rules, regulations and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records and accounts by the contracting agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations and orders.

6. In the event of the Contractor’s noncompliance with the nondiscrimination clauses 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 may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order No. 11246, as amended, and such other sanctions may be imposed and remedies invoke as provided in Executive Order No. 11246, as amended or by rule, regulation or order of the Secretary of Labor, or as otherwise provided by law.
7. The Contractor will include the Provisions of Paragraph 1 through 7 in every Subcontract or purchase order unless exempted by rules, regulations or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order No. 11246, as amended, so that such provisions will be binding upon each Subcontractor or Vendor. The Contractor will take such action with respect to any Subcontract or Purchase Order, as the contracting 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 interest of the United States.
SECTION B-3
(NOT APPLICABLE)
SECTION B-4
INSPECTION BY CITY

PROJECT: Unitec Wastewater Treatment Plant – Phase I Expansion Project – FY 2020

The work covered by these Specifications shall at all times be subject to inspection by the City of Laredo authorized inspectors.

The Contractor shall furnish the City Inspector with every reasonable facility for ascertaining whether the work performed is substandard and deviates from the requirements of the plans and specifications. The City Inspector shall have the authority to halt the construction of any portion of the work not meeting requirements until such time as said work has been corrected to the satisfaction of the Inspector and the Engineer.

City’s normal working hours are Monday through Friday from 8:00 A.M. to 5:00 P.M. The contractor shall notify the City at least twenty-four (24) hours in advance for any work that is to be scheduled beyond the limits of the City’s working hours, and the Contractor shall not begin any such work scheduled unless proper inspection and/or testing has been pre-arranged with the City, with the cost for such inspection beyond the City’s working hours (City Inspector overtime rate is $66.47 per hour) borne by the Contractor.
NOTE: Signs are to be installed in ground on 4’ x 4’ posts
Blue borders
White background
Red letter
Two (2) project signs are required - 4’ x 8’

CONTRACTOR TO REMOVE SIGNS UPON COMPLETION OF PROJECT
DIVISION B

SECTION 7

ILLEGAL DUMPING

The general contractor shall not dispose of any material whatsoever taken from the project site, onto any areas not considered to be legal dump sites. Materials such as broken concrete, asphalt, rebar, trash, etc. are to be disposed of properly, i.e. at the city landfill or as directed by the city engineer. Unless otherwise noted, no material, including dirt, is to be dumped or placed into an existing creek or channel.

The general contractor is hereby instructed to contact John Porter at the City Environmental Services Dept. at 956-794-1650 for additional information on illegal dumping city ordinances.

*Building construction debris should be hauled to the Landfill only by a franchised hauler.
DIVISION C

References and General Requirements
SECTION C-1  
DEFINITION OF TERMS 

C-1.01 DEFINITION OF TERMS:  
Whenever the terms defined herein occur on the Plans, in any other documents or instrument herein contemplated or to which the Specifications apply, the intent and meaning shall be as follows: 

C-1.02 OWNER: (Or Party of the First Party):  
The individual, firm corporation or the political subdivision for whom the facilities covered by these Plans and Specifications are to be constructed. 

C-1.03 CONTRACTOR: (Or Party of the Second Part):  
The individual, firm, or corporation with whom the Contract is made by the Owner. 

C-1.04 ENGINEER:  
Engineer employed by the Owner, or such other Engineer, or Supervisor authorized by the Owner to act on their behalf. 

C-1.05 CONSULTANT:  
Licensed Engineer or Architect employed by the Owner, and authorized by the Owner to act on their behalf. The decisions by the Owner are final. 

C-1.06 BIDDER:  
An individual, firm or corporation submitting a proposal. 

C-1.07 SUPERINTENDENT:  
An authorized representative of the Contractor. 

C-1.08 INSPECTOR:  
An authorized representative of the Owner and Engineer 

C-1.09 LABORATORY:  
A testing laboratory approved by the Owner and Engineer. 

C-1.10 CONTRACT:  
The Agreement between the Owner and the Contractor covering the furnishing of all materials and labor necessary to complete the work and consisting of the Plans and Specifications, together with such supplemental agreements as may be made from time to time.
C-1.11 WORKING DAY:

A "Working Day" is defined as any day not including Saturdays, Sundays, or any legal holidays, observed by the Owner, in which weather or other conditions, not under the control of the Contractor, will permit construction of the principal units of work for a continuous period of not less than seven (7) hours. If the contractor opts to work on Saturday, Sunday, or legal holiday requiring construction inspection, said days are considered working days and charged to the contract time.

C-1.12 WORK:

All structures, services, machinery, equipment, or other facilities that are described in the Plans and Specifications together with such additions or modifications as may be ordered by the Owner from time to time.

C-1.13 WORK, ORDER, OR NOTICE TO PROCEED:

A document authorized by the Owner and issued by the Engineer directing the Contractor to proceed on all or part of the work and a specified date.

C-1.14 CHANGE ORDER:

A supplemental agreement adding to or modifying the Contract, including such additional Plans and Specifications as necessary to properly describe the required change.

C-1.15 SURETY:

The corporate body which is bound with the Contractor for the faithful performance of the work covered by the Contract.

C-1.16 PLANS:

The drawings published by the Engineer showing the locations, character, dimensions and details of the work which are part of the Contract.

C-1.17 SPECIFICATIONS:

The directions, provisions and requirements contained herein pertaining to the method and manner of performing the work, or to the quantities, or to the qualities of materials to be furnished under the Contract. The term "Specifications" shall be deemed to include the Contract Documents, the Special Provisions, the General Provision, and the Technical Provisions as contained herein, together with all supplemental agreements and change orders. Specifications are part of the Contract. Plans take precedence over Specifications if in conflict.

C-1.18 CALENDAR DAYS:

A "Calendar Day" is defined as any day of the week inclusive of Saturdays, Sundays, and legal holidays.
SECTION C-2
DEFINITION OF ABBREVIATIONS

C-2.01 DEFINITION OF ABBREVIATIONS:

Whenever the abbreviations defined herein occur on the Plans, in the Specifications, Contract, Bond, advertisement, Proposal, or in any other Instrument herein contemplated or to which the Specifications apply or may apply, the intent and meaning shall be as follows:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.S.H.O</td>
<td>American Association of State Highways Official</td>
</tr>
<tr>
<td>HP</td>
<td>Horsepower</td>
</tr>
<tr>
<td>K.W.</td>
<td>Kilowatt</td>
</tr>
<tr>
<td>Am. or Amp.</td>
<td>Ampere</td>
</tr>
<tr>
<td>KVA</td>
<td>Kilovolt</td>
</tr>
<tr>
<td>A.S.T.M.</td>
<td>American Society for Testing Materials</td>
</tr>
<tr>
<td>In. or &quot;</td>
<td>Inch or Inches</td>
</tr>
<tr>
<td>Lin.</td>
<td>Linear</td>
</tr>
<tr>
<td>Asph.</td>
<td>Asphalt</td>
</tr>
<tr>
<td>Lb. or #</td>
<td>Pound</td>
</tr>
<tr>
<td>Ave.</td>
<td>Avenue</td>
</tr>
<tr>
<td>A.W.W.A.</td>
<td>American Waterworks Association</td>
</tr>
<tr>
<td>Max.</td>
<td>Maximum</td>
</tr>
<tr>
<td>Min.</td>
<td>Minimum</td>
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<td>MH</td>
<td>Manhole</td>
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<td>IP.</td>
<td>Iron Pin</td>
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<tr>
<td>B &amp; S.</td>
<td>Bell and Spigot</td>
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<td>Mono.</td>
<td>Monolithic</td>
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<td>Blvd.</td>
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<td>No.</td>
<td>Number</td>
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<tr>
<td>B.T.U.</td>
<td>British Thermal Unit</td>
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<td>Abbreviation</td>
<td>Definition</td>
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<td>%</td>
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<td>BM</td>
<td>BenchMark</td>
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<td>PL</td>
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<td>C.I.</td>
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<td>Curb &amp; Gutter</td>
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<tr>
<td>C.L.</td>
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<td>Replace</td>
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<td>Circular Mil</td>
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<td>R.C.S.D.P.</td>
<td>Reinforced Concrete Storm Drain Pipe</td>
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<td>C.F.M.</td>
<td>Cubic Feet per Minute Cleanout</td>
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<td>C.O.</td>
<td>Clean Out</td>
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<td>R.P.M.</td>
<td>Revolutions per minute</td>
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<td>Conduit Minute</td>
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<td>Corrugated</td>
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<td>Right of Way</td>
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<td>Cubic</td>
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<td>Culvert</td>
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<td>Double Strength</td>
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<td>Standard</td>
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<td>Elev. or El.</td>
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<td>Texas Highway Department</td>
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<td>F</td>
<td>Fahrenheit</td>
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<td>V.C.P.</td>
<td>Vitrified Clay Pipe</td>
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<td>Ft. or '</td>
<td>Foot or Feet</td>
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<tr>
<td>V</td>
<td>Volt</td>
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<td>Gal.</td>
<td>Gallon</td>
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<td>Yd.</td>
<td>Yard</td>
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<tr>
<td>S.O.P</td>
<td>Secretaria de Obras Publicas (Mexican Secretaries of Public Works)</td>
</tr>
<tr>
<td>Tex. D.O.T., or TxDOT</td>
<td>Texas Department of Transportation</td>
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SECTION C-3  
INSTRUCTION TO BIDDERS

C-3.01 EXAMINATION OF PLANS, SPECIFICATIONS, SPECIAL PROVISIONS, AND SITE OF WORK:

Submission of a Proposal shall constitute prima facie evidence that the Bidder has carefully examined the site of the proposed work, the Proposal, Contract Forms, Plans and Specifications, and has satisfied himself as to the character, quality, and quantity of work to be performed, materials to be furnished, and as to the requirements of these Specifications, Special Provisions, and Contract.

Any information on the Plans or in the Specifications as to the soil, or material borings, or tests of existing materials, or location of existing utilities is for the convenience of the Bidder. The accuracy of the information is not guaranteed, and no claims for extra work or damages will be considered if it is found during construction that the actual conditions or locations vary from those indicated on the Plans or in the Specifications.

C-3.02 INTERPRETATION OF ESTIMATES:

Any estimate of quantities of work to be done and materials to be furnished in the proposal or on the Plans is given only as a basis of comparison of Proposals and the Award of the Contract. Such estimate is the result of careful calculation and is believed to be correct, but the Owner does not expressly, or by implication, agree that the actual quantities involved will correspond exactly therewith, nor shall the Bidder plead misunderstanding or deception because of such estimate of quantities, or of the character, location or other conditions pertaining to the work. Payment to the Contractor under unit price contracts will be made only for the actual quantities of work performed or materials furnished in accordance with the Plans and Specifications, and it is understood that the quantities may be increased or diminished as hereinafter provided without in any way invalidating the unit bid prices.

C-3.03 PREPARATION OF PROPOSAL:

The Bidder shall submit his proposal on the forms furnished by the Owner. All blank space in the proposal form shall be filled in for each and every item for which quantity is given, and the Bidder shall state the price (typed, or written in ink, both in words and numerals for which he proposed to do each item of work. In case of conflict between words and numerals, the words will govern.

The Proposal shall be signed in ink by the person or persons making, or authorized to make the bid. If the Proposal is offered by an individual, his name and post office address shall be given. If the proposal is offered by a firm or partnership, the name and post office address of each member of the firm or partnership shall be given. If the Proposal is offered by a corporation, the name and title of the person signing the Proposal, and the post office address of the corporation shall be given.

Any person signing a Proposal as agent must file with the Owner legal evidence that he has the authority to do so, and that the signature is binding upon the firm or corporation.
C-3.04 REJECTION OF PROPOSAL:

A Proposal showing any alterations or of words or figures, erasures, additions not called for, alternate bids not called for, incomplete bids, condition bids, or proposals not accompanied by proposal guaranty as required, will be considered as an irregular bid and may be rejected. The Owner reserves the right to waive technicalities as to changes, alterations, or reservations, and to make the award to the best interest of the Owner.

C-3.05 PROPOSAL GUARANTY:

Each Proposal shall be accompanied a certified check, cashier's check or bid bond in the amount of five (5%) percent of the total amount bid. Checks shall be made payable unconditionally to the Owner.

C-3.06 DELIVERY OF PROPOSAL:

Each Proposal must be an original and must be sealed, together with the proposal guaranty, in an envelope plainly marked with the name of the project as shown on the Notice to Bidders, and the name and address of the Bidder. When submitted by mail, this envelope shall be placed in another envelope addressed as indicated in the Notice to Bidders.

Only those proposals actually in the hands of the designated official at the time set in the Notice to Bidders shall be considered. Proposals submitted by telephone, telegraph or fax, will NOT be considered.

C-3.07 WITHDRAWAL OF PROPOSAL:

A Bidder may withdraw his proposal provided he submits to the official designated to receive bids his request in writing to do so prior to the time set for opening of proposals.

C-3.08 PUBLIC OPENING OF PROPOSALS:

Proposals will be publicly opened and read aloud at the time and place set in the Notice to Bidders.

C-3.09 COMPETENCY OF BIDDERS:

Before any Contract is awarded, the Owner may require the Bidder to furnish a complete statement of his financial resources. His experience in similar work, his equipment available for the work proposed, or any other information necessary to establish his competency and reliability as a Contractor.

C-3.10 DISQUALIFICATION OF BIDDER:

Any of the following causes may be considered as sufficient for the disqualification of the Bidder and the rejection of his Proposal:

More than one proposal for the same work from an individual or corporation under the same of different name. Evidence of collusion among Bidders.

An unbalanced Proposal.

Failure to submit a unit price for each item of work shown on the Proposal.
Lack of competency as revealed by the financial statement, experience record, or plant and equipment statement furnished.

Lack of responsibility as shown by past work judged from the standpoint of workmanship and progress.

Uncompleted work which, in the judgment of the Owner, might hinder or prevent the prompt completion of additional work if awarded.

Being in arrears on existing Contracts.

Having defaulted on a previous Contract.

C-3.11 MATERIALS GUARANTY:

Before any Contract is awarded, the Owner may require the Bidder to furnish a complete statement of the origin, composition or manufacturer of any and all materials proposed to be used in the work, together with samples, which may be subjected to tests to determine their quality and fitness for the work.
SECTION C-4
AWARD AND EXECUTION OF CONTRACT

C-4.01 CONSIDERATION OF PROPOSALS:

For the purpose of award, after the proposals are opened and read, the bids considered the most advantageous to the Owner will be carefully studied. The bids will then be compared and the results made public. Until the award of the Contract is made, the Owner reserves the right to reject any or all proposals, to waive technicalities, to advertise for new proposals, or to proceed to do the work otherwise when the best interests of the Owner will be thereby promoted.

C-4.02 AWARD TO CONTRACT:

Contract will not be awarded until the necessary investigations as to the competency of the low bidder are made. Award of Contract will be made by the Owner, upon recommendation by the Engineer, to the lowest responsible bidder meeting the requirements of the Owner. Award of Contract will be made within sixty (60) days after the opening of proposals, unless stated otherwise in the Notice to Bidders.

C-4.03 RETURN OF PROPOSAL GUARANTIES:

As soon as the proposal price has been compared the Engineer may, at his discretion, return the proposal guaranties accompanying in those proposals which, in his judgment, will not be considered in making the award. When award is made, the successful bidder's proposal guaranty only will be retained until after Contract and Bond have been executed.

C-4.04 PERFORMANCE AND PAYMENT BOND:

Within ten (10) days after Notification of Award of Contract, the successful bidder shall execute and file with the Owner a separate surety and payment bond as required by Chapter 93 of the Acts of the Regular Session of the 56th Legislature of Texas, in the full amount of the contract price as a guarantee of the faithful performance of the Contract and payment of all obligations which may be incurred for material and labor used in the work. Bonds shall be executed by a surety company authorized to do business in the State of Texas on the bond forms provided in these Documents. Any surety shall be subject to the approval of the Owner.

C-4.05 EXECUTION OF CONTRACT:

Within ten (10) days after Notification of Award of contract, the successful bidder shall sign and place in the hands of the Owner the necessary agreement entering into a Contract with the Owner.

C-4.06 NOTICE TO PROCEED:

The Notice to Proceed shall be issued within ten (10) days of the execution of the Agreement by the Owner provided that the Contractor has properly executed and submitted all Documents required by the Owner within the same period of time. Should there be reasons why the Notice to Proceed cannot be issued within such period, the time may be extended by mutual agreement between the Owner and Contractor. If the Contractor has submitted all Documents required and the Notice to Proceed has not been issued within the ten (10) day period or within the time extension, the Contractor may terminate the Agreement without further liability on the part of
either party. Furthermore, should the Contractor fail to execute all the requirements within this same ten (10) days period or within the time extension, the Owner may terminate the Agreement.

C-4.07

The Owner may make such investigations as he deems necessary to determine the ability of the Bidder to perform the work, and the Bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request.

C-4.08 APPROVAL OF CONTRACT:

No Contract shall be binding upon the Owner until it has been signed by the Owner and returned to the Contractor.

C-4.09 FAILURE TO EXECUTE CONTRACT:

Failure to comply with any of the requirements of these Specifications, to execute Contract within ten (10) days after notification of work, or to furnish surety as required, shall be just cause for the annulment of the award. In case of annulment of award, the proposal guaranty shall become the property of the Owner, not as penalty, but as a liquidated damage.

C-4.10

After the Notice to Proceed is issued, the Owner shall provide the Contractor with three (3) complete sets of Plans and Specifications for Contractor's use during construction. In the case that additional sets are required, the Contractor shall make arrangements to obtain the extra sets at his own expense.

C-4.11 RESPONSE TIME DURING THE PROSECUTION OF THE PROJECT:

The contractor shall furnish the owner with three (3) local telephone numbers where contractor or a responsible representative of contractor can be reached at any and all time during the prosecution of this project, and especially during weekends or holidays. Failure of contractor to respond to any such emergency which causes Owner provided personnel, equipment and materials to be used in such emergency will result in the contractor being charged an amount which shall be twice the cost incurred by the Owner in using personnel, equipment and materials to handle such emergency due to failure of the contractor to do so, and, in addition, the contractor will be charged a penalty of $500.00 for each emergency to which it does not respond. In this connection, "failure to respond" means the failure of the contractor to respond to telephone calls from the relevant staff or owner.
SECTION C-5
SCOPE OF WORK

C-5.01 INTENT OF PLANS AND SPECIFICATIONS:

It is the intent of the Plans and Specifications to describe the complete work to be performed under the Contract. Except as provided on the Plans or in the Specifications, it is also the intent that the Contractor shall furnish all materials, supplies, tools, equipment, labor and incidentals necessary to complete the work.

C-5.02 CHANGES AND INCREASED OR DECREASED QUANTITIES OF WORK:

The Owner has the right to make such changes and alterations in the Plans or in the quantities of work as he may consider necessary or desirable, and such changes and alterations shall not be considered as a waiver of any condition of the Contract, nor shall they invalidate any provision thereof. The Contractor shall perform the work as increased or decreased, and no allowance will be made for anticipated profits.

Payment to the contractor will be made for the actual quantities of work done and materials furnished at the unit prices as set forth in the Contract, except as follows:

When the total cost of work to be done, or of materials to be furnished, is more than one hundred and twenty-five 125 percent of the total contract price for the item stated in the Proposal, then either party to the Contract, upon demand, shall be entitled to a revised consideration on that portion of the work above one hundred and twenty-five (125%) percent of the total contract price stated in the Proposal.

When the total cost of work to be done, or of materials to be furnished, is less than seventy-five (75%) percent on the total contract price for the item stated in the Proposal, then either party to the Contract, upon demand, shall be entitled to a revised consideration on the work actually done.

Revised consideration shall be determined by supplemental agreement between the parties, which supplemental agreement shall be included with, and shall become a party of, the Contract.

C-5.03 OMITTED ITEMS:

The Owner may, in writing, order the omission from the work of any item found unnecessary to the project. Such omission shall be subject to all provisions of Par. C-5.02.

C-5.04 EXTRA WORK:

When the proper completion of the project requires work for which no quantities or prices were shown in the Proposal, such work shall be called "EXTRA WORK" and shall be performed by the Contractor when so directed in writing by the Owner. "EXTRA WORK" shall be performed in accordance with these Specifications and as may be directed by the Engineer.

Prices for extra work shall be itemized and covered by a supplement agreement submitted by the Contractor and approved by the Owner prior to the starting of such work.

Claims for extra work not authorized in writing by the Owner prior to the performance thereof will be rejected.
C-5.05 MAINTENANCE OF TRAFFIC:

When the work requires partial or complete closing of any driveway, alley, street, or roadway, the Contractor shall so schedule and prosecute his work that traffic will be hindered to a minimum.

C-5.06 REMOVAL AND DISPOSAL OF STRUCTURES AND OBSTRUCTIONS:

All structures and/or obstructions on the site of the work, which are not to remain in place or which are not to be used in the new construction shall be removed as directed by the Engineer. Such items of removal are not listed in the Proposal will not be paid for as separate items; the cost of doing such work shall be included in the unit price bid for other items.

C-5.07 TOOLS AND ACCESSORIES:

When special wrenches, gauges, or other special tools or accessories are required to properly maintain and operate any machine or equipment furnished under this Contract, the furnishing of such tools and accessories shall be deemed to have been included in the Contract and they shall be furnished by the Contractor without extra cost to the Owner.

C-5.08 GUARANTEES:

All structural, mechanical and electrical equipment or instrument shall be guaranteed against mechanical and physical defects, leakage, breakage, or other damage occurring during normal operation for a period of one (1) year after such equipment or instruments have been accepted by the Owner. The Contractor shall promptly repair or make good, at his own expense, any defect in such equipment or instruments.

C-5.09 GENERAL GUARANTEE:

All work included in the Contract shall be guaranteed against faulty material or workmanship for a period of one (1) year after the work has been accepted by the Owner.

Neither final acceptance of the work, nor final payment thereof, nor occupancy and use of the work by the Owner shall constitute a waiver of the Owner's right to require the Contractor to repair or make good any such faulty materials or workmanship.

C-5.10 FINAL CLEANING UP:

Upon completion of the work and before acceptance and final payment will be made, the Contractor shall remove from the site all machinery, equipment, tools, and materials and shall dispose of all rubbish, temporary structures, and surplus backfill. The site shall be left in a neat and presentable condition throughout. Any land area, driveway, sidewalk, alley, street or road (concrete or asphalt) which has been cut or disturbed during the prosecution of the work shall be repaired at the Contractor's expense to a condition at least as good or better as originally existed.
C-5.11 EXISTING STRUCTURES:

The Plans show the locations of all known surfaces and subsurface structures. However, the exact location of gas mains, water mains, conduits, sewer etc., is unknown and the Owner assumes no responsibility for failure to show any of these structures on the Plans or to show them in their exact location. It is mutually agreed such failure will not be considered sufficient basis for claims for additional compensation for extra work or for increasing the pay quantities in any manner whatsoever, unless the obstruction encountered is such as necessitates, or requires the building of special work, provision for which is not made in the Plans and Proposal, in which case the provisions in these Specifications for extra work shall apply.
SECTION C-6
CONTROL OF WORK AND MATERIALS

C-6.01 AUTHORITY OF ENGINEER:

The work will be observed, tested and inspected by the Engineer, and performed to his satisfaction, in accordance with the Contract, Plans and Specifications. The Engineer will decide all questions which may arise as to the quality and acceptability of materials furnished and work performed, as to the manner of performance and rate of progress of said work, as to the interpretation of the Plans or Specifications relating to the work, as to the fulfillment of the Contract on the part of the Contractor and to the rights of different Contractors on the project.

The decisions of the Owner will be final.

C-6.02 OWNER ENGINEER AS REFEREE:

The Owner's Engineer will act as referee in all questions, arising under the terms of the Contract between the parties thereto, and his decisions shall be final and binding.

C-6.03 ADEQUACY OF DESIGN:

It is understood that the Owner selected the Engineer named herein to prepare the Plans and Specifications, and all supplements thereto, and it is agreed that the Owner will be responsible for the adequacy of the design, sufficiency of the Plans and Specifications, and safety of structures, provided the Contractor has complied with said Plans and Specifications, all modifications thereof, and additions and alterations thereto approved by the Engineer. The burden of proof shall be upon the contractor to show that he has fully complied with the Plans and Specifications, all modifications thereof, and all additions and alterations thereof.

C-6.04 PLANS:

Plans will show the lines, grades, cross sections, details and general features of the work. Where shop drawings or working drawings are required, they shall be furnished by the Contractor and approved by the Engineer. Authorized alterations to the Plans will be endorsed on approved copies of the Plans or shown on supplementary sheets.

The approval by the Engineer of the Contractor's shop drawings or working drawings will not relieve the Contractor of any responsibility under the Contract.

The Contractor shall furnish the Engineer with such blue print copies of shop drawings or working drawings as may be required for approval and for the purposes of supervision.

The contract price shall include the cost of furnishing all such prints.

C-6.05 CONFORMITY WITH PLANS:

The finished work shall conform with the lines, grades, cross sections, details and dimensions shown on the Plans. Such deviations from the Plans as may be required will, in all cases, be determined by the Engineer and authorized in writing.
C-6.06 COORDINATION OF PLANS AND SPECIFICATIONS AND SUPPLEMENTAL AGREEMENTS:

The Plans, Specifications, and supplemental agreements are essential parts of the Contract, and a requirement occurring in one is as binding as though occurring in all. In case of disagreement, Plans shall govern over "Technical Provisions," and "Special Provisions" shall govern over "Technical Provisions." The Contractor shall not take advantage of any apparent error or omission on the Plans or Specifications. In the event the Contractor discovers any apparent error or discrepancy, he shall immediately call upon the Engineer for his interpretation and decision, and such decision shall be final.

C-6.07 COOPERATION OF CONTRACTOR:

The Contractor shall give the work the constant attention necessary to facilitate the progress thereof and shall cooperate with the Engineer and with other Contractors in every way possible.

The Contractor shall have on the work at all times, a satisfactory and competent English-speaking Superintendent, authorized to receive order, and act for him as his agent. The Contractor shall designate to the Engineer in writing the name of such Superintendent, and the designated Superintendent may not be removed from the work without the written permission of the Engineer.

C-6.08 CONSTRUCTION STAKES:

The Contractor shall furnish and set at his own expense any and all construction stakes and blue tops as seems necessary for the satisfactory prosecution of the work.

Any missing construction stakes which have been destroyed by the different utility companies, vandals and/or the contractor at the time of construction will be replaced by the contractor at his own expense.

The Engineer may, at his option, make spot or complete checks on all construction alignment and grades to determine the accuracy of the contractor's survey work. These checks, however, will not relieve the Contractor of his responsibility of constructing the work to the lines and grades as shown on the plans or approved change orders. Computations, sketches, and other drawings used in the design and layout of this project will be made available to the Contractor, however these items will not relieve the contractor of his responsibility.

C-6.09 QUANTITIES OF MATERIALS:

It shall be the responsibility of the Contractor to verify all quantities of materials shown on the Plans before ordering such materials. Payment is provided for acceptable materials, and materials rejected due to improper fabrication or excess quantity or other reasons within the control of the Contractor will not be paid for regardless of the quantities or dimension shown on the Plans.

C-6.10 APPROVAL OF MATERIALS:

The sources of supply of materials shall be subject to the approval of the Engineer. Representative samples of materials proposed for use shall be submitted, if required, for examination and testing by an independent testing laboratory selected by the Owner.
Results obtained from testing such samples may be used for preliminary approval, but will not be used as final acceptance of materials. All materials proposed for use may be inspected or tested at any time during their preparation or use.

If at any time, it is found that sources of supply which have been approved do not furnish a product of uniform quality, or if the product becomes unacceptable at any time, the Contractor shall furnish approved material from another source.

Any material, which after approval has for any reason become unfit for use, shall not be incorporated into the work.

C-6.11 SAMPLES AND TESTS:

Samples and testing procedures shall conform to the requirements of appropriate designations of the American Association of State Highway Officials or the American Society for Testing Materials.

Test for determining the fitness of materials; tests for the purpose of obtaining preliminary approval of materials; tests for determining concrete mixes will be at the expense of the Contractor. Tests for the actual control of the work, such as soil compaction tests and concrete compressive strength test, will be at the expense of the Owner. Any and all retesting because of failure in soil compaction or concrete compressive strength tests shall be done at the expense of the Contractor. Tested and accepted subgrade shall be covered and protected with the flexible base within a maximum of seven (7) days. Tested and accepted flexible base shall be primed and cured a minimum of seventy two (72) hours and shall be cured with asphalt within seven (7) days. Failure to comply with the seven (7) days limitations may result in the need for re-testing at the Contractors expense depending on weather conditions and at the discretion of the Engineer. The Contractor shall provide such facilities as the Engineer may require for conducting field tests and collecting and forwarding samples. All sampling and testing shall be under the control of the Engineer and shall be done in laboratories approved by him.

C-6.12 STORAGE:

Materials shall be stored as to insure the preservation of the quality and fitness for the work. Material which is not, in the opinion of the Engineer, properly stored and protected will not be included as material in hand in the estimates.

C-6.13 AUTHORITY AND DUTIES OF INSPECTORS:

Inspectors employed by the Owner shall be authorized to inspect all work done in any part of the project and all preparation, fabrication, or manufacturer of the materials to be used.

The Inspector shall be authorized to call to the attention of the Contractor any failure of the work or materials to conform to the Specifications or the Plans. He will in no case act as foreman or perform other duties for the Contractor, nor shall he interfere with the management of the work. In the event the Contractor does not comply with the requirements of the Owner and the Engineer, he may stop all work until the non-compliance is corrected.

If the progress of the work becomes unduly delayed because of negligence on the part of the Contractor, the Inspector shall notify the Owner and the Engineer, who may require the Contractor to give reasons for the delay. If it is found that the Contractor is at fault, then it is the prerogative of the Owner to demand correction.
Inspection as provided herein shall not relieve the Contractor from any obligation to perform the work in conformity with the requirements of the Plan and Specifications. No Inspector shall be authorized to revoke, alter, enlarge or release any requirements of the Plans and Specifications, or to issue instructions contrary to the Plans and Specifications, or to approve or accept any portion of the work.

The Contractor shall furnish every reasonable facility for ascertaining whether or not the work is performed in accordance with the Plans and Specifications.

No backfill shall be made unless inspected by the Engineer or the Owner's representative designated in writing and verbal approval of field Engineer is given to such work; if the Contractor should backfill any work without such inspection and approval, the Contractor shall remove or uncover such portions of the finished work as may be directed. After examinations, the Contractor shall restore said portion of the work to the standard required by the Plans and Specifications. Should the work thus exposed and examined prove acceptable or unacceptable, the uncovering or removing and the replacing of the covering or making good of the parts removed shall be done at the Contractor's expense.

C-6.14 SUSPENSION OF WORK:

In case of any dispute arising between the Contractor and the Inspector as to materials furnished or the manner of performing the work, the Inspector shall have authority to reject materials or suspend work until the question at issue can be referred to and decided by the Engineer.

If the Contractor refuses to suspend work on verbal order, the Inspector shall issue a written order to suspend work giving the reason for such suspension. After placing the order in the hands of the Contractor's man in charge, the Inspector shall immediately leave the job. Work done during the absence of the Inspector shall not be paid for.

C-6.15 REMOVAL OF DEFECTIVE AND UNAUTHORIZED WORK:

All work which has been rejected or condemned shall be repaired or removed and replaced as the Engineer may direct, at the expense of the Contractor. Materials not conforming to the requirements of the Plans and Specifications shall be removed immediately from the site of the work and replaced with satisfactory material at the expense of the Contractor.

Work done without lines and grades, work done beyond the lines and grade shown on the Plans, work done without inspection, or any extra or unclassified work done without written authority and prior agreement in writing as to the prices will be done at the Contractor's risk and will be considered unauthorized. At the option of the Engineer, such work may not be measured and paid for, or may be ordered removed and replaced at the expense of the Contractor.

Upon the failure of the Contractor to repair satisfactorily or to remove and replace rejected, unauthorized, or condemned work or materials immediately after receiving formal notice from the Engineer, the Owner may at his own option:

a. Recover for such defective work or materials on the Contractor's bond, or;

b. Recover from such defective work or materials by action in a court having proper jurisdiction in such matter, or;

c. Employ labor and equipment and satisfactorily repair, or remove and replace, such defective work or materials and charge the cost of same to the Contractor, which cost will be deducted from any money due him.
C-6.16 DISPUTED CLAIMS FOR EXTRA WORK:

In case the Contractor deems extra compensation is due him for work or materials not clearly covered in the Contract, or not ordered by the Engineer as "EXTRA WORK", the Contractor shall notify the Engineer in writing of his intention to make claim for such extra compensation before he begins the work on which he bases the claim and shall afford the Engineer every facility for keeping actual cost of the work.

Failure on the part of the Contractor to give such notice or to afford the Engineer every facility for keeping account of actual cost of the work shall constitute waiver of the claim for extra compensation. The filing of such notice by the Contractor and the keeping of cost by the Engineer shall not in any way be construed to prove the validity of the claim. Extra work of any kind should only be performed by Contractor upon receipt of an approved Change Order issued by Owner. When the work has been completed, the Contractor shall within ten (10) day file claim for extra compensation with the Engineer, who will present it to the Owner for consideration.

C-6.17 FINAL INSPECTION

Whenever the work provided for under the Contract has been satisfactorily completed and the final cleaning up performed, the Contractor shall notify the Engineer to make the "Final Inspection". Such inspection will be made within ten (10) days of such notification. After such final inspection, if the work is found to be satisfactory, the Contractor will be notified in writing of the acceptance of same. No time charge will be made against the Contractor between the date of notification of the Engineer and the date of the final inspection.

C-6.18 TEXAS LAW TO APPLY

Any Legal action brought on this matter must be brought in the State District Courts of Webb County Texas.
SECTION C-7

LEGAL RELATIONS AND RESPONSIBILITIES TO THE PUBLIC

C-7.01 LAWS TO BE OBSERVED:

The Contractor shall make himself familiar with and shall observe and comply with, all Federal, State, and local laws, ordinances and regulations which in any manner affect the conduct of the work, and shall indemnify and save harmless the Owner and the Owner's representative against any claim arising from the violation of any such law, ordinance, or regulation whether by himself or by his employees.

C-7.02 PERMITS AND LICENSES:

The Contractor shall procure all permits and licenses, pay all charges and fees, and give all notices necessary to the due and lawful prosecution of the work.

C-7.03 PATENTED DEVICES, MATERIALS AND PROCESSES:

If the Contractor is required or desires, to use any design, device, material or process covered by letters, patent, or copyright, he shall provide for such use by suitable legal agreement with the patentee or Owner of such patent. The Contractor and his surety shall indemnify and save harmless the Owner from any and all claims for infringement by reason of the use of any such patented design, device, material, or process, or any trademark or copyright in connection with the work agreed to be performed under this Contract, and shall indemnify the Owner for any costs, expenses, and damages which it may be obliged to pay for reasons of any such infringement at any time during the prosecution, or after the completion of the work.

C-7.04 PUBLIC, SAFETY AND CONVENIENCE:

The safety of the public and the convenience of traffic shall be regarded as of prime importance during construction and provisions thereof, made necessary by the work, shall be the direct responsibility of the Contractor, and shall be performed at his own expense. Where the Contractor is required to construct temporary crossings for streams, culverts, ditches or trenches, his responsibility for accidents shall include the approaches as well as the structures of such crossing.

C-7.05 SANITARY PROVISIONS:

The Contractor shall, at his own expense, provide and maintain in a neat, sanitary condition such accommodations for the use of his employees as may be necessary to comply with the requirements of the State Department of Health and of other authorities having jurisdiction.

C-7.06 BARRICADES AND WARNING SIGNS:

The Contractor shall furnish and maintain adequate barricades, warning and directing signs, red flags, lights and other traffic control devices as are necessary to comply with the latest edition of the TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREET AND HIGHWAYS.

All provisions of barricades and warning signs shall be considered an incidental and necessary part of the work and no direct payment will be made therefore. All costs of providing such safeguards shall be included in the prices bid for other parts of the work.
C-7.07 USE OF EXPLOSIVES:

When the use of explosives is necessary in the prosecution of the work, the Contractor shall use the utmost care not to endanger life or property. All explosives shall be stored in a secured manner and all storage places shall be marked clearly with the words “DANGEROUS EXPLOSIVES”. The method of storing and handling explosives and highly inflammable materials shall conform to the requirements of Federal and State laws and regulations. The Contractor shall not use explosives until he has taken the legal precautions necessary to save harmless the Owner from any claims arising from such use of explosives.

C-7.08 PROTECTION AND RESTORATION OF PROPERTY:

The Contractor shall take all measures necessary to protect public or private property which might be injured by any process of construction, and in case of any injury or damage to said property, he shall restore at his own expense the damaged property to a condition similar or equal to that existing before such injury or damage was done, or he shall make good such injury or damage in an acceptable manner.

Where the work involves excavation any public or private driveway, alley street or roadway, the Contractor shall do any work necessary to restore such driveway, alley, street or roadway to a condition similar or equal to that existing before such work was done. The Contractor shall be responsible for any subsidence of backfill or pavement failure due to such excavation, and shall promptly repair any such subsidence or failure.

C-7.09 PROTECTION OF EXISTING UTILITIES:

The Contractor shall contact the utility company for exact location prior to doing any work that might interfere with or damage present utilities.

The Contractor shall take all measures necessary to protect existing surface drains, seers, underdrains, conduits, utilities, or similar underground structures, and to provide temporary service when service in any of these is interrupted.

When such facilities are encountered, the Contractor shall notify the Engineer who will arrange for their removal, if necessary. Any utility lines cut or damaged shall be repaired and restored to working conditions as determined by the Engineer.

C-7.10 RESPONSIBILITY FOR DAMAGE CLAIMS:

THE CONTRACTOR SHALL SAVE HARMLESS THE OWNER FROM ALL SUITS, ACTION IN OR CLAIMS BROUGHT ON ACCOUNT OF ANY INJURIES OR DAMAGES SUSTAINED BY ANY PERSON OR PROPERTY IN CONSEQUENCE OF ANY NEGLIGENCE IN SAFEGUARDING THE WORK BY THE CONTRACTOR; OR ON ACCOUNT OF ANY CLAIM OR AMOUNT RECOVERED FOR ANY INFRINGEMENT OF PATENT OR REWARD UNDER THE "WORKMEN'S COMPENSATION LAWS" OR ANY OTHER LAWS. HE SHALL BE HELD RESPONSIBLE FOR ALL DAMAGE OR INJURY TO PROPERTY OF ANY CHARACTER OCCURRING DURING THE PROSECUTION OF THE WORK RESULTING FROM ANY OMISSION, NEGLIGENCE, OR MISCONDUCT ON HIS PART IN THE MANNER OR METHOD OF EXECUTING THE WORK, OR FROM DEFECTIVE WORK OR MATERIALS.
C-7.11 RESPONSIBILITY FOR THE WORK:

Until acceptance of the work by the Engineer, in writing, it shall be under the charges and care of the Contractor. The Contractor shall rebuild and make good at his own expense all injuries and damage to the work occurring before its completion and acceptance. In case of suspension of work for any cause, the Contractor shall be responsible for all the preservation of all materials.

C-7.12 USE OF COMPLETED WORK:

Whenever, in the opinion of the Engineer, any portion of the work is in acceptable conditions, it may be entered upon and used by the Owner upon the written order of the Engineer. Pending final completion and acceptance of the entire work, all necessary repairs and renewal of any part of the work so used, due to defective material or work, to natural causes other than wear and tear, or to the operations of the Contractor, shall be performed by the Contractor at his own expense.

C-7.13 NO WAIVER OF LEGAL RIGHT:

Inspection by the Engineer or by any of his duly representatives, any order, measurement, or certificate by the Engineer; any order by the Owner for the payment of money, any payment for or acceptance of any of work, or extension of time; or any possession taken by the Owner shall not operate as a waiver of any provision of the Contract, or any power therein preserved to the Owner, or of any right to damages therein provided. A waiver of any breach of the Contract shall not be held to be a waiver of any other or subsequent breach.

The Owner reserves the right to correct any error that may be discovered in any estimate that may have been paid, and to adjust that or any subsequent estimate to meet the requirements of the Contract. The Owner reserves the right to claim and recover sums as may be sufficient to correct any error or make good any deficit in the work resulting from error, dishonesty, or collusion in the work after the final payment has been made.

C-7.14 RESPONSIBILITIES OF PARTIES AS TO UTILITY WORK:

It shall be the responsibility of the Contractor to check and coordinate his work with the public and private utility companies which have authority from the Owner to own and operate lines, pipes, conduits, or other means of conveyance within the streets Right-of-Way. The Contractor shall contact the Engineer concerning any and all utility relocation work needed, and it shall be the responsibility of the Contractor to advise the Engineer of any lines or utility poles to be relocated. The Engineer shall assist in coordinating the various utility relocation activities but shall not be responsible for any delays occasioned by this work, although appropriate allowance for additional contract time will be made by the Engineer if warranted. The Owner shall not be responsible for any acts of the Contractor or any damages resulting from work done by the Contractor relating to the removal, alteration, or other activity concerning utilities.
SECTION C-8
PROSECUTION AND PROGRESS

C-8.01 RIGHT-OF-WAY:

The Owner will furnish all and or right-of-way necessary for the performance of the contract and will use due diligence in acquiring land or right-of-way. Should all necessary land or right-of-way not be acquired prior to the beginning of construction, the Contractor shall begin with work upon such land or right-of-way as the Owner may have acquired.

C-8.02 DELAYS DUE TO OWNER:

Should the Owner be prevented or enjoined from proceeding with the work or authorizing its prosecution, either before or after its commencement, by reason of any litigation or by reason of the Owner's inability to acquire necessary land or right-of-way, the Contractor shall not be entitled to make or assert any claim for damage by reason of such delay, or to withdraw from the contract except by consent of Owner.

The time for completion of the work will be extended by such time as determined by the Engineer as will compensate for the time lost by reason of said delay.

C-8.03 SUBLTETING OR ASSIGNING OF CONTRACT:

The "Owner" does not allow, permit, negotiate, authorize nor approve any assignment of contract proceeds between the "Owner", the "Contractor", and/or with a bank, lending institution or any type of financial institution either before, during or after a contract award.

The "Owner" agrees to pay the "Contractor" for specified services as stated in the agreed contract. The "Owner" does not agree to pay any additional party either jointly or separately for the contract under discussion.

C-8.04 SUBCONTRACTING:

The Owner will not recognize any subcontractor on the work. The Contractor shall be fully responsible to the Owner for the acts and omissions of his subcontractors, and of persons either directly or indirectly employed by them.

C-8.05 PROSECUTION OF WORK:

Prior to beginning of the work, the Contractor shall submit to the Engineer such schedules, charts, or briefs as may be required, outlining the manner of prosecution of the work. The contractor shall begin the work within ten (10) calendar days after the date set in the "Work Order" or notice to proceed and shall continuously prosecute same with such diligence as will enable him to complete the work within the time specified.

The contractor shall notify the Engineer at least twenty-four (24) hours prior to the beginning at any point. He shall not begin new portions of the work to the detriment of portions already begun.

Owner's normal working hours are Monday through Friday from 8:00 AM to 5:00 PM. The contractor shall notify the owner at least twenty-four (24) hours in advance for any work that is to be scheduled beyond the limits of the owner's working hours, and he shall not begin any such work schedule unless proper inspection by the Contractor has been pre-arranged with the Owner, with the cost for such work beyond the owner's working hours borne by the Contractor.
If at any time the methods, equipment, or sequence of operations used by the Contractor are found to be inadequate to secure the quality of the work or rate of progress required by the contract, the Engineer may in writing order such modifications in the Contractor's methods, equipment, or sequence of operations as he may deem necessary and the contractor shall comply with such order.

C-8.06 WORKMEN AND EQUIPMENT:

All workmen employed by the Contractor shall be skilled and competent. Any person employed by the Contractor who in the opinion of the Engineer does not perform his work in a proper and skillful manner or who is disrespectful, intemperate, disorderly, or otherwise objectionable shall at the written order of the Engineer be immediately removed from the work and shall not be employed again on any part of the work without written consent from the Engineer.

The Contractor shall furnish and use such suitable machinery and equipment as may be required in the opinion of the Engineer to properly prosecute the work. The Contractor shall at the written order of the Engineer remove from the work any equipment found unsuited to properly perform the work.

Upon failure of the Contractor to remove from work any person or equipment as ordered by the Engineer, the Engineer may withhold all estimates which have or may become due, or may suspend the work until such orders are complied with.

C-8.07 TEMPORARY SUSPENSION OF WORK:

The Engineer shall have the authority to suspend the work wholly or in part for such period or periods as he may deem necessary due to unsuitable weather, or such other conditions as are considered unfavorable for the prosecution of the work or for such time as is necessary due to failure on the part of the Contractor to comply with orders given or to perform any or all provisions of the contract. If work is stopped for an indefinite period, the Contractor shall store all materials in such manner that they will not become an obstruction nor become damaged in any way, and he shall take every precaution to prevent damage or deterioration of the work performed.

The Contractor shall not suspend the work without written authority from the Engineer and shall proceed with the work promptly when notified by the Engineer to resume operations.

C-8.08 COMPUTATION OF CONTRACT TIME:

The Contractor shall complete the work within the number of days stated in the contract. The number of days used shall be the number of days from the first day of actual commencement of operations or the 10th day after the date set in the Work Order or Notice to Proceed whichever comes first, and counting that day as the first elapsed day of contract time.

If the completion of the contract requires unforeseen work, or work and materials in greater quantities than those set forth in the proposal, then additional days or suspension of time charge will be allowed the Contractor equal to the time which in the opinion of the Engineers the work as a whole is delayed.
C-8.09 FAILURE TO COMPLETE THE WORK ON TIME:

The time set forth in the proposal for the completion of the work is an essential element of the contract. If the contractor fails to complete the work in the number of working days specified, a time charge will be made for each day thereafter until the work has been satisfactorily completed.

Unless an amount per day is set forth in the "Special Provisions" to be deducted from the amount due the Contractor for each day charged in excess of the number specified, the time charge shall be based on the monetary loss suffered by the Owner as the result of such delay. Such deductions shall in no way be considered a penalty, but as compensation to the owner for the added expense to him for engineering supervision and other costs.

C-8.10 ABANDONMENT OF WORK OR DEFAULT OF CONTRACT:

The Engineer may give notice in writing to the Contractor and his surety of delay, neglect, or default stating which if the Contractor:

- Fails to begin work within the time specified, or fails to perform the work with sufficient workmen and equipment;
- Fails to provide materials of sufficient quantity to insure the completion of the work within the contract time; or
- Performs the work unsuitably; or
- Neglects or refuses to remove materials or perform new work such as may have been rejected; or
- Discontinues the work without authority; or
- Refuses to suspend or resume operations when so directed by the Engineer; or
- Becomes insolvent or is declared bankrupt; or
- Commits any act of bankruptcy insolvency; or
- Makes an authorized assignment for the benefit of any creditor; or
- Fails from any other cause whatsoever to carry out the work in an acceptable manner.

The ten (10) days after such notice if given, if a satisfactory effort has not been made by the Contractor or his surety to correct such delay, neglect, or default, the Owner may declare the work abandoned and so notify the Contractor and his surety.

After receiving such notification of abandonment, the Contractor shall not remove from the work any machinery, equipment, tools, materials or supplies then on the site. The Owner shall have the power and authority without violating the contract to take prosecution of the work out of the hands of the contractor and to appropriate or use any or all materials and equipment on the site as
may be suitable and acceptable and enter into an agreement for the completion of the contract according to the terms and provisions thereof, or use such other methods as he may elect for the completion of the contract in an acceptable manner.

All costs and charges incurred by the Owner, together with the cost of completing the work under the contract shall be deducted from any money due or which may become due to the contractor. In the case the cost to the Owner is less than the amount which would have been payable under the contract if it had been completed by the Contractor, then the Contractor shall be entitled to receive the difference. In case the cost to the Owner exceeds the amount which would have been payable under the contract, if it had been completed by the Contractor, the Contractor and his surety shall be liable and shall pay the Owner the amount of such excess.
SECTION C-9
MEASUREMENT AND PAYMENT

C-9.01 MEASUREMENT OF QUANTITIES:

All work completed under the Contract will be measured in United States standard measures. Linear and surface measurements will be taken horizontally unless otherwise shown on the Plans. Structures will be measured to the neat lines shown on the Plans.

When any material is cubic yards in the vehicle, such measurement will be made at the point of delivery. The capacity of each vehicle shall be plainly marked on said vehicle and the capacity of marking shall not be changed without written permission of the Engineer. The Engineer shall have authority to require all vehicles to have uniform capacity.

C-9.02 SCOPE OF PAYMENT:

The Contractor shall accept the payment as provided in this Contract as full compensation for furnishing all materials, equipment, tools, labor and incidentals necessary to complete the work and for performing all work contemplated and embraced under this contract, as full compensation for loss or damage arising from the nature of the work, or from action of the elements, or from any unforeseen difficulties which may be encountered during the prosecution of the work; as full compensation for all expenses incurred in consequence of the suspension or discontinuance of the work; as full compensation for all expenses incurred in consequence of the suspension or discontinuance of the work herein specified; as full compensation for expenses incurred in any infringement of patent, trade-mark, or copyright; and as full compensation for completing the work in conformity with the requirements of the Plans and Specifications. Payment will be made only on items which are complete, in place, tested and accepted by the owner. Materials on hand shall be considered for payment ONLY when proper PAID invoices are submitted with Contractor's pay estimates. Materials on hand must be placed in a secured area designed for the project under this contract and be available for inspection by Owner Engineers at all times. The Contractor must provide an inventory of all materials on a form acceptable to the Owner Engineer and which must accompany each pay request. The payment of any partial or current estimate shall in no way affect the obligation of the Contractor at his own cost to repair or renew any defective parts of the construction or to replace any defective materials used in the construction and to be responsible for all damages due to such defects. Any items to complete the work indicated on plan shall be considered subsidiary to include positions of work and no further compensation will be made.

No monies payable under this contract, except the estimate for the first month or period, shall become due and payable until the Contractor shall satisfy the Owner that he has fully settled and paid for all materials and equipment used in or upon the work and labor done in connection therewith and the Owner may if he so elects pay and or all bills wholly or in part, and deduct the amount or amounts paid from any estimate(s) except the first estimate. In event the surety on any bond given by the Contractor becomes insolvent or is placed in the hands of a receiver or has its right to do business in the State revoked by Law, the Owner may if he so elects withhold payment of any or all estimates until the Contractor shall give a good and sufficient bond in lieu of the bond so executed by said surety.

C-9.03 PAYMENT FOR ALTERED QUANTITIES:

When alterations in the Plans or quantities of work not requiring supplemental agreements are ordered and performed, the Contractor shall accept payment in full at the contract price for the
actual quantities of work done. No allowance for anticipated profits will be made. Increased or decreased work involving supplemental agreements will be paid for as stipulated in such agreements.

C-9.04 PAYMENT FOR OMITTED ITEMS:

When any item ordered omitted from the Contract, the Contractor shall accept payment in full at the contract price for any work actually performed on such item prior to the date of issuance of such order. No allowance will be made for anticipated profits on work ordered omitted. Acceptable materials ordered by the Contractor, or delivered on the work prior to the date of issuance of such order will be paid for at the actual cost to the Contractor and shall thereupon become the property of the Owner. The Contractor shall submit immediately certified statements covering all money expended in the preparation for any item ordered omitted and shall be entitled to reimbursement for any money expended in preparation for any items when such preparation is of no value to the remaining items of the Contract.

C-9.05 PAYMENT FOR EXTRA WORK:

Extra work performed under a supplemental agreement will be paid for according to the terms of such supplemental agreement.

Extra work if performed on a force account basis will be paid for as follows:

For all labor and foreman, the Contractor will receive the wage paid on the project for each hour that said labor and foremen are actually engaged on such work to which shall be added the actual cost of premiums for public liability and workmen's compensation insurance and social security taxes for the actual amount of such payroll.

For all materials used on such work the Contractor will receive the actual cost of such materials including freight charges.

For machinery and equipment used on such work the Contractor will receive an agreed rental price for each hour that such machinery and equipment is actually used on such work. The agreed price shall include the cost of fuel, lubrication and repairs.

To the sum of the foregoing an amount equal to fifteen (15) percent thereof will be added, as compensation for the use of small tools, Superintendent's services, timekeeper's services.

Premium on bond and all other overhead expenses incurred in the prosecution of the extra work including Contractor's profit. The sum of such payments provided for shall be accepted by the Contractor's as full compensation as provided in C-9.02.

C-9.06 PARTIAL PAYMENTS:

Once a month and within the thirty (30) days after submittal on a correct and complete estimate, the Owner shall make a progress payment to the basis of a duly certified and approved estimate of the work performed during the preceding calendar month under this Contract. To insure the proper performance of the Contract, the Owner shall retain ten (10) percent ** of the amount of each estimate until final completion and acceptance of all work covered by this Contract.

**NOTE Retainage for construction contracts over four hundred thousand ($400,000) shall be five (5) percent.

In the event that the base bid is less than twenty-five thousand ($25,000) the total contract price will be paid in one payment upon completion and acceptance of the project.
Should any defective material or work be discovered or should a reasonable doubt arise as to the integrity of any part of the work completed prior to final acceptance and payment, there will be deducted from the first estimate presented after the discovery of such work, an amount equal to the value of the defective or questionable work. Such defective work will be made from all subsequent estimates until the defects have been remedied or the cause for doubt removed.

C-9.07 TERMINATION OF THE CONTRACT BY THE CONTRACTOR:

If the work is stopped for a period of thirty (30) days under an order of any court of other public authority having jurisdiction, or as a result of an act of government, such as declaration of a national emergency making materials unavailable, through no act or fault of the Contractor or subcontractor or their agents or employees or any other persons performing any of the work under a Contract with the Contractor, or if the work should be stopped for a period of thirty (30) days by the Contractor because the Engineer has not issued a Certificate for payment as provided in C-9.06 or because the Owner has not made payment within the ten (10) days after such stopping of work, then the Contractor may, upon seven (7) additional days written notice to the Owner and the Engineer, terminated the Contract and recover from the Owner payment for all work executed and for any proven loss sustained upon any materials, equipment, tools, construction equipment and machinery, including reasonable profit and damages.

C-9.08 TERMINATION OF THE CONTRACT BY THE OWNER:

If the Contractor is adjudged a bankrupt, or if he makes a general assignment for the benefit of his creditors, or if a receiver is appointed on account of his insolvency, or if he persistently or repeatedly refused or fails, except in cases for which extension of time is provided, to supply enough properly skilled workmen, or proper materials, or if he fails to make prompt payment to Subcontractors or for materials or labor, or persistently disregards laws, ordinances, rules, regulations or orders of any public authority having jurisdiction, or otherwise is guilty of a substantial violation of a provision of the Contracts Documents, then the Owner, upon certification by the Engineer that sufficient cause exists to justify such action, may without prejudice to any right or remedy and after giving the Contractor and his surety, if any, seven (7) days written notice, terminate the employment of the Contractor and take possession of the site and of all materials, equipment, tools, construction equipment and machinery thereon owned by the Contractor and may finish the work by whatever method he may deem expedient. In such case the Contractor shall not be entitled to receive any further payment until the work is finished.

C-9.09

If the unpaid balance of the Contract Sum exceeds the costs of finishing the work, including compensation for the Engineer's additional services made necessary thereby, such excess shall be paid to the Contractor. If such costs exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or to the Owner, as the case may be, shall be certified by the Engineer, upon application, and this obligation for payment shall survive the termination of the Contract.

C-9.10 ACCEPTANCE OF FINAL PAYMENT:

When the work provided for in the contract has been completed and the final inspection has been made by the Engineer, and all parts of the work have been approved and accepted, the final estimate
showing all sums due the Contractor shall be prepared. All prior partial estimates and payments shall be subject to correction in the final estimate and payment. No payment on the final estimate will be made until the Contractor furnishes satisfactory evidence that all claims growing out of lawful demands of laborers, work, men, mechanics, subcontractors, material, men, furnishers of machinery and parts thereof, and suppliers of all kinds have been satisfied. Upon final payment the Contractor shall execute a certificate and release upon the Owner on the form specified.

C-9.11 AFFIDAVIT OF PAYMENT OF DEBTS AND CLAIMS AND RELEASE OF LIENS:

Each and every pay estimate must be accompanied by an "Affidavit of Payment of Debts and Claims and Release of Liens" form (sample of which follows this Section).

C-9.12 MATERIALS ON HAND INVENTORY:

When materials on hand payment is requested, and "Inventory of Materials on Hand" is required and must be included with Contractor's Pay Estimate. Proof of payment for materials on hand is also to be included with the Materials Inventory. A sample form follows this section.

C-9.13 PHOTOGRAPHS

The Contractor shall submit with each monthly progress pay estimate four (4) each 3 1/2" x 5" color photographs depicting generally the work done during that month, and each photograph properly identified and dated.
AFFIDAVIT OF PAYMENT OF DEBTS AND CLAIMS
AND RELEASE OF LIENS

TO: CITY OF LAREDO PROJECT: Unitec Wastewater Treatment Plant –
WEBB COUNTY, TEXAS Phase I Expansion Project – FY 2020

By this instrument the undersigned Contractor engaged in the construction of the above project hereby certifies that on this date, or any time prior thereto, except listed below, the Contractor has paid the full cost of, or has otherwise satisfied all obligations for all materials and equipment furnished, for all work, labor, and services performed and for all known indebtedness and claims against the undersigned for damages arising in any manner on or against the project, its land, improvements and equipment of every kind.

The undersigned hereby certifies that he has received all payments currently due under this Contract for work on the above referred (except Retainage). Therefore, the undersigned does hereby waive and/or release any and all liens against the property and project as of the _____ day of ________________, 2020.

__________________________________________
Contractor

__________________________________________
Authorized Signature

__________________________________________
Typed Signature and Title

STATE OF TEXAS
COUNTY OF WEBB

Before me, the undersigned authority, on this day personally appeared ____________________________ known to me to be the person whose name is subscribed to the foregoing instrument, and being first duly sworn, acknowledged to me that he/she executed the same for the purpose and consideration therein expressed and declared to me that the statements contained herein are true.

SWORN AND SUBSCRIBED TO before me this _______ day of __________________________, 2020.

__________________________________________
Signature – Notary Public for the State of Texas

____________________________
Notary Public’s Typed Signature

My Commission expires: ____________________________
MATERIALS ON HAND INVENTORY

Project:  **Unitec Wastewater Treatment Plant – Phase I Expansion Project – FY 2020**

Contractor:  

Estimate No._________ Dates:  From_________ to _________

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Warranty Statement

City of Laredo Warranty Statement Form

Project Information

Name: ______________________________ Location: ______________________________
Cost: ______________________________ Start Date: ______________________________
Contract/P.O. #: ____________________ Council Acceptance: ____________________

Completion Date: ____________________

Contractor/Sub-Contractor/Vendor Information

Name: ______________________________ Address: ______________________________
Contact Number: ____________________ Email Address: _________________________

Warranty Information

Coverage Type (Detail): ______________________________

Required Maintenance (Detail): ______________________________

Manuals Received (if applicable): __________ Expiration Date: __________ Copies
Provided To: ______________________________

Warranty Statement

We are the ______________________________ contractor for the above indicated project. We guarantee our workmanship, equipment and materials to be free from defects for a period of ________________ from the completion date.

Signature: ______________________________ Date: ______________________________

For Warranty Management Office Use Only:

Entered into Warranty Management Tracker? Entered By: ________________________
Date Entered: ____________________ Warranty Management Act # Assigned:

Division C
DIVISION D

Technical Provisions
I. WATER SPECIFICATIONS
SECTION 102
EXCAVATION AND BACKFILL FOR UTILITIES

D-102.01 SCOPE: This section shall govern all excavation and backfill which will be encountered during the work, and supplements those paragraphs pertaining to excavation in Sections entitled "SPECIFICATIONS FOR SDR 26-GRAVITY SEWER PIPING", "WATER LINE CONSTRUCTION", and "PVC PIPE WATER CONDUITS & INSTALLATION" of these specifications.

D-102.02 CLASSIFICATION: All excavation for this Project shall be considered unclassified. The Contractor is expected to determine the nature of the work and to make his bid prices reflective of the actual conditions which will be encountered. No claim for extra compensation shall be made by the Contractor due to rock, or other unfavorable excavation conditions encountered during the course of the work.

D-102.03 EXISTING UTILITIES: Before commencing excavation, the Contractor shall notify all utility companies with sufficient lead time, and confirm the location of existing underground lines and conduits in the work area by calling 811.

D-102.04 CLEARING: The Contractor shall do all clearing, grubbing, etc. necessary to complete the work.

D-102.05 DEWATERING: The Contractor shall provide and maintain adequate equipment to remove and dispose of all surface and ground-water entering excavations, trenches, or other parts of the work.

D-102.06 EXCAVATION: Unless otherwise ordered by the Engineer in writing, trench shall be as indicated in the Drawings, and trenching for water lines shall be excavated to a depth of five feet.

D-102.07 SHEETING AND SHORING: Where necessary to protect workmen, the work, or the existing structures, the Contractor shall sheet, brace, and shore the excavation to prevent caving or sliding. This item is further described in Division D, Section 802, entitled "SHEETING AND BRACING".

D-102.08 DISPOSAL OF EXCESS SOIL: Unless otherwise specified, the Contractor shall dispose of all unsuitable or excess excavation spoil daily. Disposal shall be made at a location and in a manner which is acceptable to the Owner.

D-102.09 PIPE ZONE: The "pipe zone" shall mean that portion of the trench which extends from 24" above the top of the pipe joints to the bottom of the excavation. "Above the pipe zone" shall mean that portion of the trench which shall extend from 24" above the top of the pipe joints to the top of the finished surface.

D-102.10 BLASTING: Shall be prohibited except where allowed in writing by the City and Engineer. The Contractor shall take all necessary precautions as specified in the General Provisions of these Specifications. The Contractor shall be solely responsible for any damage incurred due to blasting.
D-102.11 OVER-EXCAVATION: In the event of over-excavation, the over-excavated depth of the trench shall be filled with the appropriate bedding material.

D-102.12 STABILIZATION: Subgrades for pipe work shall be firm, dense, and thoroughly consolidated. The subgrade shall be free of mud, muck, loose material and debris, and shall remain firm and intact under the workmen's feet.

D-102.13 PIPE EMBEDMENT & PIPE ZONE BACKFILL: The first layer of backfill shall be sufficient to provide a compacted depth of one-half the outside diameter of the barrel. This layer shall be placed by hand and tamped with hand or pneumatic tampers. The rest of the pipe zone shall be placed in a similar manner in layers not to exceed 8" loose measure to the top of the pipe zone. Unless otherwise specified, the embedment and material in the pipe zone shall be zero P.I. sand or gravel material, as specified by the engineer. Select excavation material may be acceptable; however, the contractor shall be required to submit ample sieve analysis results from a reputable independent testing laboratory to the engineer in order to use such materials for embedment. Backfill material containing rock over 3" in any dimension shall not be used in trenches under paved areas. The pipe trench shall be backfilled in a manner so as to prevent future settlement for a period of one year after date of final payment. All secondary backfill material shall be as required on section D-102.14, 1.2.

Before leaving the work at night or any other time, the upper ends of all pipes shall be securely closed with a tight fitting plug and provisions shall be made to keep the line from floating out of place should the trench fill with water. Any damage to the lines from failure to follow these provisions shall be repaired at Contractor's expense.

Provisions must be made at all times to keep the interior of the pipe that has been laid free from dirt, silt, gravel, and any other foreign matter and any such material that is deposited within the pipe from any cause whatsoever must be removed as the work progresses.

D-102.14 BACKFILLING: All trenches and excavations shall be backfilled within 24 hours after pipes are installed therein unless other means of protecting the pipe is directed by the Engineer. At no times, however, shall any backfilling be done until the Engineer has inspected the pipe to be covered. Backfilling requirements:

Materials:

1.1. Initial (primary) backfill to a point of 12 inches above the top of pipe shall be done as follows:

1.1.1. Suitable excavated material placed in uniform lifts not more than 6 inches in depth and shall be compacted to the density specified herein. The maximum dry density and optimum moisture shall be determined as per TxDot Tex-114-E. Test for in place density shall be in accordance with TxDOT Tex-115-E within 24 hours after compaction. Each lift shall be compacted to the required density and moisture as shown bellow, unless otherwise shown on the plans:
1.1.2. Zero PI Sand. When shown on the plans, backfill the primary trench zone with zero PI sand. Non-plastic material meeting the specifications below will not be required to be tested for density.

OPTION ZERO P.I.
SIEVE ANALYSIS

<table>
<thead>
<tr>
<th>Passage</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot; sieve</td>
<td>95-100%</td>
</tr>
<tr>
<td>1/4&quot; sieve</td>
<td>85-100%</td>
</tr>
<tr>
<td>No.40 sieve</td>
<td>75-100%</td>
</tr>
<tr>
<td>No.80 sieve</td>
<td>20-90%</td>
</tr>
<tr>
<td>No.200 sieve</td>
<td>00-20%</td>
</tr>
</tbody>
</table>

The sand shall be placed in layers no to exceed 10 inches in depth and lightly tamped to consolidate the mass against pipe and earth surfaces. There is no separate item for sand, unless shown on the plans as a separate pay item.

1.1.3. Flowable Backfill. When shown on the plans, conform with Division D Section 134. There is no separate item for sand, unless shown on the plans as a separate pay item.

1.1.4. Select Fill or Flexible Base (gravel, caliche, crushed limestone).

Clean gravel approved by the engineer may be used for backfill from the bottom of the trench to the 12 inches above the top of pipe. The gravel shall be placed in layers no to exceed 10 inches in depth and lightly tamped to consolidate the mass against pipe and earth surfaces.

Flexible base material (caliche, crushed limestone) may be used from the bottom of the trench to 12 inches above the top of the pipe or to the bottom of the street base in lifts no to exceed 8 inches. Material shall contain the required moisture to obtain the density for each layer to no less of 95% of the maximum dry density. There is no separate item for sand, unless shown on the plans as a separate pay item.

1.2. Secondary Backfill. After the initial backfill has been completed at a point of 12 inches above the top of pipe, the material for secondary backfill shall be placed in uniform layers no more than 10 inches in depth (loose measurement) and shall be compacted to the required density specified herein. Excavation material used for secondary backfill shall comply with the following unless shown on the plans:

Secondary Backfill
Under Pavement

<table>
<thead>
<tr>
<th>Subgrade Mat.</th>
<th>PI ≤ 20</th>
<th>PI &gt; 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>≥ 95% Max Dry Dens.</td>
<td>≥ 95% Max Dry Dens.</td>
</tr>
<tr>
<td>Moisture Cont.</td>
<td>± 2% of Opt. or greater</td>
<td>≥ Opt. Moisture</td>
</tr>
</tbody>
</table>

Within the R.O.W. or Easement

<table>
<thead>
<tr>
<th>Subgrade Mat.</th>
<th>PI ≤ 20</th>
<th>PI &gt; 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>≥ 90% Max Dry Dens.</td>
<td>≥ 90% Max Dry Dens.</td>
</tr>
<tr>
<td>Moisture Cont.</td>
<td>± 2% of Opt. or greater</td>
<td>≥ Opt. Moisture</td>
</tr>
</tbody>
</table>

(1). **Timing of backfill:** All trenches and excavation shall be backfilled within twenty-four (24) hours after pipes are installed, unless other means of protecting pipe is directed by the Engineer. At no time, however, shall any backfilling be done until the Engineer has inspected the pipe to be covered. In the case the trench cannot be backfilled, steel plates shall be used to protect the public.

(2). **Backfill placement:** After the bedding has been prepared and the pipes installed as required by the pertinent specifications, selected materials from excavation or borrow shall be placed along both sides of the pipe equally in uniform layers not exceeding six (6) inches in depth (loose measurement) in the primary backfill zone and ten (10) inches in depth (loose measurement) in the secondary backfill zone, wetted if required, and thoroughly compacted so that on each side of the pipe there shall be a berm of thoroughly compacted material at least as wide as the external diameter of the pipe, except insofar as undisturbed material obtrudes into this area.

(3). **Addition to backfill:** Whenever excavation is made for installing pipe culverts or sewers across private property or beyond the limits of the embankment, the top soil removed in excavating the trench shall be kept separate and replaced, as nearly as feasible, in its original position, and the entire area involved in the construction operations shall be restored to a presentable condition.

(4). **Earth trench:** In earth trench, the pipe shall be placed on the natural, undisturbed earth foundation with the trench bottom flat or nearly so. Where rock, shale, or boulders are encountered in the trench, the same shall be removed to a depth of six (6) inches below the grade line and the trench shall be refilled with good, sound earth, gravel, or granular material up to original grade and tamped into place.

(5). **Inspection:** Prior to the final approval of the utility lines, the Engineer, accompanied by the Contractor's representative, shall make a thorough inspection by appropriate methods of the entire installation. Any indication of defects in material or workmanship or obstruction in the pipe due to the Contractor's negligence shall be corrected by the Contractor without additional
Division D - Technical Provisions

1. GENERAL: There are five (5) different conditions for backfill of proposed pipe. The plans indicate which condition shall prevail in each section or block of the "pipe route". If the plans do not indicate a backfill condition, Condition "A" shall prevail.

Please refer to the appendix for Utility Trench Backfill Methods.

D-102.15 WATER JETTING: Only in "Condition C" above, and for pipe diameters of 12" or less, and in trenches 8’ or less, and only when authority is obtained in writing from the City Engineer, backfill may be compacted with water by use of the jetting method. When using the jetting method, backfill above the pipe zone shall be placed in lifts not to exceed 5 feet. Water jetting shall be delivered under sufficient volume and pressure through an approved jetting hose and pipe nozzle. The jetting hose shall have a minimum inside dimension of two inches (2”). The jetting hose shall be connected to an approved minimum two inches (2”) water pump capable of delivering water at the volume and pressure as required by the Engineer. The pipe nozzle shall be of sufficient length to introduce the water at a depth of not less than one foot (1’) above the preceding lift. Points of trench jetting shall be staggered along the length of the trench and spaced at not more than three feet (3’) on centers. Each five feet (5’) lift shall be jetted initially at a depth of not more than one foot (1’) above the preceding lift. Sufficient water shall be introduced into the secondary backfill to cause complete subsidence of the backfill and develop free standing water at the surface of each lift. After the final lift has been jetted as approved, twelve (12) hours shall be allowed for the reduction of the materials moisture content. When the backfill moisture content is acceptable for mechanical or pneumatic compaction, the surface shall be compacted to the satisfaction of the Engineer. The surface of the final lift of trenches subject to traffic shall be compacted by ditch tamping equipment.

D-102.16 SITE RESTORATION: The Contractor shall remove and dispose in an acceptable manner of all excess construction material, trash, debris, excess spoil material, etc., from the construction site. All pavement, fences, drainage structures, drainage ditches, and etc., shall be replaced to a condition as good as, or better than, the original structure as existed. The site shall be graded to a smooth well drained condition.

D-102.17 EXISTING GROUND WATER CONDITIONS: Where ground water conditions exist, the following shall apply inclusive of crushed stone or gravel backfilling. No pipe shall be laid in trench containing water. There will be no separate payment for trench dewatering or the materials, equipment, or labor required to reestablish wet trenches to the conditions and specifications required herein. Non-Storm Water Discharge Permit will need to be obtained from the Environmental Services Department.

D-102.18 DISPOSAL OF EXCAVATED MATERIALS: Excavated materials, so far as needed and of a suitable and acceptable character, shall be piled adjacent to the excavations to be used as backfill as required. All excavated material that is unsuitable for backfilling purposes or which is in excess of the amount required or needed to satisfactorily complete the backfill, shall be disposed of daily. The character and suitability of all backfill material shall meet the approval of the Engineer. Desirable top soil, or sod, etc., shall be carefully piled separately from the other excavated material.
so that it can be placed in this original position when required. Excavated material shall be handled at all times in such manner as to cause a minimum of inconvenience to public travel and to permit safe and convenient access to private and public properties adjacent to or along the line of the work. In parkways and easements, where it is necessary to deposit excavated materials on lawns during the progress of the work, care shall be taken to prevent damage to such lawns. Where damage is done to such lawns all expense of replacing the lawn shall be borne by the Contractor.

**D-102.19 REMOVAL AND REPLACEMENT OF SOD, SHRUBBERY, PLANTS, ETC.:** Where it is necessary to remove the sod, shrubbery, plants, etc., in order to make any excavation for this work, such areas as are backfilled shall have the same sod, shrubbery, plants, etc. replaced in good condition or if necessary to furnish new sod, shrubbery, or plants of the same kind and in good condition, same shall be furnished by the Contractor at his expense.

The sod, where removal is deemed necessary, shall be removed in squares cut out with a sharp spade or other satisfactory tool; the square shall be of such sizes that they may be conveniently handles without breaking. Such sod shall be removed in layers of not less than four inches (4") depth and shall be stored and given proper attention to protect sod from drying out, pending the time of replacement.

If trees and plants shall be removed, this work shall be done in the approved manner as to require protection of roots, branches, etc.; when backfilling is completed the trees and plants shall be replaced in their original position or as near such position as possible.

If irrigation system has to be removed and replaced, refer to Section 806.

**D-102.20 PROTECTION OF TREES, PLANTS, SHRUBBERY, ETC.:** In developed areas where trees, plants, shrubbery, etc., are adjacent to the line of work, the Contractor shall protect such trees, plants, or shrubbery by wooden boxes, frames, or guards of sufficient strength to prevent any injury from machinery, trucks, or workmen during the prosecution of the work.

**D-102.21 Payment.** No pay item will be included in the proposal nor direct payment made for excavation and backfill. The cost for placing the material shall be included in the unit price bid for the specific work function.
SECTION 104
PVC WATER PIPE

D-104.01 GENERAL

1. Description
This work shall consists of the construction, complete in place of PVC Water Pipe as specified herein, and in conformity with the lines, grades, dimensions, materials, and design shown on the plans.

D-104.02 PRODUCTS

1. Polyvinyl Chloride Water Pipe

A. GENERAL
All polyvinyl chloride (PVC) water pipe shall of the rigid (UNPLASTICIZED) type and must bear the National Sanitation Foundation seal of approval for potable water pipe. Each joint of pipe shall consist of single continuous extrusion; bells or other components attached by solvent welding are not acceptable. Pipe shall be pressure rated at 305 psi (DR 14, C-900) as indicated.

Pipe shall have push-on, rubber joints of the bell and spigot type with thickened general bells with rubber gasket joints. The wall thickness of each pipe bell and joint coupling must be greater than the standard pipe barrel thickness. Clearance must be provided in every gasket joint for both lateral pipe deflection and for linear expansion and contraction. Concrete thrust blocking shall be placed behind bends and tees. Concrete support cradles or blocking shall be required for support of all fire hydrants, valves and AWWA C110 fittings; such support shall be provided for AWWA C153 fittings when required by the Engineer.

Pipe installed in any project must be manufactured within last twelve (12) months.

B. APPLICABLE SPECIFICATIONS
Except as modified or supplemented herein, PVC pipe shall meet the following standards:

- DR 14, C-900, Class 305 PVC Pipe to be used for installation of water mains 8” to 12” not deeper than 16 feet unless specifically identified in the plans. The use of 6” diameter is allowed for the Fire Hydrant assembly and other stubouts. All installation methods, testing procedures and backfilling requirements must be followed as per these specifications.

- Fittings used with PVC Pressure pipe shall be AWWA C-110 or AWWA C-153 compact ductile iron mechanical joint fittings manufactured in USA with 316 stainless steel bots, rods and nuts.

- DR 21 for PVC Pressure Pipe, in 2 and 3 inches nominal size,

- DR 18, C905, Class 235, for water mains 16 to 24 inches nominal size. Any pipe greater than 24” requires a separate specification submittal.
Standard sizes, dimensions and tolerances shall be as follows:

<table>
<thead>
<tr>
<th>Nominal Size (inches)</th>
<th>Outside Avg. Diameter (inches)</th>
<th>Diameter Tolerance (inches)</th>
<th>Wall Min. Thickness (inches)</th>
<th>Thickness Tolerance (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>6.900</td>
<td>+0.011</td>
<td>0.493</td>
<td>+0.046</td>
</tr>
<tr>
<td>8</td>
<td>9.050</td>
<td>+0.015</td>
<td>0.646</td>
<td>+0.060</td>
</tr>
<tr>
<td>12</td>
<td>13.200</td>
<td>+0.015</td>
<td>0.943</td>
<td>+0.088</td>
</tr>
</tbody>
</table>

All pipe 2" and larger must be approved Underwriter's Laboratories for use in buried water supply and fire protection systems.

Concrete steel cylinder pipe: Requires a separate submittal for review and approval by the Utilities Director.

C. MATERIAL REQUIREMENTS
   All pipe and fittings shall be made from clean, virgin, NSF approved, Class 12454B PVC free of defects. Clean reworked materials generated from the manufacturer's own production may be used within the current limits of the referenced AWWA C-900 or C-905.

D. MARKING
   Permanent marking on each joint piece shall include the following at intervals of not more that 5 feet:
   - Nominal pipe size and OD base (e.g., 4 CIPS)
   - The type of plastic material (e.g., PVC 12454B)
   - The Standard Dimension Ratio and the pressure rating in psi for water at 73 F (e.g., DR 14, 200 psi).
   - The AWWA designation with which the pipe complies (e.g., AWWA C-900).
   - The manufacturer’s name or code and the National Sanitation Foundation (NSF) mark.
   - Install the marking facing up.

E. TRACER TAPE
   For all non-metallic pipe 8" and larger, directly above centerline of the pipe and approximately 18" below finished grade, shall be placed Conductive Tracer Detection Tape. The tape shall be encased in a protective, inert, plastic jacket and color coded in accordance with APWA Uniform Code.

D-104.03 EXECUTION

1. Excavation
   Trench all shall be straight. The minimum width of trench excavation shall not be less than the internal diameter of the pipe plus twelve (12") inches. The pipe shall have a minimum cover
of 36" unless shown otherwise on the plans.

2. Embedment Using Gravel or Granular Material

Where rock shale or boulders are encountered in the trench, the same shall be removed to a depth of 6" below the grade line and the trench shall be refilled with sand, gravel, or up to the original grade and tamped into place. Where ground water is found, replace the backfill material with gravel or granular material as shown on the construction plans, otherwise, at least the bedding and primary backfill shall be replaced with gravel or granular material.

3. Pipe Laying

Pipe shall not be laid where the sub-grade is in a condition unsatisfactory to the Engineer. If sub-grade is soft, spongy, or disintegrated, the material shall be removed until a firm, stable and uniform bearing is reached and the sub-grade brought back to grade with suitable materials thoroughly compacted in place. Embedment for the pipe or the pipe itself will NOT be laid in water.

Where pipe is installed beneath railroad tracks, construction clearance to cross under railroad trackage shall be obtained by Contractor or facility owner from proper railroad authorities. Any expense of bracing or support to tracks during excavation operation beneath trackage shall be considered part of the contractor.

Where pipe shall be installed beneath State Highways, construction clearance and other requirements to cross under State Highways shall be obtained from State Highway District Engineer by facility owner.

Proper traffic control devices as per TMUTCD shall be placed and maintained to assure maximum traffic and pedestrian safety, or as directed by Local, Railroad, State Highway authorities or other governing agencies.

Owner will obtain all permits for construction, and will make a formal application for the right to cross canals, railroads, highways, pipe lines etc., Contractor must cooperate fully with all agencies involved while construction in areas controlled by such agencies.

Before pipe is laid, all dirt shall be removed from inside; and all lumps, blisters, excess coal tar, dirt, oil, and grease removed from both inside and outside of pipe.

After pipe is laid, care shall be taken to avoid entrance of dirt, water or small animals by use of tight bulk heads in all openings.

Contractor shall not leave more than 600 linear feet of open trench.

4. Service Saddles

Service saddles shall be of the un-hinged type on PVC Class 900 pipe (size 6" to 12"). The saddle body and bottom is to be of 85-5-5-5 solid brass or as per the latest regulations,
material as per ASTM B-62, single width with a minimum of two (2) silicone bronze bolts and a cc-thread.

Bronze saddles with bronze bolts must meet the latest revision of AWWA specifications for saddles to be used on Class 900 PVC pipes.

-Saddles 6" to 12" are to be Jones J-996, or approved equal.
-Saddles 14" to 16" are to be Jones J-979, or approved equal

On January 4, 2014 the water pipe, fittings and fixtures must comply with the S.3874 Reduction of Lead in Drinking Water Act SEC.2 (d) (1) (A) not containing more than 0.2 percent lead when used with respect to solder and flux and (B) not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures.

For tapping sleeve valves Stainless Steel Saddle including body, bolts and nuts shall be Type 316 as per ASTM A240M (to meet or exceed).

These specifications are not intended to eliminate any material or equipment of equal quality and purpose of that specified, but instead designed to set standards. If the contractor wishes to use equal material or equipment, he shall submit a sample and/or written proof of quality that substitute is of equal or better quality to Engineer and Water Utilities Engineer and shall function as these plans and specifications intend.

5. Pipe Joints

Manufacturer's recommendations shall be followed.

6. Pipe Restraints

- **Mechanical joints:** Refer to Section 132
- **Concrete Thrust Blocks**

Thrust blocks shall be made of concrete and shall only be used where specifically call for in the plans or otherwise indicated by the engineer or inspection, in addition to restraints when the pipe line changes direction, as at tees and bends; changes size, as at reducers (also some crosses and tees); stops, as at dead end; or is expected to develop thrust at valves. The dimensions of the thrust block shall be as per concrete mix used should be of a minimum strength of 2500 psi or as specified by Engineer, dimensions should be.

The size and type of thrust block depends on pressure, pipe size, kind of soil, and the type of fitting. View Concrete thrust block details Drawing No. 104.

**Thrust based on 150 psi water pressure. Area based on 2,000 psf soil bearing**
7. **Storage**

Storage of PVC shall be in the shade or shall be covered with a suitable cover. PVC pipe shall not be exposed to the sun longer than 24 hours while being laid.

8. **Hydrostatic Tests**

All pipe lines constructed under this contract before being accepted shall be tested with a hydraulic test according to *Section 116 "Hydrostatic Tests for Pressure Mains"*.

The cost of testing and finding leaks and repairing the same and re-testing, if necessary, shall be at the expense of the Contractor. The water required to fill the lines shall be furnished by the Contractor.

9. **Line Disinfection**

The completed water line shall be disinfected according to *Section 118 "Disinfection of Potable Water Mains"*.

The chlorinated water shall then be discharged from the water line and replaced with fresh potable water.

The Contractor will furnish all labor materials and equipment necessary to complete the proper disinfection of the line and the cost of this operation shall be included in the bid price for installation of the distribution system.

10. **Measurement**

PVC pipe will be measured for payment in linear feet along the center line of the trench.

---

### PVC Water Pipe

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>TEE</th>
<th>90 BEND</th>
<th>45 BEND</th>
<th>22 1/2 BEND</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Thrust (PSF)</strong></td>
<td><strong>Min. Req'd Area (S.F.)</strong></td>
<td><strong>Thrust (PSF)</strong></td>
<td><strong>Min. Req'd Area (S.F.)</strong></td>
<td><strong>Thrust (PSF)</strong></td>
</tr>
<tr>
<td>6&quot;</td>
<td>5700</td>
<td>3</td>
<td>8055</td>
<td>4</td>
</tr>
<tr>
<td>8&quot;</td>
<td>9870</td>
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<td>7</td>
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<tr>
<td>10&quot;</td>
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<td>8</td>
<td>22800</td>
<td>12</td>
</tr>
<tr>
<td>12&quot;</td>
<td>22965</td>
<td>12</td>
<td>32460</td>
<td>16</td>
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<td>31155</td>
<td>16</td>
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</tr>
<tr>
<td>16&quot;</td>
<td>40320</td>
<td>20</td>
<td>57015</td>
<td>29</td>
</tr>
</tbody>
</table>
deduction will be made for valves and fittings.

11. **Payment**

PVC pipe will be paid for at the unit price per linear foot, complete in place, as provided in the proposal and contract. The contract price per linear foot shall be the total compensation for the furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete work, including excavation, granular embedment material, backfill, and disposal of surplus materials, in accordance with the plans and these specifications.
SECTION 106
DUCTILE IRON PIPE

GENERAL

D-106.01 DESCRIPTION:

1. Scope: This section describes the manufacture, construction, and installation of ductile iron pipe and fittings.

D-106.02 QUALITY ASSURANCE: Reference Standards:

a. AWWA - C105, C110, C111, C115, C151, C153, C600, C651.
b. ASTM - C33, C150

D-106.03 SUBMITTALS:

1. Submit manufacturer's data on pipe furnished, indicating compliance with the Specifications regarding dimensions, thickness, weights, and materials. Where flanged pipe is called for, submit complete piping layout indicating the length of each flanged joint to be furnished.

PRODUCTS

D-106.04 DUCTILE IRON PIPE AND FITTINGS:

1. GENERAL:
   a. Ductile iron pressure pipe six inches (6") in diameter and larger shall conform to the current American National Standard Specifications for Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids, AWWA C151 (A 21.51). The interior of the pipe shall be cement-mortar lining in accordance with the latest edition of ANSI/AWWA C104 Standard. All pipe shall be AWWA Class 150, or higher rated pipe.
   b. Ductile iron pipe less than six inches (6") in diameter shall be prohibited.

2. DESIGN REQUIREMENTS:
   a. The ductile iron shall conform in all respects to the Current Specification for Ductile Iron Castings, ASTM Designation A536.
   b. Thickness Class: Ductile iron pipe shall be Class 52 minimum unless otherwise shown on the plans.

3. JOINTS:
   a. All ductile iron pressure pipes shall be furnished with one of the following types of joints. Buried pipe shall be furnished with push-on or mechanical joint ends unless otherwise noted. Exposed pipe shall be flanged.

<table>
<thead>
<tr>
<th>TYPE OF JOINT</th>
<th>REFERENCE STANDARD</th>
</tr>
</thead>
</table>

Division D - Technical Provisions
Push-on Joint AWWA C111
Mechanical Joint AWWA C111
Flanged Ends AWWA C110 & 115

b. All screwed flanges shall be ductile iron.
c. Provide restrained joint inside encasement.

4. COATING AND LINING: All ductile iron pipe and all fittings shall be bituminous coated outside in accordance with AWWA Standards, and polyethylene wrapped as per **D-106.10**.

5. UNDERWRITER'S APPROVAL: Ductile iron pipe shall be approved by the Underwriter's Laboratory and shall be accepted by the State Fire Insurance Board for use in water distribution systems without penalty. All pipes shall be new.

6. BOLTS AND NUTS: Bolts and nuts for pipe mechanical joints shall be Type 316 stainless steel. Flange bolts and nuts for above ground installation shall conform to Type 304 stainless steel. Flange bolts and nuts for below ground or in a vault or submerged installations shall be Type 316 stainless steel.

**D-106.05 FLANGE GASKETS:** Flange gaskets shall be full faced and conform to Appendix A of AWWA C115.

**EXECUTION**

**D-106.06 EXECUTION:** Lay all pipes in accordance with AWWA C600, except as modified herein.

**D-106.07 PIPE LAYING AND JOINTING:**

1. After the subgrade and embedment materials have been placed and the length of pipe has been placed in the trench, center the spigot in the bell and apply the pipe joint lubricant recommended by the pipe manufacturer. Force the spigot "home" using cables or excavating machinery. Use timbers to protect the bell of the joint from damage during jointing operation, especially when excavating machinery is used to force the pipe home.

2. Lay the pipe in such a fashion that the full length of the barrel of the pipe is resting on the embedment. Excavate bell holes so the bell of the pipe does not touch the bottom of the ditch. Take precautions to prevent dirt and embedment materials from entering the joint space. No blocking up of the pipe or joints will be permitted.

**D-106.08 CUTTING OF PIPE:** Saw cut pipe for closure pieces in a neat, workmanlike manner without damage to the pipe. Make each cut square to the centerline of the pipe and bevel the outside edge of the pipe at the cut to the same configuration and dimensions as the factory applied spigot level.
D-106.9 **PROTECTION OF PIPE:** At all times when pipe laying is not in progress, cover the open ends of the pipeline with a water tight cap to prevent water, debris, and animals from entering the pipe. Remove all foreign matter or dirt from the pipe during laying operations. Do not lay pipe in water or when trench conditions are unsuitable for such work.

D-106.10 **POLYETHYLENE TUBE PROTECTION:** All buried cast iron and ductile iron pipe and fitting shall be provided with polyethylene tube protection. Install polyethylene tube according to AWWA C105. Completely cover all fitting and connections with 8 mil (minimum) low density polyethylene film or 4 mil (minimum) cross laminated high-density polyethylene meeting ANSI/AWWA Specification C-105 current, with all edges and laps taped securely to provide a continuous and watertight wrap. Repair all punctures of the polyethylene, including those caused in the placement of bedding aggregates, with duct tape to restore the continuous protective rap before backfilling.

D-106.11 **HYDROSTATIC TESTS:** All pipe lines constructed under this contract before being accepted shall be tested with a hydraulic test according to Section 116"Hydrostatic Tests for Pressure Mains".

The cost of testing and finding leaks and repairing the same and re-testing, if necessary, shall be at the expense of the Contractor. The water required to fill the lines shall be furnished by the Contractor.

D-106.12 **LINE DISINFECTION:** The completed water line shall be disinfected according to Section 118"Disinfection of Potable Water Mains".

The chlorinated water shall then be discharged from the water line and replaced with fresh potable water.

The Contractor will furnish all labor materials and equipment necessary to complete the proper disinfection of the line and the cost of this operation shall be included in the bid price for installation of the distribution system.

D-106.13 **MEASUREMENT:** Ductile Iron pipe will be measured for payment in linear feet along the center line of the trench. No deduction will be made for valves and fittings.

D-106.14 **PAYMENT:** Ductile Iron pipe will be paid for at the unit price per linear foot, complete in place, as provided in the proposal and contract. The contract price per linear foot shall be the total compensation for the furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete work, including excavation, granular embedment material, backfill, and disposal of surplus materials, in accordance with the plans and these specifications.
SECTION 108
BUTTERFLY VALVE

D-108.01 DESCRIPTION: This item shall govern the furnishing of all materials and doing all of the work required to install butterfly valves of the sizes called for in the plans and/or as directed by the Engineer.

D-108.02 MATERIALS

1. All butterfly valves shall be manufactured in accordance with the latest revision of AWWA C504 for Class 150B service and comply with the following details:

   • Valve Bodies shall be constructed of cast iron ASTM A-126 Class Band conform to AWWA C504 in terms of laying lengths and minimum body shell thickness.
   • Flanged valves shall be fully faced and drilled in accordance with ANSI Standard B16.1 Class 125.
   • All valves installed below grade shall be Mechanical Joints with joint restraints as per Section 132.
   • Valve Discs shall also be made from cast iron ASTM A-126 Class B (3"- 20"). Disc shall be furnished with 316 stainless steel seating edge to mate with the rubber seat on the body. The disc shall be an on-center, lens-shaped design to afford minimal pressure drop and line turbulence. Disc shall be retained by Type 316 stainless steel pin, extending through the full diameter of the shaft to withstand the specified line pressure up to valve rating and the torque required to operate the valve. Disc stops located in the flow stream are not allowed.
   • On the 30” and larger disc designs, the disc must be of a flow-through design. All surfaces shall be visually inspected and measurable to assure all structural members are at full disc strength. Disc and shaft connection shall be made with stainless steel through pins.
   • Valve Seat shall be Buna N rubber located on the valve body. In sizes 20" and smaller, valves shall have bonded seats that meet test procedures outlined in ASTM 0-429 Method B. Valve seats shall be field adjustable around the full 360° circumference and replaceable without dismantling the actuator, disc or shaft and without removing the valve from the line.
   • Valve Shafts shall conform to stainless steel Type 316. Shaft seals shall be standard self-adjusting, Chevron V-Type packing. Shaft seals shall be of a design allowing replacement without removing the valve shaft.
   • Valve Bearings shall be sleeve type that are corrosion resistant and self lubricating. Bearing load shall not exceed 1/51h of the compressive load strength of the material.
   • Valve Actuators shall be fully grease packed and have stops in the open/close position. The actuator shall have a mechanical stop which will withstand an input torque of 450 ft. Ibs. The traveling nut shall engage alignment grooves in the housing.
• The Valve Interior and Exterior Surfaces, except for seating, shall be coated in accordance with TT-C-494A and AWWA C550. Valve interior and exterior surfaces except for seating shall be a minimum of 8 mils Ameron 370 or approved equal.

2. CAST IRON VALVE BOXES: Stems of all buried valves shall be protected by valve box assemblies. Valve box castings shall conform to ASTM A48, Class 30B. Testing shall be verified by the manufacturer. Valve box extension shall be as per manufacturer recommendations. Valve boxes shall be two piece, cast iron, screw type. The drop cover shall be lettered "WATER". A 24"x24"x6" thick minimum concrete collar around the valve box shall be provided.

D-108.03 CONSTRUCTION METHODS

SETTING VALVES: Valves shall be set in place as piping is being laid. A concrete or steel support shall be provided for each butterfly valve. Valves shall be set with stems vertical. Valve boxes shall be placed and adjusted so that the lids are slightly below finished grade and so that the base does not bear directly upon any part of the valve.

PLASTIC WRAP AND SAND: The valve and fittings beneath shall be completely wrapped with 8 mil (minimum) low density polyethylene film or 4 mil (minimum) cross laminated high-density polyethylene meeting ANSI/AWWA Specification C-105 current, with all edges and laps taped securely to provide a continuous and watertight wrap. Repair all punctures of the polyethylene, including those caused in the placement of bedding aggregates, with duct tape to restore the continuous protective rap. Sand shall be used to a point 6" all around the valve.

BACKFILLING: Backfill around valve and valve box shall be placed in accordance with the adjacent pipe backfill, as shown in the plans and specified separately herein.

D-108.04 MEASUREMENT

Butterfly Valves will be measured each complete assembly.

D-108.05 PAYMENT

Payment for "Butterfly Valves" will be paid for at the unit price bid per each, which price shall be full compensation for all labor, materials, equipment, including couplings, reaction blocking, joint restraint, valve box assembly, concrete collar, valve concrete or steel support, valve stem extensions, packing operator extensions, and other incidentals necessary to complete the installation and make the valve fully functional as intended.
SECTION 110
WATER VALVES

D 110.01 GENERAL

1. Description
This item to consist of valves furnished and installed as indicated. Unless otherwise indicated, all valves 4" and larger shall be AWWA type valves suitable design and fully equipped for service buried in earth, without need for further modification and shall be wrapped with 8 mil polyethylene film with all edges and laps securely taped to provide continuous wrap. Unless otherwise indicated, all valve stems shall be adjusted to situate the operating nut not less than 30" but not more than 36" below the proposed ground or paving surface of the finished project.

D 110.02 PRODUCTS

1. Materials
Contractor shall, as requested by the Utilities Director, submit descriptive information and evidence that materials and equipment Contractor proposes for incorporation into work is of the kind and quality that satisfies the specified functions and quality.

1. Iron Body Gate Valves, 6" to 12" shall comply with AWWA C509, resilient wedge gate valve.
2. Iron Body Gate Valves larger than 12", including Tapping Valve, shall conform to AWWA C515.
3. Stainless Steel Type 316 Tapping Sleeve:
   a. Mechanical Joint end outlet and neck conforming to type 316 Stainless steel. The valve inlet flange shall have a machined projection or raised face complying with MSS SP-60 for accurate alignment to the mating recess in the tapping sleeve flange. Seat rings and body casting shall be over-sized as required to accommodate full size cutters; the outlet end shall be constructed and drilled to allow the drilling machine adapter to be attached directly to the valve.
   b. Test plug ¾” NPT shall be stainless steel type 316
   c. Body, bolts, nuts shall be stainless steel type 316, nuts coated to prevent galling.
   d. SBR Body gasket to be full circumferential with hydro mechanical outlet seal, bridge plate to be stainless steel type 316.
   All tests and inspections called for by the applicable standards shall be performed by the manufacturer. Upon request, results of these tests shall be made available to the City.
5. Other Requirements:
   Each submittal shall be accompanied by:
   -Complete data covering the operator, including type and size, model number, etc., the manufacturer’s name and address of his nearest service facility, the numbers of turns to fully open and close the valve, detailed instruction for calibrating the limit stops for open and closed positions and any other information which may be necessary to operate and maintain the operator.
   - Complete dimensional data and installation instructions for the valve assembly as it is to be installed, including the operator.
- Complete replacement parts lists and drawings, identifying every part from both the valve and operator.

2. Valves
   1. a. Stem Seals: All valves shall be approved O-ring type stem seals. At least two O-rings shall be in contact with the valve stem where it penetrates the valve body. All Valves must open counter clock and close clock wise.
   b. Operation: All valves shall be approved O-ring type stem seals. At least two O-rings shall be in contact with the valve stem where it penetrates the valve body.
   c. Gearing: Valves shall gear and, when necessary for proper bury depth and cover, shall be horizontal bevel-geared type enclosed in a lubricated gear case.
   d. Bypass: Unless otherwise indicated, 16" and larger gate valve shall be equipped with a bypass of the non-rising stem type which meets the same AWWA standard required for the main valve.
   e. Valve Ends: Valve ends shall be push-on, flanged or mechanical joint, as indicted or approved.
   f. Gear Case: All geared valves shall have enclosed gear cases of the extended type, attached to the valve bonnet in a manner that makes it possible to replace the stem seal without disassembly and without disturbing the gears, bearing or gear lubricant. Gear cases shall be designed and fabricated with an opening to atmosphere so that water leakage past the stem seal does not enter the gear case.
   g. Valve Body: Valves in 16" and larger sizes installed in the horizontal position shall have bronze rollers, tracks, scrapers, etc.
   h. Bolts: The valves shall have bolts and nuts for the stuffing box and bonnet with the following compositions: type 316 stainless steel, nuts coated to prevent galling
   i. Stem: The valve stem shall be made of bronze ASTM B-132 alloy C67600 bar stock material. The stem shall have at least one "anti-friction" thrust washer above and below the stem collar to reduce operating torque. Valves with cast stems or two piece stem collars are not acceptable.
   j. Body thickness: The valve body, bonnet, stuffing box, and disc shall be composed of ASTM A-126 Class B grey iron or ASTM A395. The body and bonnet shall also adhere to the minimum wall thickness as set forth in Table 2, section 4.3.1 of AWWA C509.
   k. Resilient wedge: The valve disc and guide lugs must be fully encapsulated in SBR ASTM D2000 rubber material. Guide caps of an acetal bearing material shall be placed over solid guide lugs to prevent abrasion and to reduce the operating torque.
   l. Coatings: The valves shall have all internal and external ferrous surfaces coated with a fusion bonded thermosetting powder epoxy coating of 10 mils nominal thickness. The coating shall conform to AWWA C550.
   m. The valve type shall be NRS (non-rising stem) or OS&Y (outside screw & yoke) as specified
   n. The valve shall have an arrow cast on the operating nut or hand wheel showing opening direction. The direction of opening shall be as specified.
   o. The NRS valves shall be provided with a 2” square operating nut and OS&Y valves shall be provided with a hand wheel. The bolt that attaches the operating nut to the stem shall be recessed into the operating nut so as not to interfere with valve wrench operation.
   m. Warranty: The valves shall be warranted by the manufacturer against defects in materials or workmanship for a period of ten (10) years from the date of manufacture. The manufacturing facility for the valves must have current ISO certification.
D 110.03 EXECUTION

1. Construction Methods

1. Setting Valves

   Unless otherwise indicated, main valves, blow-off valves and piping shall be set and jointed in the manner described for cleaning, laying, and jointing pipe.

   Unless otherwise indicated, valves shall be set at the locations shown on the drawings as piping is being laid and such that their location does not conflict with other appurtenances such as curb ramps. A concrete or steel support shall be provided for each valve. Valves shall be installed so the tops of operating stems will be at the proper elevation required for the piping at the location indicated above but not exceeding 5 ft. in depth. Valve boxes and valve stem casings shall be firmly supported and maintained, centered and aligned plum over the valve or operating stem, with the top of the box or casing installed flush with the finished ground or pavement in existing streets, and installed with the top of the box or casing approximately 6" below the standard street subgrade in streets which are excavated for paving construction or where such excavation is scheduled or elsewhere as directed by the Engineer.

2. Protective Covering

   Unless otherwise indicated, all flanges, nuts, bolts, threaded outlets and all other steel component shall be coal tar coated and shall be wrapped with standard 8 mil (minimum) low density polyethylene film or 4 mil (minimum) cross laminated high-density polyethylene meeting ANSI/AWWA Specification C-105 current, with all edges and laps taped securely to provide a continuous and watertight wrap. Repair all punctures of the polyethylene, including those caused in the placement of bedding aggregates, with duct tape to restore the continuous protective rap before backfilling.

3. Valve Box, Casing and Cover

   Stems of all buried valves shall be protected by valve box assemblies. Valve box castings shall conform to ASTM A48, Class 30B. Testing shall be verified by the manufacturer. Valve box extension shall be as per manufacturer recommendations. Valve boxes shall be two piece, cast iron, screw type. The drop cover shall be lettered "WATER". A 24"x24”x6” thick minimum concrete collar around the valve box shall be provided.

D 110.04 MEASUREMENT

All types of valves will be measured per each complete assembly.

D 110.05 PAYMENT

Payment shall be full compensation in accordance with the pay item seen in the bid, for excavation, furnishing, hauling and placing valves and barrel extensions including all incidental and subsidiary material and work; preparing, shaping, dewatering, shoring of trenches, bedding, placing, adjusting to grade, couplings, sleeves, concrete support, joint restraints, valve stem extenders, concrete collars complete in place, and compacting backfill materials and for all other incidentals necessary to complete the installation, as indicated, complete in place.
SECTION 116
HYDROSTATIC TESTS FOR PRESSURE MAINS

D-116.01 GENERAL

1. Summary

A. Measurement and Payment
   1. Separate payment will not be made for hydrostatic testing of water mains. Include costs for testing, repair of defects, and retesting required in this section in appropriate unit prices bid for water line construction.
   2. The costs associated with purchase of water to fill proposed lines for flushing, disinfecting, chlorination, dechlorination, and hydrostatic testing shall be paid by the Contractor. Said costs shall be subsidiary to the unit price bid for construction of appropriate size of water line.

2. Quality Assurance
   A. Contractor shall perform hydrostatic tests on water lines in accordance to AWWA C600-93 and these specifications. Hydrostatic test must be performed in the presence of the City of Laredo Utilities Inspector.

3. Submittals
   A. Submit in accordance with the Standard General Conditions and Supplementary Conditions.
   B. Copies of all testing results shall be submitted to the Engineer prior to acceptance of piping system.

D-116.02 PRODUCTS

1. Water
   A. Water used to fill proposed lines, for flushing, for disinfection, and testing of lines shall be potable water from the City of Laredo. Contractor shall coordinate and contract with the City for a temporary construction meter to be located off an existing fire hydrant, if available; otherwise a temporary fire hydrant shall be furnished by the Contractor.

D-116.03 EXECUTION

1. General
   A. Conduct pressure and leakage tests in accordance with Section 3 of AWWA C600 of these specifications. Contractor must notify City of Laredo Utilities Engineer 48 hours prior to pressure and leakage testing.
   B. Commence test procedures when following conditions met.
   1. Pipe section to be tested is clean and free of dirt, sand, or other foreign material.
   2. Pipe outlets plugged with test plugs. Plugs, pipes, fittings, and valves secured to prevent blowouts.
   3. Value of applied test pressure checked at each point in test section to ensure it does not exceed maximum allowable pressure of pipes, valves, fittings, and
Hydrostatic Tests for Pressure Mains

appurtenances.

C. Safety: Perform pressure testing in accordance with OSHA requirements and in manner protecting worker, bystanders, and adjacent property.

D. Correct leaks defects, and retest until acceptable results obtained.

D-116.04 PRESSURE TESTS

A. Test pressures shall be as follows:
   1. Water Main Test Pressure: 150 psi at highest elevation in test section.

B. Test Procedure:
   1. Add water to expel air.
   2. Pressurizing equipment shall include regulator set to avoid over pressurizing and damaging otherwise acceptable line.
   3. Make test connection, subject main to normal water pressure, and examine for leaks.
   4. Apply test pressure by means of force pump of design and capacity that required pressure can be applied and maintained without interruption for duration of test.
   5. Measure test pressure by means of tested and properly calibrated pressure gauge.
   6. Maintain initial test pressure for sufficient length of time to permit inspecting piping under test, but not less than 30 min.
   7. In case repairs are required, repeat pressure test until pipe installation conforms to specified requirements.
   8. Perform final test at required test pressure for 4 hrs.

C. Water main considered to have failed pressure test if applied pressure drops 1 psi.

D-116.05 LEAKAGE TEST

A. Conduct pressure test and initial leakage test concurrently. Final leakage test may be waived by Engineer if found unnecessary to add water during duration of final pressure test.

B. Leakage defined as quantity of water to be supplied into newly laid pipe, or section thereof, necessary to maintain specified leakage test pressure after main has been filled with water and entrapped air expelled.

   1. Leakage shall not exceed number of gph as determined by following formula for rubber-sealed joints.

\[
L = \frac{ND(P)^{1/2}}{7,400}
\]

   Where:
   L= allowable leakage in gallons per hour
   N= number of joints under test
   D= nominal diameter of main in inches
   P= average pressure in lbs./sq. in. gauge during leakage test
2. If section under test contains joints of various diameter allowable leakage will be sum of computed leakage for each size of joint.

C. Test Procedure:

1. Submit test section to approximately 150 psi gauge pressure at highest elevation of water main under test.
2. Conduct final leakage test for 4 hours.
3. Repair defects and retest until acceptable results obtained.

D-116.06 MEASUREMENT AND PAYMENT

There will no separate measurement or payment for Hydrostatic Tests for Pressure Mains, all cost shall be included in the various bid items involved.
SECTION 120
CONCRETE ENCASEMENT, CRADLES, SADDLES, AND COLLARS

D-120.01 DESCRIPTION: This Item shall govern for placing concrete encasement, cradles, saddles, and collars, when called for the Project plans or as directed by the Engineer.

D-120.02 MATERIALS: Concrete: All concrete shall, at a minimum, conform to the provisions of TxDOT Specifications, (Item 421) 2004 edition or latest revision, "Concrete" (Class B) or shall be of the class noted on the plans.

D-120.03 CONSTRUCTION METHODS:

1. Concrete Encasement: When concrete encasement is show on the plans or when directed by the Engineer, the trench shall be excavated and fine graded to a depth conforming with details and sections shown on the plans. The pipe shall be supported by precast concrete blocks of the same strength as the concrete for encasement and securely tied down to prevent floatation. Encasement shall then be placed to a depth and width conforming with details and sections shown on the plans.

2. Concrete Cradles: When concrete cradles are shown on the plans or when called for by the Engineer, the trench shall be prepared and the pipe supported in the same manner as described in this specification and shall be constructed in accordance with details and sections shown on the plans.

3. Concrete Saddles: When shown on the plans or when directed by the Engineer, pipe to receive concrete saddle shall be backfilled in accordance with TxDOT (Item No. 402) "Excavation, Trenching, and Backfill" to the spring line and concrete placed for a depth and width conforming with details and sections shown on the plans.

4. Concrete Collars: When shown on the plans or when directed by the Engineer, concrete collars shall be constructed in accordance with details and sections shown on the plans.

D-120.04 MEASUREMENT: "Concrete Encasement, Cradles, Saddles, and Collars", will be measured by the cubic yard of accepted work, complete in place. Reinforcing, if required, shall not be measured for payment.

D-120.05 PAYMENT: There will be no separate payment for Concrete Encasement, Cradles, Saddles, and Collars; all materials, manipulation, labor, tools, equipment, and incidentals necessary to complete the work shall be included in the various bid items involved.
SECTION 122
ADJUSTING VALVE BOXES TO GRADE

D-122.01 GENERAL: Section includes adjusting elevation of valve boxes to new grades.

D-122.02 REFERENCE:
A. ASTM C270 - Specification for Mortar for Unit Masonry.

PRODUCTS

D-122.03 CONCRETE MATERIALS:
A. For cast in place concrete, conform to requirements to Section 504- Concrete and Section 406 - Concrete Structures.
B. For mortar mix, conform to requirements of ASTM C270, Type S, using Portland Cement.

EXECUTION

D-122.04 EXAMINATION: Examine existing valve box for damage or defects that would affect adjustment to grade and report such damage or defects to the Utilities Engineer.

D-122.05 ESTABLISHING GRADE: Coordinate grade related items with existing grade and finished grade or paving.

D-122.06 ADJUSTING VALVE BOXES:
A. Salvage and reuse valve box, if in good condition.
B. Remove and replace 6-inch ductile iron or PVC riser pipe with suitable length for depth of cover required to establish the adjusted elevation to accommodate actual finish grade.
C. Reinstall valve box and riser piping plumbed in vertical position. The nut of the valve shall be centered. The drop cover shall be lettered "WATER". A 24"x24"x6” thick minimum concrete collar around the valve box shall be provided.

D-122.07 BACKFILL AND GRADING:
A. Backfill the area of excavation surrounding each adjusted valve box and compact according to requirement of Section 102 - Excavation and Backfill for Utilities.
B. Grade to ground surface to drain away from each valve box. Place earth fill around the valve box concrete slab, if the valve is outside of the pavement area.

D-122.08 MEASUREMENT AND PAYMENT: There will be no separate payment for Adjusting Valve Boxes to Grade; all materials, manipulation, labor, tools, equipment, and incidentals necessary to complete the work shall be included in the various bid items involved.
SECTION 128
DISPOSAL OF WASTE MATERIAL AND SALVAGEABLE MATERIAL

D-128.01 GENERAL: Section includes disposal of waste material and salvageable material.

D-128.02 SUBMITTALS:

A. Obtain and submit disposal permits for proposed disposal sites if required by local ordinances. TCEQ and/or EPA.
B. Submit a copy of written permission from a property owner, along with description of property prior to disposal of excess material adjacent to the Project. Submit a written and signed release from property owner upon completion of disposal work.

EXECUTION

D-128.03 SALVAGEABLE MATERIAL:

Excavated Material: when indicated on plans, load haul, and deposit excavated material at a location or locations shown on plans outside the limits of project.

Base, Surface, and Bedding Material: Local shell, gravel, bituminous, or other base and surfaced material designated for salvage.

Pipe Culvert: Load culverts designated for salvage into designated trucks.

Other Salvageable Materials: Conform to requirements of individual specification section.

Coordinate disposal of material with Environmental Services Director.

D-128.04 EXCESS MATERIAL:

A. Vegetation, rubble, broken concrete, debris, asphaltic concrete pavement, excess soil, and other materials not designated for salvage, shall become property of the Contractor and shall be removed from the job site and legally disposed of.
B. Excess soil may be deposited on private property adjacent to the project when written permission is obtained from property owner. See Paragraph 128.02B above.
C. Waste materials shall be removed from the site on a daily basis, such that the site is maintained in a neat and orderly condition.

D-128.05 MEASUREMENT AND PAYMENT: There will be no separate payment for waste material disposal; all materials, manipulation, labor, tools, equipment, and incidentals necessary to complete the work shall be included in the various bid items involved.
SECTION 130
DUCTILE IRON FITTINGS

D-130.01 DESCRIPTION: This item shall consist of grey-iron and ductile-iron fittings installation and adjustment installed in accordance with these specifications and as directed by the Engineer.

D-130.02 MATERIALS AND CONSTRUCTION:
1. Fittings: All fittings shall conform to American Water Works Association (AWWA) Standards for Grey-Iron and Ductile-Iron Compact Fittings, and AWWA Standard C-153 for Ductile Iron Compact Fittings, Class D, manufactured in the USA. Fittings 6 inches through 24 inches in size shall be mechanical joint type unless otherwise specified on the plans. Fittings shall be installed with the thrust blocking and/or joint restraint, as shown in the plans. Adapters shall be used where necessary to provide a transition between asbestos-cement pipe and the fittings. All bolts and nuts shall be stainless steel type 316, nuts coated to prevent galling. Ductile Iron Fittings and restraints shall be wrapped with standard 8 mil (minimum) low density polyethylene film or 4 mil (minimum) cross laminated high-density polyethylene meeting ANSI/AWWA Specification C-105 current, with all edges and laps taped securely to provide a continuous and watertight wrap. Repair all punctures of the polyethylene, including those caused in the placement of bedding aggregates, with duct tape to restore the continuous protective rap before backfilling.

2. Cleaning Ductile-Iron: All lumps, blisters, and excess coal-tar coating shall be removed from the ends of cast-iron fittings. The outside of the spigot and the inside of the bell shall be wire-brushed and wiped clean, dry, and free from oil and grease before the pipe is laid. The interior of the pipe shall be blown clean with compressed air or swabbed out clean and dry as directed by the Engineer. Immediately prior to placing any pipe in the trench, the interior shall be cleaned by an approved brush or swab or with compressed air to remove all dirt and foreign materials. All pipe and fittings shall be suspended above ground to be inspected for defects by the Contractor.

D-130.04 MEASUREMENT: Ductile-Iron Fittings will be measured per each complete assembly.

D-130.05 PAYMENT: Payment for Cast-Iron and Ductile Iron Compact Fittings will be included in the unit price bid for all types and sizes installed. Such payment shall also include excavation, selected embedment material, anticorrosion embedment when specified, backfilling, hauling and disposition of surplus excavated materials, polyethylene wrapping, asphaltic material for ferrous surfaces, all glands, nuts, bolts, gaskets and concrete reaction and thrust blocking and joint restraint systems.
SECTION 132
PIPE JOINT RESTRAINT SYSTEMS

D 132.01 GENERAL

1. Description
This specification covers pipe joint restraint systems to be used on domestic water mains for PVC C-900 pipe sizes 4-inch through 12-inch diameter and PVC C-905 pipe sizes 16-inch through 24-inch diameter, and for Ductile Iron pipe sizes from 4-inch through 24-inch diameter. Joint restraint systems are classified as “mechanical joint” or non-metallic restrained joint “for the specific type of pipe joint to be restrained.

D 132.02 PRODUCTS

1. General Requirements
A. Underwriter Laboratories (U.L) and Factory Mutual (FM) certifications are required on all restraint systems.

B. Unless otherwise noted, restraint systems to be used on PVC C-900 and C-905 pipe shall meet or exceed A.S.T.M. Standard F1674-96, “Standard Test Methods for Joint Restraint Products for Use with PVC Pipe,” or the latest revision thereof and shall be made in USA only. Restraint systems used on ductile pipe shall meet or exceed U.L. Standard 194 and shall be made in USA only.

C. Non-metallic restrained joint pipe and couplings shall be utilized specifically for C-900 PVC pipe and fittings in sizes 4”-12”, and for C-905 PVC pipe and fittings in size 16”.

D. Each restraint system shall be packaged individually and include installation instructions.

E. Each restraint system shall be wrapped with 8 mil. of polyethylene film with all edges and laps securely taped to provide continued wrap.

2. Specific Requirements:
A. Restrainer for PVC C-900/C-905 & Ductile Iron Push-on Type Connections:

1. Pipe restraints shall be utilized to prevent movement for push-on D.I. or PVC (C900&C905) (compression type) bell and spigot pipe connections or where a flexible coupling has been used to join two sections of plain-end pipe D.I. or PVC (C900&C905). The restrainer may be adapted to connect a plain end D.I. or PVC pipe to a ductile iron mechanical joint (MJ) bell fitting. The restrainer must not be directionally sensitive.
2. The pipe shall be restrained by a split retainer band. The band shall be cast ductile iron, meeting or exceeding ASTM A536-80, Grade 65-45-12. The inside face or contact surface of the band shall be of sufficient width to incorporate cast or machined non-directionally sensitive serration to grip the outside circumference of the pipe. The serration shall provide full (360 degrees) contact and maintain pipe roundness and avoid any localized points of stress. The split band casting shall be designed to “bottom-out” before clamping bolt forces (110ft-lb minimum torque) can over-stress the pipe, but will provide full non-directionally sensitive restraint at the rated pressures.

3. All T-head bolts, nuts and restraining rods shall be 316 Stainless Steel. Nuts coated to prevent galling.

4. The split ring type non-directionally sensitive restrainer system shall be capable of a test pressure twice the maximum sustained working pressure listed in section D and be for both D.I. and/or PVC C900.

5. Restraint systems sizes six through twelve inches shall be capable of use for both ductile iron and/or PVC C900.

6. The restraint system may consist of two types: the two split retainer rings and for new construction use only the one split and one solid cast backup ring.

B. Non-metallic restrained joint pipe and couplings for PVC C-900/C-905 Type Connections:

1. Gasketed restrained coupling connections shall join two sections of factory grooved PVC (C900/C-905) pipe, NSF 61. The restrainer coupling must not be directionally sensitive.

2. The coupling shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F-477 and shall be DR-14 Class 305 C-900 for 4” -12” pipe, meeting or exceeding the performance requirements of AWWA C-900, latest revision; and DR-18 C-905 for 16” pipe, meeting or exceeding the performance requirements of AWWA C-905, latest revision. The inside face or contact surface of the coupling connection shall be of sufficient width to incorporate a factory machined non-directionally sensitive groove in both pipe and coupling to grip the outside circumference of the pipe. The couplings shall provide full (360 degrees) contact and maintain pipe roundness and avoid and localized points of stress. The coupling shall be designed with an internal stop to align the precision-machined grooves in the coupling and pipe prior to installation of a non-metallic thermoplastic restraint spleen, and will provide full non-directionally sensitive restraint at the rated pressures.
3. High-strength flexible thermoplastic spleens shall be inserted into mating precision–machined grooves in the pipe and coupling to provide full non-directional restraint with evenly distributed loading.

4. The non-metallic restrained joint pipe and couplings for PVC C-900/C-905 type non-directionally sensitive restrainer system shall be capable of a test pressure twice the maximum sustained working pressure and be for PVC: C-900 pipe sizes four (4) through twelve (12) inch, and C-905 pipe size sixteen (16) inch.

5. Non-metallic restrained joint pipe and couplings for PVC C-900 restrained systems sizes four (4) through twelve (12) inches shall be capable of use for both (DR 18) and four (4) through eight (8) inches for (DR 14) PVC C900 pipe. Non-metallic restrained joint pipe and couplings for PVC C-905 restrained systems size sixteen (16) inches shall be capable of use for (DR 18) PVC C905 pipe.

6. The non-metallic restrained joint pipe and couplings for PVC C-900 restraint system and for PVC C-905 restraint system shall consist of a pipe and couplings system produced by the same manufacturer meeting the performance qualifications of Factory Mutual (FM) and Underwriters Lab (UL).

D. Fitting Restraint for Ductile Iron Pipe (Only):

1. Radial bolt type restrainer systems shall be limited to ductile iron pipe in conjunction with Mechanical Joint (MJ) bell end pipe of fittings. The system shall utilize a standard MJ gasket with a ductile iron replacement gland conforming to ASTM A 536-80. The gland dimensions shall conform to Standard MJ bolt circle criteria.

2. Individual wedge restrainers shall be ductile iron heat treated to a minimum hardness of 370 BHN. The wedge screws shall be compressed to the outside wall of the pipe using a shoulder bolt and twist-off nuts to insure proper actuating of the restraining system.

3. All bolts, nuts and restraining rods shall be 316 Stainless Steel. Nuts coated to prevent galling.

4. Standard MJ gasket shall be virgin SBR meeting ASTM D-2000 3 BA 715 or 3 BA 515.

E. Maximum Sustained Working Pressure Requirements:

<table>
<thead>
<tr>
<th>Nominal Diameter</th>
<th>PVC C-900 / C-905</th>
<th>Ductile Iron</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 &amp; 6 inch</td>
<td>305 psi</td>
<td>350 psi</td>
</tr>
<tr>
<td>8 inch</td>
<td>305 psi</td>
<td>250 psi</td>
</tr>
<tr>
<td>10 &amp; 12 inch</td>
<td>305 psi</td>
<td>200 psi</td>
</tr>
</tbody>
</table>
3. Tests:

The City of Laredo Utilities Department may, at no cost to the manufacturer, subject random joint restraint system products to testing by an independent laboratory for compliance with these standards. Any visible defect of failure to meet the quality standards herein will be ground for rejecting the entire order.

4. Product List:

The attached qualified product list identifies specified manufacturers models approved for installation in City of Laredo water distribution systems.

**Recommended Manufacturers and Models: (Subject to Review & Approval by City of Laredo)**

**A. Slip on Joint Restraint Systems:**

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>PVC C-900/C-905</th>
<th>MATERIAL</th>
<th>D.I. 16” Above</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ford/Uni-Flange (4” - 16”)</td>
<td>1390C</td>
<td>1390C</td>
<td>1390C</td>
</tr>
<tr>
<td>EBBA Iron Sales, Inc (4” - 12”)</td>
<td>1500</td>
<td>1700</td>
<td>1700</td>
</tr>
<tr>
<td>Romac Industries, Inc. (4” - 8”)</td>
<td>Model 611</td>
<td>Model 611</td>
<td>470SJ</td>
</tr>
</tbody>
</table>

**B. Non-Metallic Restrained Joint Pipe and Couplings for PVC C-900/C-905 RJ Type Connections:**

Certain Teed Corporation, Certa-Lok C-900/RJ
4” – 12” Class 305 (DR-14)

Certa-Lok C-905/RJ
16” Class 235 (DR-18)

**D. Fitting Restraint (MJ):**
**MANUFACTURER** | **MATERIAL**  
---|---
**Pipe Joint Restraint Systems** | **PVC C-900/C-905, DR-14/DR-18** | **Ductile Iron**
EBBA Iron Sales, Inc. | 2000 PV (Only C-900) | Megalug1100
Ford/Uni-Flange | UFR-1500-C 14”- 24” | Series 1400
Star Pipe Products (Domestic) | StarGrip Series 4000 (3”-12”) | StarGrip Series 3000 (3”-12”)

**E. Restrained Flange Adapters:**

| **MANUFACTURER** | **MATERIAL**  
---|---
| **PVC C-900** | **Ductile Iron**
EBBA Iron Sales, Inc. | 2100 Megaflange | 2100 Megaflange
Ford/Uni-Flange | 900 | 200, 400, 420

**D 132.03 MEASUREMENT AND PAYMENT:** There is no pay item for joint restraint systems. The cost of furnishing and installing joint restraints shall be included with and considered fully subsidiary to the unit bid price of the items that they restrain: pipe, valves, fittings, Etc.
SECTION 134
FLOWABLE BACKFILL
(Controlled Low Strength Material)

D-134.1 Description: Furnish and place flowable backfill for trench, hole, or other void without consolidation.

D-134.2 Materials.

A. Cement. Furnish cement conforming to D-504.02

B. Fine Aggregate. Provide fine aggregate that will stay in suspension in the mortar to the extent required for proper flow and that meets the gradation requirements of the aggregate gradation chart below.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4 in.</td>
<td>100</td>
</tr>
<tr>
<td>No. 200</td>
<td>0–30</td>
</tr>
</tbody>
</table>

Test fine aggregate gradation in accordance with Tex-401-A. Plasticity Index (PI) must not exceed 6 when tested in accordance with Tex-106-A.

C. Mixing Water. Use mixing water conforming to the requirements of TxDot Item 421, “Hydraulic Cement Concrete.”

D-134.3 Construction. Submit a construction method and plan, including mix design and shrinkage characteristics of the mix, for approval. Provide a means of filling the entire void area, and be able to demonstrate that this has been accomplished. Prevent the movement of any inserted structure from its designated location. If voids are found in the fill or if any of the requirements are not met as shown on the plans, remove and replace or correct the problem without additional cost to the City of Laredo. Unless otherwise shown on the plans, furnish a mix meeting the requirements of Sections 134.3.A, “Strength,” and 134.3.B, “Consistency.”

A. Strength. The 28-day compressive strength range, when tested in accordance with Tex-418-A, must be between 80 psi and 150 psi unless otherwise directed. Two specimens are required for a strength test, and the compressive strength is defined as the average of the breaking strength of the 2 cylinders.

B. Consistency. Design the mix to be placed without consolidation and to fill all intended voids. Fill an open-ended, 3-in.-diameter-by-6-in.-high cylinder to the top to test the consistency. Immediately pull the cylinder straight up. The correct consistency of the mix must produce a minimum 8-in.-diameter circular spread with no segregation. When necessary, use specialty type admixtures to enhance the flowability, reduce shrinkage, and reduce segregation by maintaining solids in suspension.
Mix the flowable fill using a central-mixed concrete plant, ready-mix concrete truck, pug mill, or other approved method. Cure test specimens in accordance with Tex-447-A. The laboratory will sample, make, and test all specimens.

**D-134.4 Placement**

The controlled low strength material shall be placed directly into the excavation. The CLSM shall be placed in a uniform manner that will prevent voids in or segregation of the material. Foreign material which falls into the trench prior to and during placing of the CLSM shall be immediately removed. The CLSM shall have consistency, workability, plasticity, flow characteristics and pumpability (when required) such that the material when placed is self-compacting.

Mechanical compaction or vibration may be used to consolidate around structures, pipes, multiple conduits, etc. when directed by the engineer, otherwise no mechanical compaction or vibration shall be required.

When CLSM is used for backfill around water or sanitary sewer pipes install zero PI sand or gravel 12” above the top of the pipe. When CLSM is used for backfill around conduits, the CLSM shall be placed equally on both sides of conduit to prevent lateral displacement. Also, the CLSM shall be placed in lifts. The height of each lift shall not exceed the depth that will cause floating of the pipe or conduit. When placing the CLSM in greater lift depths, sufficient anchorage shall be provided so the pipe or conduit will not float.

The minimum clear distance between the outside of the pipe or conduit and the side of the excavation (each side) shall be 12 inches.

When CLSM is used behind retaining walls, the depth of each lift shall be limited so it will not induce hydraulic loads greater than the design loads.

For long trenches or installations which require a large amount of CLSM, bulkheads of wood, dirt, sand bags, etc. can be used to control the material’s flowability. The bulkhead shall be removed prior to the continuation the backfilling.

A minimum of 24 hours shall elapse prior to backfilling the remaining portion of the trench with other backfill material in accordance with Section102, “Excavation and Backfill for Utilities”.

**D-134.5 Measurement:** This item will be measured by the cubic yard of material placed when indicated as a separate pay item. Measurement will not include additional volume caused by slips, slides, or cave-ins resulting from contractor’s operations.

**D-134.6 Payment:** When indicated as a separate pay item, the materials furnished and work performed will be paid for at the unit price bid as measured. This price is full compensation for furnishing, hauling, placing the materials, equipment, tools, labor, and incidentals. When the Project Manual, plans or other specifications indicate the use of flowable backfill as incidental to another pay item, no direct payment for the material will be made.
SECTION 136
CEMENT-STABILIZED BACKFILL

D-136.1. Description: When shown on the plans, backfill the excavation to the bottom of pavement base with cement-stabilized sand or caliche.

D-136.2 Materials:
   A. Cement: Cement shall consist of Type I Portland Cement conforming to ASTM C150
   B. Sand: Zero P.I. sand as aggregate for cement-stabilized backfill. Use only approved aggregate up to the bottom of existing pavement section base.
   C. Caliche
   D. Water: Water shall be clean and clear, free of oils, acids, alkalis, organic matter or other deleterious substances and shall conform to the requirements of ASTM C94.

D-136.3 Execution:
Sand/caliche-cement Mixture Product. The mixture shall consist of a minimum of two (2) sacks of Portland cement per cubic yard based on the dry weight of the aggregate. The mixture shall contain sufficient water to hydrate the cement (not flowable).

The cement, sand/caliche and water shall be mixed in a pugmill type mixer, which meets the approval of the Engineer. It shall be mixed for a minimum period of two minutes per batch. No mixing will be allowed on street surface.

D-136.4 Placement:
Place cement-stabilized backfill equally along the sides of structures to prevent strain on or displacement of the structure. Fill voids when placing cement-stabilized backfill. Use hand operated tampers if necessary to fill voids.

The sand cement mixture shall be placed in maximum eight (8) inch thick lifts, loose measure, and thoroughly rodded and tamped around the pipe, boxes, structures, bridge approaches and paving sections. Placement and compaction shall be performed in a manner that will thoroughly fill all voids without placing undue strain on or displacement of the structure.

Cement stabilized sand backfill below the top of sewers, manholes, inlets or other structures shall be placed equally along all sides of the structure. Cement stabilized sand backfill/bedding shall be placed in a manner that will completely fill all voids in the trench. Should compaction be required to fill all voids in the areas described, hand operated tampers may be used.

Materials not placed and not compacted within four (4) hours after mixing shall be rejected.

Do not place or compact sand/caliche-cement mixtures in standing or free water.

D-136.5 Performance:
Random samples of the delivered product will be taken in the field at the direction of the Engineer and tested. A minimum of one (1) sample per week or job shall be taken at random to represent a production that is less than one hundred (100) tons per week. Two (2) samples per week shall be taken at random to represent a production greater than one hundred (100) tons per week. The Engineer shall have the option to obtain additional samples for testing.

D-136.6 Measurement: When specified or shown on the plans as a pay item will be measured by the cubic yard. Measurement will not include additional volume caused by slips, slides, or cave-ins resulting from contractor’s operations.

D-136.6 Payment: When indicated as a separate pay item, the materials furnished and work performed will be paid for at the unit price bid as measured. This price is full compensation for furnishing, hauling, placing the materials, equipment, tools, labor, and incidentals. When the Project Manual, plans or other specifications indicate the use of cement stabilized sand as incidental to another pay item, no direct payment for the material will be made.
II. WASTEWATER SPECIFICATIONS
SECTION 202
PVC SEWER PIPE

D-202.01. GENERAL

1. Submittals:

A. Test Results: Include results of tests with shipment of materials. Furnish 2 additional copies of test results to Engineer.

B. Submit in accordance with the Standard General Conditions and Supplementary Conditions.

C. Contractor shall submit all final testing reports for deflection testing and for low pressure air testing of sewer pipe in accordance with Section B- Testing Sewer Systems.

D. Any deviations from the standards shall be approved by the Director of Utilities in writing.

D-202.02. PRODUCTS

1. Polyvinyl Chloride (PVC) Sewer Pipe

A. All 4”- 15” PVC Sewer Pipe and Fittings used in this contract shall be made of plastic, meeting the requirements of: ASTM D3034. All 4”- 15” PVC sewer pipe, service saddles and fittings shall be SDR- 26. All 18”- 27” PVC Sewer Pipe and Fittings used in this contract shall be made of plastic, meeting the requirements of: F679, PS-115.

B. Fittings:

1. Fittings such as saddles, elbows, tees, and wyes shall be of material and construction corresponding to and have joint design compatible with adjacent pipe.

2. Provide submittals for approval of adapters for transitions to other types of pipe.

C. Pipe Joints:

1. Rubber Gasket: Bell and spigot joint, sealed by a rubber gasket so assembly will remain watertight under conditions of service including movements resulting from expansion, contraction, settlement, and deformation of pipe. Gaskets shall conform to ASTM C361.

D. Pipe Markings: Mark at intervals of 5 feet or less with following.

1. Manufacturer's name or trademark.
2. Nominal pipe size.
3. PVC cell classification, for example 12454-B.
4. Legend, "Type PSM SDR-26 PVC Sewer Pipe".
5. ASTM D3034
6. Extrusion date, period of manufactured or lot number.
E. Fitting Markings

1. Manufacturer's name or trademark.
2. Nominal size.
3. Material designation "PVC".
4. PSM type.
5. ASTM D3034

F. Dimensions:

1. Dimensions of pipe shall be in accordance with Table 1, except wall thickness may be not less than 97% of specified minimum.

2. Average wall thickness shall meet minimum wall thickness requirements of Table 1.

<table>
<thead>
<tr>
<th>TABLE 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC SEWER PIPE DIMENSIONS</td>
</tr>
<tr>
<td>PIPE SIZE (IN)</td>
</tr>
<tr>
<td>SDR 26 (PS 115) ASTM D3034</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>8</td>
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<tr>
<td>10</td>
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<tr>
<td>12</td>
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<tr>
<td>15</td>
</tr>
<tr>
<td>PS 115, ASTM F679</td>
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<tr>
<td>18</td>
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<tr>
<td>21</td>
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<tr>
<td>24</td>
</tr>
<tr>
<td>27</td>
</tr>
</tbody>
</table>

* 30 or greater, submit for approval

2. Source Quality Control

A. Testing:

1. Tests conducted by approved testing agency shall be performed to determine the following.
Division D - Technical Provisions

D 202.03 EXECUTION

1. Installation

A. Trench, backfill, and compaction shall be done in accordance with Section 102, "Excavation and Backfilling for Utilities".

B. Rubber Gasket Joint:
   1. Immediately before making joint, lubricate outside of gasket and inside of bell of groove of last pipe with approved manufacturer lubricant.
   2. Assure gasket and ends of pipe are clean and free of sand and gravel.
   3. Introduce spigot or tongue of pipe being laid, with gasket in place, into bell or groove end of previously laid pipe.
   4. Carefully set pipe to line and grade, and join pipes per manufacturer recommendations.
   5. Use jack or "come-along" to ensure joints are tights.

2. Field Quality Control

A. Pipe shall be subject to rejection for failure to conform to requirements of Specifications or following:
   1. Any fractures or cracks.
   2. Chips or imperfections.
   3. Defects indicating improper proportioning, mixing, and molding.
   4. Variations of more than 1/8 in./lin.ft. in alignment of pipe intended to be straight.
   5. Damaged ends, where such damage prevents making satisfactory joint.
   7. Manufactured date exceeding one year.

B. Specially fabricated fittings, stubs, or pipe sections, shall be submitted for approval by Engineer prior to manufacture.

3. Measurement

   PVC sewer pipe will be measured for payment in linear feet for the various sizes and types
shown on the plans along the horizontal centerline of the pipe no deduction will be made for manholes or fittings.

4. Payment

Plastic sewer pipe will be paid for at the unit price per linear foot, complete in place, as provided in the proposal and contract. The contract price per linear foot shall be the total compensation for furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete the work, including excavation, granular embedment material, backfill, and disposal of surplus materials, in accordance with plans and specifications.
SECTION 208
FIBERGLASS REINFORCED PLASTIC MANHOLES

D-208.01 MATERIALS
Fiberglass reinforced plastic manholes shall be in accordance with ASTM D3753 “Glass Fiber-Reinforced Polyester Manholes” and the requirements of this specification. The inside diameter of the manhole barrel shall be either 48” or as indicated in the plans. A concentric reducer over the barrel shall have an inside diameter of 30 inches. The minimum wall thickness for all manholes regardless of depth shall be ½” (.480”).

D-208.02 GOVERNING STANDARDS
① ASTM D3753 - Standard specifications for glass fiber reinforced polyester manholes.
② ASTM D2412 - Test method for external loading properties plastic pipe by parallel-plate loading.
③ ASTM C581 - Practice for determining chemical resistance of thermosetting resins.
④ ASTM D2584 - Test method for ignition loss of cured reinforced resins.
⑤ ASTM D695 - Test method for compressive properties of rigid plastics.
⑥ ASTM C790 - Test methods for flexural properties of unreinforced and reinforced plastics and electrical insulating materials.
⑦ ASTM D2583 - Test methods for indentation hardness of rigid plastics by means of barcol impressor.

The contractor shall furnish the manufacturer’s certificate that the material meets the standards set forth herein. All fiberglass manhole sections shall be identified with the manufacturer’s name, identification number, and manhole length.

Fiberglass – Reinforced Polyester Manholes shall include a 6’ X 6’ reinforced concrete collar in accordance to Detail 208-4.

D-208.03 MANHOLE RINGS AND COVERS
All manhole rings and covers for streets shall have a clear opening of no less than 30” labeled SANITARY SEWER and CITY OF LAREDO with emblem (EJIW 41430043A01 or approved equal) and shall have the seating surface of ring machined to secure a snug fit.

The castings for manhole rings and covers shall be as detailed on drawings. They shall be grey iron castings boldly filleted at angles and the rises shall be sharp and perfect. The casting shall be true to pattern, form, and dimensions, free from cracks, sponginess, blow holes, or other pouring faults affecting their strength and value for the service intended. Surfaces of the castings shall bee free from burnt on sand and shall be reasonable smooth. Runners, risers, fins, and other cast-on places shall be removed from the surface.

D-208.04 EXCAVATION
The contractor shall be all necessary excavation for the various manholes. Such excavation shall be of sufficient size as to permit the proper installation of the base and wall forms, and allow room for striping of such forms. All such excavation shall conform to the size and dimensions as shown on the drawings, plus a maximum of four (4) feet to permit working room. Care shall be taken to insure that the excavation is not carried to a greater depth that required. If it becomes necessary to shore the walls and also permit the construction of the manhole itself without necessitating the removal of any
shoring until such time as the entire manhole is completed. No shoring shall be left or back filled around, unless authorized by the Engineer. Shoring shall remain in place for at least twenty-four (24) hours after the masonry or concrete work has been completed.

D-208.05 GENERAL CONSTRUCTION METHODS
All manhole work shall be completed and finished in a careful and workmanlike manner, special care being given to sealing the joints around all pipe that extend through the wall of the manhole. Joints for sewer pipe for line and drop connections in sizes 8”-15” shall be made by means of InsertaTee watertight compression connection or approved equal as shown in the plans and details. Install in accordance with the manufacturer’s written instructions. Connections for pipe larger that 15” shall be made using a pre-approved connection. Install in accordance with the manufacturer’s written instructions after finishing of wall has additional concrete to shape or form on the drawing.
Where old manholes are to be adjusted to meet new lines and grades, all old masonry or concrete shall be thoroughly cleaned and wetted before joining any new masonry or concrete to it. All work on manholes shall be done in a workmanlike manner and in conformity with the usual practice used for such work. All materials for adjusting old manholes shall conform to the requirements set out in these specifications for manhole work.

D-208.06 BACKFILLING
The backfilling around the outside of manholes shall commence as soon as the concrete or masonry has been allowed to cure the required time and the forms and shoring have been removed. Such backfill shall be placed in layers of not more than six inches and shall be thoroughly tamped before the next layer is installed. It is anticipated that the backfilling shall be either hand or mechanically tamped. Whichever method is used, care must be exercised to insure that the backfill is thoroughly compacted to the density shown on the drawings. When a density is not shown on the drawings, compaction shall be 90% standard proctor density (ASTM D-690). Unless shown otherwise on the drawings suitable material selected from the excavation shall be used for backfill. Material must be subject to approval by the Engineer.

D-208.07 DROP MANHOLES
Drop manholes shall consist of construction of a standard sanitary sewer manhole with one standard drop connection on one side only when 24 inches above the manhole invert, as shown in the detail drawings. All material used in the drop connection shall conform to the requirements of the pertinent specifications.

D-208.08 MEASUREMENT
This item will be measured by each individual structure completed. The depth will measure from the flow line to the top of the rim. The size shall be the nominal inside diameter. This item includes but, is not limited to the following:
① Structural Excavation;
② Loading, hauling, and disposing of all excess material;
③ Furnishing all labor and materials;
④ Placing and compacting all backfill;
⑤ Final Grading.

D-208.09 PAYMENT
This item will be paid for at the Contract unit price bid per each structure for the various sizes, types and various depths of manholes complete and in place as shown in the drawings and specified herein.
SECTION 214
SANITARY SEWER CLEANOUTS

D-214.01 DESCRIPTION: This Specification shall govern for the furnishing, excavating, laying, or placing, and backfilling, shoring, and other operations necessary to the installing of all sanitary sewer cleanouts. Cleanout connections shall be provided at the end of the sanitary sewer main and shall be a minimum of 8 inch (8”) diameter. The location shall be clearly indicated on the construction drawings.

D-214.02 MATERIALS:

Cast iron boot and cover shall be in accordance to ASTM A48 Class 30B.

PVC pipe and fittings 6 inch (6”) through 12 inch (12”) diameter shall conform to Section 202.

D-214.03 EXECUTION: An eight-inch (8”) cleanout shall be provided outside of the pavement or as approved by the Utilities Director at one foot (1’) from the property line within the R.O.W., easement line or as indicated on the plans. A cast iron cleanout cover shall be placed over every cleanout for the main line as per Detail No.

D-214.04 BACKFILL: All trenches and excavations in this section shall be in accordance with, Section 102.

D-214.05 CONCRETE CUSHION, CRADLE, OR COLLAR: Concrete cradle, cushion, or collar, shall be constructed as shown on the plans. Where concrete cradle or cushion is constructed beneath the sewer pipe, the sub-grade shall be prepared to the dimensions and form as shown on the plans. Concrete cradle, cushion, or collar shall be placed in a dry trench unless, in the opinion of the Engineer, such a method is not practicable. Where the concrete is placed in a wet trench, the work shall be done strictly as directed or approved by the Engineer.

D-214.06 MEASUREMENT: All sewer cleanouts shall be measured in accordance with the above specifications per each complete in place, of the size, type, depth constructed, and accepted by the Engineer.

D-214.07 PAYMENT: All sewer cleanouts, shall be paid for at the unit price bid per each complete in place, of the size, and type constructed, which price shall be full compensation for furnishing all labor, material, and equipment, for all hauling, excavation, shaping of trench bottom, bracing, sheeting, for all installation, backfilling, tamping of backfill, and for all clean-up and incidentals necessary to furnish sewer services complete in place.
SECTION 216
ADJUSTING MANHOLES, CLEANOUTS, AND INLETS

D-216.01 DESCRIPTION: This item shall govern for the furnishing of materials and for adjusting, abandoning, or capping existing sewer manholes, cleanouts, or inlets where required by the plans. Manholes, cleanouts, and inlets shall be adjusted to positions and/or elevations as shown on the plans or as ordered by the Engineer and in accordance with these specifications.

D-216.02 MATERIALS: Manholes, cleanouts, or inlet rings, plates, grates, covers in good condition removed from the manholes, cleanouts, and inlets in the process of abandonment, capping, or adjustment may be re-used upon approval from the engineer.

D-216.03 CONSTRUCTION: Manholes, cleanouts, or inlet rings, covers, plates, and grates shall be removed carefully and the contact areas shall be cleaned of all mortar and grease. Rings, covers, plates, or grates broken in the process of removal and cleaning shall be replaced in kind by the Contractor at his expense.

If the adjustment involves lowering the top of a manhole, cleanout, or inlet, a sufficient depth of concrete shall be removed to permit reconstruction on a batter not exceeding one (1) inch horizontal to two (2) inches vertical. The manhole or inlet ring, cover, plate, or grate shall then be installed with top conforming to the proposed new surface of street or grading as the case may be.

If the adjustment involves raising the elevation of the top of manhole, cleanout, or inlet, the top course shall be cleaned of mortar and built up vertically to the new elevation using new Class "A" Concrete as per section 504, and the ring, cover, plate, or grate installed with top conforming to the proposed new surface of street or grading as the case may be.

If abandonment of an inlet, cleanout, and manhole is required, it shall be removed completely to a depth one foot below the bottom of the trench. In each instance, the bottom of the trench shall be restored to grade by backfilling and compacting by the methods provided herein for backfill.

If capping of a manhole, cleanout, or inlet is required by the plans, capping shall be in accordance with the details shown on the plans.

D-216.04 MINOR ADJUSTMENTS: New concrete manhole and existing manhole adjustments shall be in accordance to Section 210.02 (7) and 210.02 (8). New fiberglass manhole and existing fiberglass manhole adjustments shall be done using a multi-purpose rubber composite adjustment riser (18” max) and fiberglass kit approved by the manufacturer.

D-216.05 MAJOR ADJUSTMENTS: Concrete and fiberglass manhole adjustments in accordance to Section 210.02 (9)

D-216.06 MEASUREMENT: Manholes, cleanouts, or inlets completely adjusted, abandoned, or capped as prescribed above, will be measured by the unit of each manhole, cleanout, or inlet adjusted. The excavation and backfill involved will not be measured for payment.
D-216.07 PAYMENT: Each manhole, cleanout, or inlet adjusted, measured as prescribed above, complete in accordance with these specifications, will be paid for at the unit price bid for "Adjusting Manholes", "Adjusting Cleanouts", and "Adjusting Inlets", which price shall be full compensation for furnishing all required materials, including backfill as required, excavation, tools, labor, equipment, and incidentals required to complete the work.
SECTION 218
TESTING SEWER SYSTEM

D-218.01 GENERAL

1. Summary

A. Section Includes:
   1. Deflection testing of sanitary sewer lines.
   2. Leakage testing of sanitary sewer lines.
   3. Leakage testing of sanitary sewer manholes.

B. Measurement and Payment:
   1. Include costs for testing in appropriate unit prices bid for sewer line construction.

2. Submittals

A. Submit in accordance with Standard General Conditions and Supplementary Conditions.

B. Copies of all test results shall be submitted to the Engineer prior to acceptance of sewer system.

D-218.02 PRODUCTS (N/A)

D-218.03 EXECUTION

1. GENERAL

A. Commence test procedures when following condition are met.
   1. Pipe section to be tested is clean and free of dirt, sand, water or other foreign material.
   2. Pipe system shall be isolated from the existing waste water system.
   2. Pipe section to be tested has backfill placed and compacted

B. Repair visible leaks in manholes and sewers regardless of results of leakage tests.

C. Notify Engineer and City of Laredo Utilities Department in writing 48 hours before beginning tests.

D. Contractor shall furnish and pay for all water required for testing.

2. Deflection Testing of Sanitary Sewer Lines

A. Perform tests on sewer pipe in presence of Engineer and City of Laredo Utilities Inspector.

B. Provide necessary test mandrel, cable, reeling equipment, and other materials and equipment required to perform tests. Provide cable at each end of test mandrel to allow withdrawal if mandrel becomes stuck.

C. Deflection Tests shall be performed on all flexible pipes. For pipelines with inside diameters less than 27 inches, a rigid mandrel shall be used to measure deflection.
1. **Mandrel sizing.** The rigid mandrel shall have an outside diameter (OD) equal to 95% of the inside diameter (ID) of the pipe. The inside diameter of the pipe, for the purposes of determining the outside diameter of the mandrel, shall be the average outside diameter minus two minimum wall thicknesses for OD controlled pipe and the average inside diameter for ID controlled pipe, all dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.

2. **Mandrel design.** The rigid mandrel shall be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more "runners" or "legs" as long as the total number of legs is an odd number. The barrel section of the length at least 75% of the inside diameter of the pipe. A proving ring shall be provided and used for each size mandrel in use.

3. **Method options.** Adjustable or flexible mandrels are prohibited. A television inspection is not a substitute of the deflection test. Mandrels with removable legs or runners may be accepted on a case-by-case basis.

D. The test shall be performed without mechanical pulling devices. Sewer is considered to have passed deflection test if mandrel can be drawn through sewer system being tested without aid of mechanical assistance.

E. If excessive force is required or mandrel fails to pass through, sewer shall have failed deflection test.

F. The test shall be conducted after the final backfill has been in place at least 30 days. No pipe shall exceed a deflection of 5.0%. If a pipe should fail to pass deflection test, the problem shall be corrected and a second test shall be conducted after the final backfill has been in place and additional 30 days. Correct failed sewers by excavating sewer a point of failure and for distance of 10 ft on either side, allowing sewer to return to its original round cross-section and backfill according to Specifications. Remove and replace sewers failing to return to original round cross-section or failing second deflection test at not cost to Owner. Do not use devices to generate internal pressures or vibrations to correct failed sewers.

### 3. Leakage Testing of Sanitary Sewer Lines

A. Tests:
1. Pressure test sanitary sewer pipe 24 inches or smaller in diameter using low pressure air test.

B. General:
1. Conduct tests in presence of Engineer and City of Laredo Utilities Inspector.
2. Provide piping connections between section of line being tested and air supply, test pressure equipment, weirs, meters, certified pressure gauge, and other equipment, materials, and facilities necessary to make specified test.
3. Provide bulkheads, blocking, bracing or other temporary sectionalizing devices that may be required.

C. Low Pressure Air Test
1. General:
a. Conduct required low pressure air test as specified herein.
b. Plug pipe outlets with test plugs. Brace each plug securely to prevent blowouts during air test.
c. Add air slowly.
d. Pressurizing equipment shall include regulator set to avoid over-pressuring and damaging line.
e. Safety pressure test in accordance with OSHA requirements.

2. Air Test Procedures:
   a. The procedure for the low pressure air test shall conform to the procedures described in ASTM C-828, ASTM C-924, ASTM F-1417, or other appropriate procedures, except for testing times.
   b. The test times shall be as outlined in this section. For sections of pipe less than 36 inch average inside diameter, the pipe shall be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure is stabilized, the minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be computed from the following equation:

   \[ T = \frac{0.085 \times D \times K}{Q} \]

   \( T \) = time for pressure to drop 1.0 pound per square inch gauge in seconds;
   \( K = 0.0049 \times D \times L \), but not less than 1.0;
   \( D \) = average inside pipe diameter in inches;
   \( L \) = length of line of same pipe size being tested, in feet;
   \( Q \) = rate of loss, 0.0015 cubic feet per minute per square feet internal surface shall be used.

   Since a \( K \) value of less than 1.0 shall not be used, there are minimum testing times for each pipe diameter as follows:

<table>
<thead>
<tr>
<th>Pipe Diameter (inches)</th>
<th>Minimum Time (seconds)</th>
<th>Length for Minimum Time (feet)</th>
<th>Time for Longer Length (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>340</td>
<td>398</td>
<td>0.855 (L)</td>
</tr>
<tr>
<td>8</td>
<td>454</td>
<td>298</td>
<td>1.520 (L)</td>
</tr>
<tr>
<td>10</td>
<td>567</td>
<td>239</td>
<td>2.374 (L)</td>
</tr>
<tr>
<td>12</td>
<td>680</td>
<td>199</td>
<td>3.419 (L)</td>
</tr>
<tr>
<td>15</td>
<td>850</td>
<td>159</td>
<td>5.342 (L)</td>
</tr>
<tr>
<td>18</td>
<td>1,020</td>
<td>133</td>
<td>7.693 (L)</td>
</tr>
<tr>
<td>21</td>
<td>1,190</td>
<td>114</td>
<td>10.471 (L)</td>
</tr>
<tr>
<td>24</td>
<td>1,360</td>
<td>100</td>
<td>13.676 (L)</td>
</tr>
</tbody>
</table>
The test may be stopped if no pressure loss has occurred during the first 25% of the calculated testing time. If any pressure loss or leakage has occurred during the first 25% of the test period, then the test shall continue for the entire test duration as outlined in this subparagraph or until failure.

c. Provide calibrated and certified test gauge at remote test plug.

1. Gauge air pressure within test section and attach to test plug by sufficient length of hose to place gauge at ground surface. In case of test frames for individual joint testing, gauge to be remote from air supply.

d. Proceed with test after sewer and lateral installation, including backfilling, is complete and lines cleaned. Proceed as follows:

1. Flush and clean prior to conducting low pressure air test.

2. Isolate section of sewer line to be tested by means of inflatable stoppers or other suitable test plugs. One plug shall have inlet tap, or other provision, for connecting hose to portable air control source.

3. If test section is below groundwater level, determine height of groundwater above spring line of pipe at each end of test section and compute average. For every foot of groundwater above pipe spring line, increase gauge test pressure by 0.43 lb/sq. in.

4. Connect air hose to inlet tap and portable air control source. Air equipment shall consist of necessary valves and pressure gauges to control rate at which air flows into test section and to enable monitoring of air pressure within test section. Testing apparatus shall also be equipped with pressure relief device to prevent possibility of loading test section with full capacity of compressor.

5. Add air slowly to test section until pressure inside pipe is raised to 4.0 psig greater than average back pressure that may be over pipe.

6. After pressure of 4.0 psig obtained, regulate air supply so pressure is maintained between 3.5 and 4.0 psig (above average groundwater back pressure) for period of 2 min. This allows air temperature to stabilize in equilibrium with temperature of pipe walls. Pressure will normally drop slightly until temperature equilibrium is obtained. During this period, check plugs with soap solution to detect plug leakage.

7. Determine rate of air loss by time pressure drop method. After 2-min air
stabilization period, air supply is disconnected and the test pressure is allowed to decrease to 3.5 psig. Time required for test pressure to drop from 3.5 to 2.5 psig is determined if rate of air loss is within allowable time limit. If time is equal to or greater than times indicated in tables, pipe line shall be deemed acceptable.

8. Upon completion of test, open bleeder valve and allow air to escape. Plugs shall not be removed until air pressure in test section is released. During this time, no one shall be allowed in trench or manhole while pipe is being decompressed.

e. Repair sewers failing air test by removing and replacing defective pipe sections or by other approved methods at contractors cost.

1. Retest until acceptable test results obtained to be paid by contractor.

D-218.04. LEAKAGE TESTING OF SANITARY SEWER MANHOLES

A. After completion of manhole construction, all sealing or rehabilitation, all manholes shall be tested for water tightness and leakage separately and independently of wastewater lines by hydrostatic exfiltration testing.

B. Plug influent and effluent lines, including services lines, with suitability-sized pneumatic or mechanical plugs. Ensure plugs are properly rated for pressures required for test. Follow manufacturer's safety and installation recommendations. Place plugs a minimum of 6 inches outside of manhole walls. Brace inverts to prevent lines from being dislodged if lines entering manhole have not been backfilled.

C. Hydrostatic Exfiltration Testing:

1. Hydrostatic exfiltration testing shall be performed as follows: all wastewater lines coming into any manhole shall be sealed with an internal pipe plug, and then the manhole shall be filled with water and maintained full for at least one hour

   a. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour.

2. If water loss exceeds amount tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

3. For concrete manholes, a wetting period of 24 hours may be used prior to testing in order to allow saturation of the concrete.

D. Repair sewers failing air test by removing and replacing defective pipe sections or by other approved methods at contractors cost.
III. SITE SPECIFICATIONS
SECTION 402
CLEARING AND GRUBBING

D-402.01 DESCRIPTION: "Clearing and Grubbing" shall consist of the removal and disposal of trees, stumps, brush roots, vegetation, logs, rubbish, and other objectionable matter. Full compliance with NPDES (National Pollution Discharge Elimination System) permitting & Drainage Standard shall be maintained.

D-402.02 CONSTRUCTION METHODS: The right-of-way shall be cleared of stumps, brush, logs, rubbish, trees, and shrubs, except such trees and shrubs and certain areas designated by the Engineer for preservation. Those trees, shrubs, and other landscape features specifically designed by the Engineer for preservation shall be carefully protected from abuse, marring, or damage during construction operations. Continual parking and/or servicing of equipment under the branches of trees designated for preservation will not be permitted. Trees and shrubs designated for preservation that must be pruned shall be trimmed as directed and all exposed cuts over two (2) inches in diameter shall be treated with an approved material.

Areas required for embankment construction, for roadway, channel and structural excavation, and for borrow sites and material sources shall be cleared and grubbed. On areas required for roadway, channel, or structural excavation, all stumps, roots, etc., (except for designated trees and brush) shall be removed to a depth of at least two (2) feet below the existing ground surface. All holes remaining after clearing and grubbing shall be backfilled and tamped as directed by the Engineer and the entire area bladed to prevent ponding of water and to provide drainage, except, in areas to be immediately excavated, the Engineer may direct that the holes not be backfilled. When permitted by the plans, trees and stumps may be cut off as close to natural ground as practicable on areas which are to be covered by at least three (3) feet of embankment. On areas required for borrow sites and material sources, stumps, roots, etc., (except for designated trees and brush) shall be removed to the complete extent necessary to prevent such objectionable matter becoming mixed with the material to be used in construction.

All cleared and grubbed material shall be disposed of in a manner satisfactory to the Engineer. Unless otherwise provided, all merchantable timber removed as required above shall become the property of the Contractor.

D-402.03 MEASUREMENT: Payment will be made for this item as clearing and grubbing and the Contractor shall investigate the conditions as they exist in the field.

D-402.04 PAYMENT: Price shall be full compensation for placing removing, loading and disposing all materials, manipulation, labor, tools, equipment, dumping fees and details necessary to complete the work.
SECTION 404
GENERAL CONSTRUCTION AND PREPARATION OF SITE

D-404.01 INTENT OF PLANS AND SPECIFICATIONS: The intent of the plans and specifications is to prescribe a complete work or improvement which the Contractor undertakes to do so, in full compliance with the plans, specifications, special provisions, proposal, and contract. The Contractor shall do all work as provided in the plans, specifications, special provisions, proposal, and contract, and shall do such additional work as may be considered necessary to complete the work in a satisfactory and acceptable manner. The Contractor shall furnish all labor, tools, materials, machinery, equipment, and incidentals necessary to the prosecution of the work.

D-404.02 DESCRIPTION OF SITE: This item shall consist of the preparation of site for construction operations by the removal and disposal of all obstructions which are not otherwise provided for in the plans and specifications.

Such obstructions shall be considered to include removal of sections of existing utility lines (water, sewer, & force main), existing fences/gates, and other such materials as shown on the plans including concrete slabs.

This item shall include the removal of obstructions in accordance with the item "Clearing and Grubbing", Section 402. It is the intent of this item to provide for the disposal of all objectionable materials not specifically provided for elsewhere in the plans/specifications. All materials to be salvaged by the Owner shall be properly disposed of by the contractor as directed.

D-404.03 FINAL CLEAN-UP: Upon the completion of the work and before acceptance and final payment will be made, the Contractor shall clean and remove from the site of the work, surplus and discarded materials, temporary structures, and debris of every kind. Contractor shall leave the site of the work in a neat and orderly condition. Surplus and waste materials removed from the site of the work shall be disposed of at locations satisfactory to the Engineer. Grounds around any structures shall be dressed to final grade as shown on plans.

D-404.04 COORDINATION OF PROJECT: The plans, these specifications, the proposal, special provisions, and all supplementary documents are intended to describe a complete work and are essential parts of the contract. A requirement occurring in any of them is binding. In case of discrepancies, figured dimensions shall govern over specifications; and plans and quantities shown on the plans shall govern over those shown in the proposal. The Contractor shall not take advantage of any apparent error or omission in the plans and specifications, and the Engineer shall be permitted to make such corrections or interpretations as may be deemed necessary for the fulfillment of the intent of the plans and specifications. In the event the Contractor discovers an apparent error or discrepancy, Contractor shall immediately call this to the attention of the Engineer.

D-404.05 COOPERATION OF CONTRACTOR: The Contractor shall give to the work the consistent attention necessary to facilitate the progress thereof, and he shall cooperate with the Engineer, his inspectors, and with other contractors in every way possible.

D-404.06 MATERIALS-GENERAL: The materials shall be the best procurable, as required by the plans, specifications, and special provisions. The Contractor shall not start delivery of materials until
the Engineer has approved the source of supply. Only materials conforming to these specifications shall be used in the work, and such materials shall be used only after approval has been given by the Engineer and only so long as the quality of said materials remains equal to the requirements of the specifications.

The Contractor shall furnish approved materials from other sources, if for any reason the product from any source at any time before commencement or during the prosecution of the work proves unacceptable. After approval, any material which has become mixed with or coated with dirt or any other foreign substances during its delivery and handling will not be permitted to be used in the work.

D-404.07 MATERIALS-STORAGE: Any and all materials, such as cement, lime, mill work, or other materials or equipment subject to deterioration by exposure to weather or other factors, shall be stored in such a manner to protect them from deterioration or damage preceding the time they become a permanent part of final structure.

D-404.08 MEASUREMENT AND PAYMENT: All work performed will NOT be paid directly but shall be included in the unit price bid for other items of construction. Price shall be full compensation for furnishing and placing all materials, manipulation, labor, tools, equipment, and incidentals necessary to complete the work.
SECTION 410
REINFORCING STEEL

D-410.01 DESCRIPTION: This item shall provide for the furnishing and placing of bar reinforcing steel of the size and quantity designated for use in structures and other concrete items that require reinforcing steel as shown on the plans and in accordance with these specifications.

D-410.02 MATERIALS: Reinforcing steel shall conform to the requirement of Item 440, "Reinforcing Steel" of the TxDOT latest Provisions. Reinforcing steel bars produced outside of the United States are acceptable if such bar reinforcement conforms to the requirements of the ASTM Designations.

D-410.03 PLACING REINFORCEMENT: All steel reinforcing shall be accurately placed in the position shown on the plans and firmly held during the placing and setting of concrete. All reinforcement shall be inspected and approved before placement to be free from dust, rust, mill scale, paint, oil, or foreign material. When stored, it shall not be in direct contact with the ground. Bars shall be tied at all intersections. Distances from forms shall be maintained by means of stays, precast blocks, ties, hangers, metal chairs, or other approved supports. Blocks for holding reinforcement from contact with the form shall be precast concrete blocks of approved shape and dimensions or other equally suitable devices. The use of pebbles, pieces of broken stones or brick, metal pipe and wooden blocks shall not be permitted. Reinforcement in any sections shall be placed and then inspected and approved by the Inspector before the placing of concrete begins.

D-410.04 SPLACING AND LAPPING: Unless otherwise indicated, all spliced bars shall be staggered. Laps shall be in accordance with Table No. 1.

Table 1
Minimum Lap Requirements for Bar Sizes through No. 11

<table>
<thead>
<tr>
<th>Bar size No. (in)</th>
<th>Bar size No. (mm)</th>
<th>Uncoated Lap Length</th>
<th>Coated Lap Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>10</td>
<td>1 ft 4 in</td>
<td>2 ft 0 in</td>
</tr>
<tr>
<td>4</td>
<td>13</td>
<td>1 ft 9 in</td>
<td>2 ft 8 in</td>
</tr>
<tr>
<td>5</td>
<td>16</td>
<td>2 ft 2 in</td>
<td>3 ft 3 in</td>
</tr>
<tr>
<td>6</td>
<td>19</td>
<td>2 ft 7 in</td>
<td>3 ft 11 in</td>
</tr>
<tr>
<td>7</td>
<td>22</td>
<td>3 ft 5 in</td>
<td>5 ft 2 in</td>
</tr>
<tr>
<td>8</td>
<td>25</td>
<td>4 ft 6 in</td>
<td>6 ft 9 in</td>
</tr>
<tr>
<td>9</td>
<td>29</td>
<td>5 ft 8 in</td>
<td>8 ft 6 in</td>
</tr>
<tr>
<td>10</td>
<td>32</td>
<td>7 ft 3 in</td>
<td>10 ft 11 in</td>
</tr>
<tr>
<td>11</td>
<td>36</td>
<td>8 ft 11 in</td>
<td>13 ft 5 in</td>
</tr>
</tbody>
</table>

Note: bar size numbers (in.) are based on the number of eighths of an inch included in the nominal diameter of the bar. Bar size numbers (mm) approximate the number of millimeters included in the nominal diameter of the bar.
D-410.05 MEASUREMENT AND PAYMENT: No separate measurement or payment will be made under this item, but all such work done shall be deemed a subsidiary obligation of the Contractor, having been taken into account and included by him in price bid for the complete job.
SECTION 412
WELDED WIRE FABRIC

D-412.01 DESCRIPTION: This item shall govern the furnishing and placing of the various sizes of welded wire fabric as indicated on the plans or as directed by the Engineer.

D-412.02 MATERIAL: All welded wire fabric used in construction shall conform to the requirements of ASTM Designation A-185. It shall be 6 x 6- W2.9 x W2.9 welded wire fabric, plain electric welded reinforcing fabric or as indicated on the plans.

D-412.03 CONSTRUCTION METHODS: All splices in the wire fabric shall overlap sufficiently to allow two (2) pairs or transverse wires to be tied together and no splices of less than six (6) inches will be permitted.

At the edge of the construction, the wire fabric shall not be less than one (1) inch nor more than three (3) inches from the edge of the concrete and shall have no wires projecting beyond the last member parallel to the edge of the concrete. The wire fabric shall be straightened to lie flat in place without bulges or excessive vertical displacement and shall be supported properly throughout to insure its proper position in the finished construction.

D-412.04 MEASUREMENT: No measurement of welded wire fabric will be made.

D-412.05 PAYMENT: No direct payment for furnishing and placing welded wire fabric will be made. All materials and labor required will be considered subsidiary to the item in which it is used and shall be included in the unit price bid for said item.
SECTION 416
EXPANSION JOINT MATERIALS

D-416.01 DESCRIPTION: This item shall govern for furnishing and placing of all expansion joint material as herein specified in the various items of these specifications or as shown on the plans or as directed by the Engineer.

D-416.02 MATERIAL: The material used for expansion joints shall conform to either of the following:

(1) Preformed Bituminous Fiber Material shall be formed from cane or other suitable fibers of a cellular nature securely bound together and uniformly impregnated with a suitable asphaltic binder and shall meet the requirements of the Standard Specifications for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction, ASTM Designation D-1751.

(2) Boards for expansion joints shall be obtained from Redwood or Cypress timber and shall be sound heartwood, free from sapwood, knots, clustered birds-eye, checks, and splits. Occasional sound or hollow birds-eye when not in clusters will be permitted provided the board is free from any other defects that will impair its usefulness as a joint filler.

D-416.03 CONSTRUCTION METHODS: All materials used shall extend the full depth of the concrete and shall be perpendicular to the exposed face. All joints shall be shaped to conform to the contour of the finished section in which they are installed. All material shall be a minimum of one-half (1/2") inch thick.

D-416.04 MEASUREMENT: Expansion Joint Materials will not be measured for payment.

D-416.05 PAYMENT: No direct payment will be made for Expansion Joint Materials. All material supplied and installed as specified herein shall be considered subsidiary work to the various items of these specifications calling for Expansion Joint Materials.
SECTION 418
MEMBRANE CURING

D-418.01 DESCRIPTION: This item shall consist of curing by the impervious membrane method of all curbs, sidewalks, drive approaches, concrete riprap, concrete structures, and other concrete as specified in the various items of these specifications or as indicated on the plans.

D-418.02 MATERIALS: The membrane curing compound shall comply with the requirements as set forth under "Membrane Curing, Type 2, White Pigmented" of the TxDOT latest provisions.

Type 1-D (Resin Base Only) is required for bridge slabs and top slabs of direct traffic culverts and all other surfaces that required a higher grade of surface finish.

D-418.03 CONSTRUCTION METHODS: The membrane curing compound shall be applied after the surface finishing has been completed, and immediately after the free surface moisture has disappeared. The surface shall be completely sealed with a uniform coating of the curing compound applied at the rate of coverage recommended by the manufacturer or as directed by the Inspector.

Do not apply membrane curing compound on projections of reinforcing steel or concrete that will later form a construction joint.

Do not apply membrane curing to dry surfaces. Dampen formed surfaces and surfaces that have been given a first rub so that they are moist at the time of application of membrane.

The liquid-membrane forming compound must not disintegrate, check, peel, or crack during the required curing period. It must not peel or pick up under traffic and must disappear from the surface of the cured concrete by gradual disintegration.

D-418.04 MEASUREMENT: "Membrane Curing" will not be measured for payment.

D-418.05 PAYMENT: The work and materials prescribed herein will not be paid for directly, but shall be included in the unit price bid for the items of construction in which these materials are used.
SECTION 422
CONDUITS

D-422.01 DESCRIPTION
This item shall govern for the furnishing and placing of conduit of the types and sizes indicated on the plans, including junction boxes, fittings, expansion joints, attachments, and incidentals.

D-422.02 MATERIALS
All conduit and fittings shall meet the requirements of the National Electrical Code and shall be listed by Underwriters Laboratories, and shall be marked in accordance with the applicable requirements of the NEC.

Junction boxes, expansion joints, and conduit fittings shall be fabricated from a material similar to the connection conduit unless indicated otherwise on the Plans and shall be listed by Underwriters Laboratories.

Rigid metal conduit shall be steel, hot dipped galvanized inside and outside. When tested in accordance with ASTM Designation: A 90, zinc coating shall be minimum of 1.5 ounces per square foot. Electronic metallic tubing and intermediate metal conduit shall be steel, hot dipped galvanized on the outside and protected on the inside with a suitable corrosion-resistant materials. Fittings shall be rain-tight. Set screw and pressure cast fittings will not be permitted.

Polyvinyl chloride and high-density polyethylene conduit shall meet the requirements of NEMA Standard TC-2 and UL 651, and the requirements of NEC for Rigid Nonmetallic Conduit. Unless otherwise noted on the Plans, PVC and HDP conduit shall be heavy wall (Schedule 40).

Flexible conduit shall liquid-tight metal meeting requirement of NEC and be UL-listed. Where conduit system metallic, all lengths of flexible metal conduit shall be fitted with bonding jumpers.

D-422.03 CONSTRUCTION METHODS

Conduit systems for new street crossings shall be installed prior to the subgrade compaction and the Curb & Gutter construction.
All conduit systems for street crossings shall be installed at least two (2’) feet away from the existing or future sidewalk or extended to the Right of Way line.

The conduit, junction boxes, fitting, and incidentals shall be placed in accordance with the lines, grades, details, and dimensions shown on the Plans, or as directed by the Engineer. Installation of conduit shall be in accordance with the requirements of NEC. Conduit placed for concrete encasement shall be secured and supported in such a manner that the alignment will not be disturbed during placement of the concrete. No concrete shall be placed until all of the conduit ends have been capped and all box openings closed.

For electrical conduits a 12” of clearance in all directions shall be used when close to any water carrier pipe.

Where conduit is treated in the field, a standard conduit cutting die with a 3/4 inch taper per foot
shall be used. Conduit placed on structures shall be firmly fastened with three (3) feet of each outlet box, junction box or fitting and at other locations as required by the NEC.

When required by the Engineer, immediately prior to installation of conductors or final acceptance, a spherical template having a diameter of not less than 75 percent of the inside diameter of the conduit shall be drawn through the conduit to insure that the conduit is free from obstruction. Than all conduit ends shall be closed using permanent type caps.

**D-422.04 SAMPLING AND TESTING**
When tests are required, sampling and testing will be in accordance with the Department's Manual of Testing Procedures.

**D-422.05 CURB MARKINGS**
The location, size, and purpose of all conduits shall be clearly marked on street curbs.

**D-422.06 MEASUREMENT**
Conduit of the types and sizes specified on the plans will be measured by the linear foot along the main line of the conduit except that flexible metal conduit will not be paid for directly but will subsidiary to the various pay items. No measurement will be allowed under this item for conduit used in circuit protector assemblies, service poles, transformer stations, or roadway illumination assembly foundations.

**D-422.07 PAYMENT**
Conduit, measured as provided under "Measurement", will be paid for at the unit price bid in linear feet for "Conduit", of the types and sizes specified, which prices shall each be full compensation for furnishing and installing all conduit, jacking, boring, excavation, backfilling, replacing pavement, or surface treatment and marking location of conduit; for furnishing and installing all fittings, outlet boxes, bends, expansion devices, junction boxes, attachment devices and incidentals, and for all labor tools, equipment and incidentals as necessary to complete the work.
SECTION 430
CONCRETE SIDEWALKS

D-430.01 GENERAL: Section includes reinforced concrete sidewalks and accessible ramps. Applications for sidewalk permits shall be made in writing to the Building Development Services Department to construct, reconstruct, alter, remove, or replace any sidewalk section within the R.O.W. (Right-of-Way). The application shall include the location of the proposed improvements, together with a plot plan drawn to scale (or approved site plan) fully describing the nature of the proposed improvements and the locations as well as the traffic control plan. Construction of sidewalks and accessible ramps shall be in compliance with ADA. Any existing obstructions as water meters, traffic signs, fire hydrants, water valves, street lights, etc. shall be relocated outside the proposed driveway at the owner’s expense.

D- 430.02 REFERENCES:

A. ASTM C 31-Standard Practice for Making and Curing Concrete Test Specimens in the field.
C. ASTM C 42- Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
D. ASTM C 138 -Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
F. ASTM C 172 - Practice for Sampling Freshly Mixed Concrete.

D- 430.03 SUBMITTALS: Submit certified testing results and certificates of compliance.

D- 430.04 MATERIALS
A. Concrete: Conform to material and proportion requirements for concrete Section 406.
B. Reinforcing Steel: Conform to material requirements in section 410 & 412.
C. Reinforcing Fiberglass: Conform to material and proportion requirements as per Section 414. Approval from the City engineer is required.
D. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Section 416 - Expansion Joint Material.
E. Expansion Joint Filler: Conform to material requirements for expansion joint material of Section 406- Concrete Structures.
F. Forms: Use straight, unwrapped wood or metal forms with nominal depth equal to or greater
than the proposed sidewalk thickness. The use of 2” by 4” lumber as forms will be allowed.

EXECUTION

D-430.05 REPLACEMENT: Replace sidewalks and accessible ramps that are removed or damaged during construction as per this specification to the next joint. Provide replaced and new sidewalks with accessible ramps if sidewalk intersects curb at street or driveway as per the latest ADA standards.

D-430.06 PREPARATION:
A. Identify and protect utilities which are to remain.
B. Protect living trees, other plant growth, and features designated to remain.
C. Conduct clearing and grubbing operation in accordance with Section 402 - Clearing and Grubbing.
D. Excavate subgrade to the line, grade and cross-section shown on plans. Remove soft spots and pumping soils and replace with fill material having a Plasticity Index between 7 and 20.

D-430.07 PLACEMENT:
A. Setting Forms: Securely stake forms to line and grade. Maintain position during concrete placement.
B. Reinforcement: Install 6 x 6, W2.9 x W2.9 welded wire fabric or No. 3 reinforcing steel bars on 18-inch centers longitudinally and transversely. Lay longitudinal bars in walk continuously, except through expansion joints. Support reinforcement in manner to maintain reinforcement in center of slab vertically during placement.
C. Expansion Joints: Install expansion joints at 40’ to 80’ in accordance with Section 416 - Expansion Joint Material.
D. Place concrete in forms to specified depth and tamp thoroughly with “jitterbug” tamp, or other acceptable method. Bring mortar to surface. Where a sidewalk crosses a driveway, ensure that the sidewalk depth and reinforcement are not less than the driveway cross-sectional details shown on the plans.
E. Strike off to smooth finish with wood strike board. Finish smoothly with wood hand float. Brush across sidewalk with fine-haired brush. Exposed material shall not be allowed as finish surface.
F. Unless otherwise indicated on plans, mark off joints ¼ inch deep, at spacing equal to 5 feet and matching C&G joints. Use joint tool equal in width to edging tool.
G. Finish edges with tool having ¼ inch radius.
H. After concrete has set sufficiently, refill space along side of sidewalk to top of walk with
suitable material. Tamp until firm and solid. Dispose of excess material in accordance with Section 128 - Waste Material Disposal. Repair driveways and parking lots damaged by sidewalk excavation in accordance with Section 430.

D-430.08 CURING: Conform to requirements of Section 406 - Concrete Curing.

D-430.09 FIELD QUALITY CONTROL:

A. Testing will be performed under provision of Division C, General Provisions, Section 6 Control of Work and Materials.

B. Compressive Strength Test Specimens: Four test specimens for compressive strength test will be made in accordance with ASTM C 31 for each 30 cubic yards or less of sidewalk that is place in one day. Two specimens will be tested at 7 days. The remaining two specimens will be tested at 28 days. Specimens will be tested in accordance with ASTM C 39. Minimum compressive strength shall be 3000 pounds per square inch at 28 days.

C. Yield test for cement content per cubic yard of concrete will be made in accordance with ASTM C 138. If such cement content is found to be less than that specified per cubic yard, reduce batch weights until amount of cement per cubic yard of concrete conforms to requirements.

D. If the Contractor places concrete without notifying the laboratory, the City will have the concrete tested by means of a core test as specified in ASTM C 42. If the concrete does not meet the specification, the cost of the test will be deducted from payment due the Contractor.

E. Sampling of fresh concrete shall be in accordance with ASTM C 172.

F. Take slump tests when cylinders are made.

G. Concrete shall be acceptable if the average of the two 28 day compression tests is equal to or greater than the minimum 28-day strength specified.

H. If either of the two tests is less than the average of the two tests by more than 10 percent, that entire test shall be considered erratic and not indicative of the concrete strength. Core samples will be required of this concrete.

I. If any 28-day laboratory test indicates that concrete of low strength has been placed, the concrete in question shall be tested by taking cores as directed by the City Engineer may direct. At least three representative cores shall be taken and tested as specified in ASTM C 42. Cost for any additional testing required due to a failed test will be paid by the contractor.

D-430.10 NONCONFORMING: Remove and replace areas of sidewalk that fail compressive strength tests, with concrete of thickness shown on plans. Nonconforming sidewalk sections shall be replaced at no additional cost to the City.
D-430.11 PROTECTION: Maintain sidewalks in good condition until completion of work. Replace damaged sidewalks in accordance with Paragraph D-430.06 - Replacement.

D-430.12 MEASUREMENT: Sidewalks will be measured by the square foot or by the foot of different widths. Accessible ramps will be measured by each unit. The unit will consist of the curb ramp, landing, adjacent flares or side curb, and detectable warning surface as shown on the plans.

D-430.13 PAYMENT: Will be paid by the unit price bid for concrete sidewalks for the depth specified and accessible ramps. This price is full compensation for surface preparation of base; materials; removal and disposal of excavated material; drilling and doweling into the existing concrete curb, sidewalk and pavement; repair of the adjacent street or pavement structure damaged by the operations; and equipment, labor, materials, tools and incidentals.
SECTION 510
FLEXIBLE BASE COURSE

D-510.01 GENERAL: Flexible Base shall consist of a foundation course for surfacing, pavement, or other base courses; shall be composed of uncontaminated materials of uniform quality that meet the requirements of TxDOT Item 247, and shall be constructed as herein specified in conformity with the sections shown on the plans and to the lines and grades established by the Engineer.

MATERIALS

D-510.02 MATERIALS: The materials shall consist of argillaceous limestone, calcareous clay particles with or without stone, conglomerate, gravel, sand, or other granular materials. The materials shall be at least Type “B” Grade II, conforming to Item No. 247 of the Texas Department of Transportation Specifications 2004 or latest edition. The source of the material shall be approved by the Engineer prior to use. The plasticity index of caliche shall have a maximum of 12 and a minimum of 5. The Contractor shall stockpile the material to be used for this particular project. Sampling and testing shall conform to TxDOT or ASTM specifications. Triaxial test will be required only when specified by the engineer. Stones greater than 3” in any direction shall be removed from street during construction.

CONSTRUCTION METHODS

D-510.03 CONSTRUCTION METHODS: The flexible base materials shall be placed on the approved subgrade in courses not to exceed eight (8) inches compacted depth. It shall be the responsibility of the Contractor that the required amount of materials be delivered and uniformly spread and shaped. All materials shall be moved from the place where it is dumped by cutting in windrow. After the material has been cut into windrows, it shall be sprinkled, spread, shaped, and rolled in proper sequence to prevent segregation and as necessary for required compaction.

The surface upon completion shall be smooth and in conformity with typical sections and to the established lines and grades. Any deviation in excess of 1/4 inch in cross section and in length of 16 feet measured longitudinally shall be corrected. All irregularities, depressions, or weak spots which develop shall be corrected.

Flexible base shall be compacted to an apparent dry density of not less than 98 percent (98%) of the maximum dry density as determined in accordance with TxDOT Specifications Test Method TEX 113-E. Tests for density will be made within 24 hours after compaction operations are completed. If the material fails to meet the density specified, it shall be reworked as necessary to meet the density required. Just prior to the placing of any succeeding course of flexible base or surfacing on a previously completed course, the density and moisture of the top four (4) inches of the flexible base shall be checked and if tests show the density to be more than 2 percent (2%) below the specified minimum or the moisture content to be more than 3 percent (3%) above or below the optimum, the course shall be reworked as necessary to obtain the specified compaction and moisture content.

Should the base course due to any reason or cause lose the required stability, density, or finish before the surface is completed, it shall be recompacted, refinished, and retested at the sole expense of the Contractor.
The limits of placement for F.B.C. will extend 1 foot beyond the back of curb (whenever curb is specified) in order to provide proper support for concrete curb (Detail No.).

**D-510.04 MEASUREMENT**: Flexible Base: The number of square yards of flexible base course to be paid for shall be measured as the square yards in place after compaction. Thickness shall be checked by means of depth tests or cores, but no extra yardage for thickness in excess of that shown on the plans will be paid.

**D-510.05 PAYMENT**: The yardage of flexible base measured as provided for in Paragraph above will be paid for at the contract unit price for "Flexible Base". All payment made under this section shall constitute full compensation for excavation for furnishing, loading, hauling, and placing materials; for mixing, blending, sprinkling, shaping and compacting; for reconditioning the underlying course and shoulders, and for furnishing all labor, tools, and equipment as specified herein.
IV. ENVIRONMENTAL SPECIFICATIONS
SECTION 602
SILT FENCE

D-602.01 DESCRIPTION: This item shall govern for the material of silt fence fabric and related fencing materials used for control of sediment in surface runoff waters.

D-602.02 MATERIAL REQUIREMENTS:

A. Fabric. Fabric may be manufactured from polyester, polypropylene, or polyamide and shall be resistant to ultraviolet degradation, mildew and rot and shall be suitable for use in a wet soil and stagnant water environment. The edges of woven fabric shall be sealed or salvaged to prevent raveling. Fabric shall be at least 36 inches wide with 6 to 8 inches of the width buried in a trench to prevent undercutting, unless specified otherwise on the plans. The fabric shall exhibit the following physical properties when sampled and tested using the specified methods.

<table>
<thead>
<tr>
<th>Physical Property</th>
<th>Test Method</th>
<th>Silt Fence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tensile Strength, lb</td>
<td>ASTM D 4632</td>
<td>90 Min</td>
</tr>
<tr>
<td>2. Elongation @ Yield, %</td>
<td>ASTM D 4632</td>
<td>100 Min</td>
</tr>
<tr>
<td>3. Trapezoidal Tear, lb</td>
<td>ASTM D 4533</td>
<td>35 Min</td>
</tr>
<tr>
<td>4. Apparent Opening Size</td>
<td>ASTM D 4751</td>
<td>50-80 Min</td>
</tr>
<tr>
<td>5. Permittivity, sec⁻¹</td>
<td>ASTM D 4491</td>
<td>1 Min</td>
</tr>
<tr>
<td>6. Ultraviolet Stability original tensile</td>
<td>ASM D 4355</td>
<td>80 Min</td>
</tr>
<tr>
<td>strength retained after 500 hours</td>
<td></td>
<td>exposure, %</td>
</tr>
<tr>
<td>exposure, %</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B. Silt Fence: This system consists of fence posts, spaced no more than 8.5 feet apart, and fabric with and attached reinforcing net. Fence posts shall be a minimum of 42 inches long, embedded at least 1 foot, and constructed of either wood or steel. Soft wood posts shall be at least 3 inches in diameter or nominal 2 in. x 4 in. and essentially straight. Hardwood posts shall be a minimum of 1.5 in. x 1.5 in. Net reinforcement shall be a galvanized welded wire mesh of at least 12.5 gauge wire with maximum opening size of 4 in². The fabric shall be attached to the top of the net by crimping or cord at least every 2 feet, or as otherwise specified.

D-602.03 CERTIFICATION AND IDENTIFICATION: Each lot or shipment shall be accompanied by a certification of conformance to this specification. The shipment must be identified by a ticket or labels securely affixed to the fabric rolls. This ticket or label must list the following information:

   a. Name of manufacturer or supplier
   b. Brand name and style
   c. Manufacturer's lot number or control number
   d. Roll width in inches
   e. Roll length in yards
D-602.04 MEASUREMENT AND PAYMENT:

A. Unless indicated in the PROPOSAL FORMS as a pay item, no separate payment for work performed under this Item. Include cost of work performed under this Item in Contract prices bid for items of which this work is a component. When indicated in PROPOSAL FORMS as pay item measure and pay for the filter fabric fence by the linear feet of completed and accepted filter fabric fence between the limits of the beginning and ending of wooden stakes. Filter fabric fence, measured as stated will be paid for at the unit price bid for "FILTER FABRIC FENCE, COMPLETE IN PLACE".

B. Payment for filter fabric fence will include and be full compensation for all labor, equipment, materials, supervision, and all incidental expenses for construction of these items, complete in place, including, but not limited to, protection of trees, maintenance requirements, repair and replacement of damaged sections, removal of sediment deposits, and removal of erosion and sedimentation control systems at the end of construction.
**SECTION 604**  
**EROSION CONTROL BLANKETS**

**D-604.01 APPLICATION:** To protect the side slope of a natural channel and to reduce erosion. The following specification should be met for the erosion control blankets.

The mats should be made of 100% biodegradable agricultural straw/woods netting on top and bottom sides with a minimum thickness of 0.25 inch. Material should not contain any chemical additives. The blanket should be durable and flexible to work with the following information:

- Flow velocity: greater than 5 fps
- Permissible shear strength: greater than 1.5 lbs. sq. ft.
- Weight: greater than 0.5 lbs. sq. yd.
- Tensile strength/elongation: greater than 30%
- Should be capable to control side slope of 3:1 to 2:1
- Netting shall be light photodegradable polypropylene (greater than 1.5 lbs./1000 sq. ft.)

Approved Material Suppliers (to date):

<table>
<thead>
<tr>
<th>COMPANY NAME</th>
<th>CITY, STATE</th>
<th>MODEL No.</th>
<th>PHONE No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>North American Green</td>
<td>Evansville, Indiana</td>
<td>S150</td>
<td>812-867-6632</td>
</tr>
<tr>
<td>BonTerra America</td>
<td>Genesse, Idaho</td>
<td>S1</td>
<td>800-882-9489</td>
</tr>
<tr>
<td>American Excelsior Co.</td>
<td>Dallas, Texas</td>
<td>Curlex I</td>
<td>817-640-2161</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>800-777-2691</td>
</tr>
</tbody>
</table>

**CONSTRUCTION SPECIFICATIONS**

**D-604.02 SITE PREPARATION**

A. Proper site preparation is essential to ensure complete contact of the protection matting with the soil.

B. Grade and shape area of installation.

C. Remove all rocks, clods, vegetative or other obstructions so that the installed blankets, or mats will have direct contact with the soil.
SECTION 606
NPDES REQUIREMENTS

D-606.01 GENERAL: This section describes the required documentation to be prepared and signed by the Contractor before conducting construction operations, in accordance with the terms and conditions of the National Pollutant Discharge Elimination System (NPDES) Permit, as stated in the Federal Register Vol. 57 No. 175, issued by the Environmental Protection Agency on September 2, 1992.

The Contractor shall be responsible for implementation, maintenance, and inspection of stormwater pollution prevention control measures including, but not limited to, erosion and sediment controls, stormwater management plans, waste collection and disposal, off-site vehicle tracking, and other practices shown on the drawings or specified elsewhere in this or other specifications.

The Contractor shall review implementation of the Storm Water Pollution Prevention Plan (SWPPP) in a meeting with the City Engineer prior to start construction.

D-606.02 UNIT PRICES: 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 of which this work is a component.

D-606.03 REFERENCES:


EXECUTION

D-606.04 NOTICE OF INTENT: The Contractor shall fill out, sign, and date the Contractor’s Notice of Intent (NOI). The signed copy of the Contractor’s NOI shall be returned to the City. The City will complete the Owner’s Notice of Intent and will submit both notices to the EPA. Submission of the NOI is required by both the City and the Contractor before construction operations start.

D-606.05 CERTIFICATION REQUIREMENTS: Submit name, address, and telephone number of persons or firms responsible for maintenance and inspection of erosion and sediment control measures and all Subcontractors.

D-606.06 RETENTION OF RECORDS:
(a) The Contractor shall keep a copy of the Storm Water Pollution Prevention plan at the construction site or at the Contractor’s office from the date it became effective to the date of project completion.

(b) At the project closeout, the Contractor shall submit to the City all NPDES forms and
certifications, as well as a copy of the SWPPP. Stormwater pollution prevention records and data will be retained by City for a period of three (3) years from the date of project completion.

D-606.07 REQUIRED NOTICES:

(a) The following notices shall be posted from the date that this SWPPP goes into effect until the date of final site stabilization:

1. Copies of the Notices of Intent submitted by the City and Contractor and a brief project description shall be posted at the construction site or at Contractor’s office in a prominent place for the public viewing.

2. Notice to drivers of equipment and vehicles, instruction them to stop, check, and clean tires of debris and mud before driving onto traffic lanes. Post such notices at every stabilized construction exit area.

3. In an easily visible location on site, post a notice of waste disposal procedures.

4. Notice of hazardous material handling and emergency procedures shall be posted with the NOI on site. Keep copies of Material Safety Data Sheets at a location on site that is known to all personnel.

5. Keep a copy of each signed certification at the construction site or at Contractor’s office.
V. MISCELLANEOUS SPECIFICATIONS
SECTION 802
SHEETING AND BRACING

GENERAL

D-802.01 DESCRIPTION: Unstable soil encountered in trench or foundation excavation which tends to cave in or otherwise, shall be properly sheeted and braced as per OSHA requirements. Sufficient bracing material shall be left in place to guarantee safety to workmen and material where removal of such sheeting and bracing after it has served its purpose would be dangerous to workmen during backfilling or harmful to materials in place.

MATERIALS

D-802.02 MATERIALS: The sheeting material to be placed in contact with the dirt shall be either rough lumber with a minimum thickness of 2" appropriately designed steel sheet piling. Braces shall consist of lumber with a minimum thickness of 4" or metal screw jacks or other mechanical devices approved by the Engineer. All lumber shall be No. 3 common or better.

D-802.03 WHEN TO INSTALL SHEETING AND BRACING: Whenever, in the opinion of the Engineer or the Contractor, the soil at the edge of any excavation is sufficiently unstable as to endanger the safety of life, limb, or property, sheeting and bracing material shall be installed. Such material shall also be installed in all trenches whose sides are steeper than the natural angle of repose of the soil material if it were in loose uncompacted condition and the trenches are in excess of 8 feet deep, but only such portions of the total height of the trench shall be sheeted as appears necessary. Should a layer or pocket of material be encountered anywhere in the trench or other excavation which is of such type as to make possible the failure of adjacent soils, such layer or pocket shall be sheeted and braced in such a manner as to insure its permanency. Whenever a doubt exists as to the necessity of the installation of sheeting and bracing, it shall be installed.

CONSTRUCTION METHODS

D-802.04 GENERAL: Upon discovery of unstable material in any excavation, such sheeting and bracing as may be deemed adequate by the Engineer shall be installed. Stay bracing, piling boards, and box or vertical sheeting methods shall be used depending on the nature of the unstable material encountered. Metal sheeting and steel sheet piling may be used at the option of the Engineer.

D-802.05 MEASUREMENT: This item will be measured by the foot along the long axis of the trench.

D-802.06 PAYMENT: Contractor shall investigate the conditions as they exist in the field and include in the unit price bid per linear foot. This price is full compensation for the excavation and backfill required for excavation protection; furnishing, placing and removing shoring, sheeting, or bracing; dewatering or diversion of water; jacking and jack removal; and equipment, labor, materials, tools and incidentals.
SECTION 804
WORK PERFORMED ON NON-WORKING DAYS

D-804.01 WORKING DAY: A working day is Monday thru Friday, 8:00 a.m. to 5:00 p.m. excluding holidays.

D-804.02 WORK PERFORMED ON A NON-WORKING DAY: Any work which is to be performed on a non-working day must be inspected. The Engineer will decide which work will be requiring the presence of an inspector.

D-804.03 COST OF INSPECTION: The cost for having an inspector present shall be incurred by the Contractor performing the work. Such arrangements will be made in writing and submitted to the Engineer for his approval. Any testing requested by the contractor out of service hours or any overtime charged by the testing laboratory for delaying, shall be paid by the contractor.

D-804.04 STOP WORK: Any work stoppage by the contractor must be reported in writing to the engineer and owner 24 hours prior to work stoppage.
VI. TECHNICAL SPECIFICATIONS
CIVIL/MECHANICAL SPECIFICATIONS
SECTION 01 75 60

COMMISSIONING AND FACILITY START-UP

PART 1 GENERAL

1.1 DESCRIPTION

A. The responsibilities of the Contractor are to assure the equipment/structure commissioning and facility start-up process are successfully executed. The Contractor is responsible for providing all services for commissioning, testing, training, and start-up.

B. The Contractor shall be designated as the Commissioning Agent and responsible for providing a Plan of Action for commissioning of structures and equipment and is responsible to coordinate all start-up requirements in coordination with the City and Engineer.

C. Construction and Acceptance

1. The Contractor shall coordinate and direct all commissioning activities in a logical and efficient manner. Work to ensure that commissioning activities are being scheduled with supplier and receive approval from manufacturer.

2. Manufacturer must provide quality assurance and control for all installed and commissioned equipment.

3. Revise, as necessary, the Commissioning Plan of Action.

4. Plan and conduct commissioning scoping meetings.

5. Review information required to perform commissioning tasks, including O&M materials, start-up and checkout procedures, sequence of operation and coordinate with Supplier/Manufacturer.

6. Develop start-up and checkout plan with Subcontractors/Suppliers. Write and distribute pre-functional checklists to all responsible for the start-up of equipment.

7. Prepare completed pre-functional checklist and start-up reports and submit for Engineer and City approval.

8. Write the functional performance test procedures for equipment and systems. Submit to City and Engineer for review 21 days prior to start-up.

9. Contractor to coordinate with manufacturer/supplier, witness, and document functional performance tests performed by equipment installed and Manufacturers. Contractor to coordinate retesting as necessary until satisfactory performance is achieved. Provide Manufacturer Authorized Factory Representative for start-up and as required for successful commissioning and operations, and as approved by the city and engineer.

10. Contractor to maintain a master deficiency and resolution record. Provide the Engineer and City with written progress reports and test results with recommended actions and supplier/manufacturer certification.

11. Provide a Final Commissioning Report to the City and Engineer for approval.
1.2 CONTRACTOR SUMMARY

A. Contractor requirements for equipment and system commissioning, testing and facility start-up, including the following:
   1. Commissioning Plan of Action – Start-up
   5. Operational Testing.
   7. Services of Manufacturer Authorized Factory Representatives.
   8. Training of OWNER's personnel.
   9. Final Commissioning Report for the complete facility submitted to the City and Engineer for review and approval.

1.3 CONTRACTOR GENERAL TESTING, TRAINING, AND START-UP REQUIREMENTS

A. Contract Requirements: Testing, training, and start-up are requisite to the satisfactory completion of the contract. Manufacturer’s Authorized Factory Representative shall be present for commissioning until successful operation.

B. Complete testing, training, and start-up within the Commissioning Plan of Action schedule.

C. Allow realistic durations in the Progress Schedule for testing, training, and start-up activities.

D. Furnish supervision, coordination, labor, power, incidentals, tools, equipment, instruments, and services required for and incidental to completing functional testing, performance testing, and operational testing for all commissioning requirements.

E. Provide Manufacturer Authorized and Experienced Factory Technical Representative for assembly, installation/testing guidance, and operator training for successful equipment commissioning.

1.4 START-UP PLAN OF ACTION

A. Contractor to submit to the City and Engineer Commissioning Plan of Action Start-Up for review and approval for each piece of equipment and each system not less than 3 weeks prior to planned initial start-up of equipment or system.

B. Provide detailed Progress Schedule with the following activities identified:
   1. Manufacturer's services.
   2. Installation certifications.
   3. Operator training.
   5. Functional testing.
   6. Performance testing.
   7. Operational testing.
C. Provide Testing Plan of Action with test logs for each item of equipment and each system when specified. Include testing of alarms, control circuits, capacities, speeds, flows, pressures, vibrations, sound levels, and other parameters as needed and as required by the City and Engineer.

D. Provide summary of shutdown requirements for existing systems which are necessary to complete start-up of new equipment and systems.

E. Revise and update Start-Up Plan of Action based upon review comments, actual progress, or to accommodate changes in the sequence of activities.

1.5 PERFORMANCE TESTING

A. Contractor to provide Manufacturer Authorized Representative to test equipment for proper performance and meet all equipment requirements at point of manufacturer or assembly prior to delivery.

B. Source Quality Control Testing
   1. Demonstrate equipment meets specified performance requirements.
   2. Provide certified copies of test results to the City and Engineer for review and approval.
   3. Do not ship equipment until certified copies have been submitted and approved by the City and Engineer.

C. Contractor to include all costs associated with witnessing performance tests.

1.6 GENERAL START-UP AND TESTING PROCEDURES

A. Mechanical Systems:
   1. Remove rust preventatives and oils applied to protect equipment during construction.
   2. Flush lubrication systems and properly dispose of flushing oils. Recharge lubrication system with lubricant recommended by manufacturer.
   3. Flush fuel system and provide fuel for testing and start-up.
   4. Install and adjust packing, mechanical seals, O-rings, and other seals.
   5. Replace defective seals.
   6. Remove temporary supports, bracing, or other foreign objects installed to prevent damage during shipment, storage, and erection.
   7. Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.
   8. Perform cold alignment and hot alignment to manufacturer's tolerances.
   9. Adjust V-belt tension and variable pitch sheaves.
  10. Inspect hand and motorized valves for proper adjustment. Tighten packing glands to ensure no leakage but permit valve stems to rotate without galling.
  11. Verify valve seats are positioned for proper flow direction.
  12. Tighten leaking flanges or replace flange gasket. Inspect screwed joints for leakage.
  13. Install gratings, safety chains, handrails, shaft guards, and sidewalks prior to operational testing.
  14. Ensure equipment leveling and grouting as required.
B. Electrical Systems:
1. Perform insulation resistance tests on wiring except 120-volt lighting, wiring, and control wiring inside electrical panels.
2. Perform continuity tests on grounding systems.
3. Test and set switchgear and circuit breaker relays for proper operation.
4. Perform direct current high potential tests on all cables that will operate at more than 2,000 volts. Obtain services of independent testing lab to perform tests.
5. Check motors for actual full load amperage draw. Compare to nameplate value.

C. Instrumentation Systems:
1. Bench or field calibrate instruments and make required adjustments and control point settings.
2. Leak test pneumatic controls and instrument air piping.
3. Energize transmitting and control signal systems, verify proper operation, ranges and settings.

D. Civil/Structural:
For new concrete structures water tightness testing, the Contractor to meet all requirements of all the ACI Manual of Concrete Practice, Latest Edition; including Section 350.1-10. A summary of the section includes, but is not limited to the following:
1. Scope
   a. Work specified – This Specification covers tightness testing of liquid in environmental containment structures designed to resist liquid loads. Provisions of this Specification shall govern except where other provisions are specified in Contract Documents.
   b. Test methods are for the tightness testing of concrete environmental engineering liquid containment structures, including
      1) Hydrostatic tightness test for open or covered containment structures.
      2) No visible leakage on walls will be allowed for this project.
      3) Unless Hydrostatic Testing has been completed and approved by the City and Engineer structures must not be backfilled.
   c. The tightness testing procedures and requirements contained herein are applicable to reservoirs, basins, and tanks constructed of concrete or a combination of concrete and other materials. Preparatory items indicated are required, unless otherwise specified, but the waiver of such items shall not change the test criteria.
   d. Cells in the structures shall be considered a single containment structure and tested individually unless otherwise permitted.
   e. The hydrostatic tightness testing procedures and requirements herein are also applicable for tightness testing of open concrete liquid transmission structures such as cast-in-place concrete channels and conduits.
   f. Unless specifically allowed by the Engineer, the containment structure shall not be tested before all the structure is complete and the concrete has attained its specified compressive strength.
2. Submittals
   a. General – Submittals required in this Specification shall be submitted for review and acceptance.
b. Repair Procedures – If required, submit for acceptance the proposed repair methods, materials, and modifications needed to assure that the Work will meet tightness requirements of Contract Documents.

c. Test Reports – Test reports provided by the Contractor shall include the results of tightness testing performed during the course of the Work and shall be submitted to the Engineer. Test reports shall include test locations in the containment structure, dates of testing, water level measurements, amounts of precipitation or evaporation (when applicable), measure temperatures and volume corrections (if any), retest results, corrective actions taken, if any, and final results. Final reports shall be provided within 7 days of test completion.

3. Quality Assurance
a. Duties and responsibilities of Contractor – The Contractor shall prepare and fill the containment structure, provide access and equipment, and make the measurements and observations for the required testing. The Engineer shall have access to observe measurements and witness observations included in the test reports, for verification.

4. General
a. The hydrostatic tightness test shall be the preliminary test for other tightness tests as well as an individual test.

b. Containment structures shall be tested for hydrostatic tightness and meet the following criteria:

<table>
<thead>
<tr>
<th>Type of containment structure</th>
<th>Default hydrostatic test quantitative criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully lined prior to hydrostatic test</td>
<td>No measurable loss</td>
</tr>
<tr>
<td>Required to have secondary containment</td>
<td>No measurable loss</td>
</tr>
<tr>
<td>*With monolithically placed floors designed to be shrinkage crack free</td>
<td>0.0125% of volume per day</td>
</tr>
<tr>
<td>Other types</td>
<td>0.050% of volume per day</td>
</tr>
<tr>
<td>Concrete paved reservoirs and channels</td>
<td>0.100% of volume per day</td>
</tr>
</tbody>
</table>

*For Aeration/Digester Basin and Clarifier.

c. “No measurable loss” of water means the drop in the water surface shall not exceed 1/8 in. in 3 days when adjusted for evaporation and precipitation.

1.7 FUNCTIONAL TESTING

A. Contractor to perform checkout and performance testing per individual structure and equipment specification sections.

B. Functionally test mechanical and electrical equipment, and instrumentation and controls systems for proper operation after general start-up and testing tasks have been completed.
C. Contractor to demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration. Perform initial checks in the presence of and with the assistance of the Manufacturer's Factory Authorized Representative.

D. Demonstrate proper operation of each instrument loop function including alarms, local and remote controls, instrumentation and other equipment functions. Generate signals with test equipment to simulate operating conditions in each control mode.

E. Conduct continuous 8-hour test under full load conditions. Replace parts which operate improperly.

F. Tightness Testing of Environmental Concrete Containment Structure.

1.8 OPERATIONAL TESTING

A. After completion of operator training, conduct operational test of the entire facility. Contractor to demonstrate satisfactory operation of equipment and systems in actual operation.

B. Conduct operational test for continuous 7-day period.

C. OWNER will provide operations personnel, power, fuel, and other consumables for duration of test.

D. Immediately correct defects in material, workmanship, or equipment which became evident during operational test.

E. Contractor to repeat operational test when malfunctions or deficiencies cause shutdown or partial operation of the facility or results in performance that is less than specified.

1.9 CERTIFICATE OF PROPER INSTALLATION

A. At completion of Functional Testing, Contractor and Manufacturer’s Factory Authorized Representative to furnish written report prepared and signed, certifying equipment:
   1. Has been properly installed, adjusted, aligned, and lubricated.
   2. Is free of any stresses imposed by connecting piping or anchor bolts.
   3. Is suitable for satisfactory full-time operation under full load conditions.
   4. Operates within the allowable limits for vibration.
   5. Controls, protective devices, instrumentation, and control panels furnished as part of the equipment package are properly installed, calibrated, and functioning.
   6. Control logic for start-up, shutdown, sequencing, interlocks, and emergency shutdown have been tested and are properly functioning.
   7. Meet all Manufacturer Specifications and Requirements.
   8. Meet hydrostatic tightness criteria.

B. Contractor to furnish written report prepared and signed by the electrical and/or instrumentation subcontractor certifying:
1. Motor control logic that resides in motor control centers, control panels, and circuit boards furnished by the electrical and/or instrumentation subcontractor has been calibrated and tested and is properly operating.
2. Control logic for equipment start-up, shutdown, sequencing, interlocks and emergency shutdown has been tested and is properly operating.
3. Co-sign the reports along with the manufacturer's representative and subcontractors.

1.10 TRAINING OF OWNER'S PERSONNEL

A. Provide operations and maintenance training for items of mechanical, electrical and instrumentation equipment. Utilize Manufacturer's Factory Authorized Representatives to conduct training sessions.

B. Coordinate training sessions to prevent overlapping sessions. Arrange sessions so that individual operators and maintenance technicians do not attend more than 2 sessions per week.

C. Provide Operation and Maintenance Manual for specific pieces of equipment or systems 1 month prior to training session for that piece of equipment or system. Provide both a hard copy and electronic copy.

D. Satisfactorily complete functional testing before beginning operator training.

E. As applicable, provide training sessions for each work shift listed below during the time periods shown. Pooling of shifts will not be permitted unless accepted by the City.

<table>
<thead>
<tr>
<th>Shift</th>
<th>Day</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tuesday, 7 a.m.-11 a.m.</td>
<td>Thursday, 7 a.m.-11 a.m.</td>
</tr>
<tr>
<td>Swing</td>
<td>Wednesday, 3 p.m.-7 p.m.</td>
<td>Thursday, 3 p.m.-7 p.m.</td>
</tr>
<tr>
<td>Graveyard</td>
<td>Monday, 11 p.m.-3 a.m.</td>
<td>Wednesday, 11 p.m.-3 a.m.</td>
</tr>
</tbody>
</table>

F. Training Sessions: Provide a minimum of two (2) training sessions for equipment.

G. The CONTRACTOR shall videotape all training sessions and provide a copy for the OWNER.

H. The CONTRACTOR shall designate and provide one or more persons to be responsible for coordinating and expediting his/her training duties. The person or persons so designated shall be present at all training coordination meetings with the OWNER.

I. The CONTRACTOR's coordinator shall coordinate the training periods with OWNER personnel and manufacturer's representatives and shall submit a training schedule for each piece of equipment or system for which training is to be provided. Such training schedule shall be submitted not less than 21 calendar days prior to the time that the associated training is to be provided and shall be based on the current plan of operation.
1.11 RECORD KEEPING

A. Contractor to maintain and submit the following records generated during start-up and testing phase of project.

1. Daily logs of structure and equipment testing identifying all tests conducted and outcome.
2. Logs of time spent by Manufacturer's Factory Authorized Representatives performing services on the job site.
3. Equipment lubrication records.
4. Electrical phase, voltage, and amperage measurements.
5. Insulation resistance measurements.
6. Data sheets of control loop testing including testing and calibration of instrumentation devices and set points.
7. Leakage testing data.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

PART 4 MEASUREMENT AND PAYMENT

A. Measurement and Payment for this item will be as indicated within the PROPOSAL FORM. If this item is not indicated within the PROPOSAL FORM, then it is to be considered subsidiary to the applicable sections(s).

B. Payment shall fully compensate the Contractor for all required labor, materials, equipment, supervision, insurance, maintenance, codes, laws, statues, or regulations, and all incidental expenses which are required to complete the work in place, ready-to-use and in accordance with the Drawings and Specifications.

END OF SECTION
SECTION 09 90 20

PAINTING

PART 1 GENERAL

1.1 DESCRIPTION

A. This specification shall govern for all work necessary to provide all painting required to complete the project.

1.2 INTENT

A. All ferrous metal or unfinished material furnished on this project shall be furnished with a protective coating, but stainless steel, aluminum, bronze, and copper, and surfaces are not to be painted. Any factory painted item that is damaged or shows any sign of corrosion prior to the date of substantial completion shall be repainted by the Contractor. Concrete or concrete block is to be painted only when shown on the drawings to be painted.

B. COLORS

1. All colors shall be selected by the Engineer and/or Owner. The Contractor shall prepare samples of colors for approval by the Engineer and/or Owner. Must meet all TCEQ requirements.

C. SAMPLES

1. The Contractor shall submit for approval samples of paint materials proposed for use, in three displays of each kind of color of paint to be applied. The Contractor shall make panels used for displays, representative of respective types of surfaces to which several kinds and colors are to be applied in actual work. The Contractor shall not order paint materials until color selections have been made and samples approved.

1.3 PREPARATION OF SURFACES

A. General

1. All surfaces shall be clean when paint is applied.

B. Concrete and Masonry:

1. The Contractor shall clean all concrete surfaces with mechanical abrasion (brushing) and water blast. The last step in the cleaning of surfaces other than sanitary sewer wet wells shall be to wash the surface to be painted with a 20% solution of muriatic acid and then rinse with potable water. In cleaning sanitary wet wells, all corroded concrete shall be removed as indicated above and the surface shall be washed with a solution of...
potable water and sodium hydroxide and then rinsed with potable water. The surface shall be thoroughly dry when paint is applied.

C. Metal:

1. General: All metal surface to be painted shall be cleaned by sandblasting, except items that are shop coated. Cleaning shall be to "Near White Metal" SP-10 or NACE #2, or "Commercial Grade" SSPC-6 or NACE #3. One of these two methods will be specified where blast cleaning is required. NOTE: All submerged surfaces will require a "Near White Metal" (SP-10 or NACE #2 blast), without exception.

2. "Near White Metal": Sandblast cleaning SP-10 or NACE #2. Definition and procedure as follows: "Near White Metal" is a method of preparing the metal surfaces for the application of protective coatings by removing mill scale, rust, oil paint, and any foreign matter by propelling sand through a nozzle with compressed air. This is defined as a surface, gray white in appearance, being almost a completely uniform metallic color, with very light shadows allowed over less than 10% of the surface area.

   Procedure:
   
   a. Before blasting, grind smooth any rough welds and sharp edges.
   b. Remove heavy deposits of oil and grease by detergent cleaning using one-pound Sodium Meta Silicate per five gallons of water.
   c. The sand used shall be 16-35 mesh, or 20-60 (unless otherwise specified) sharp angular grained silica sand that is fresh water washed, dried, properly graded and delivered to the job site in moisture proof bags (bulk sand of equal quality and size is acceptable). Sand shall not be re-used.
   d. Compressed air shall be delivered at a minimum nozzle pressure of 90 psi not to exceed 110 psi. This shall be free of detrimental amounts of condensed water and oil.
   e. All blast products shall be swept or blown from the surface before priming commences.
   f. Blast cleaning will not be conducted on surfaces that may become wet after blasting and before priming is complete, or when surfaces are less than 5 above dew point, or when relative humidity is above 85%.
   g. The blasted surface shall be primed within 8 hours.

3. "Commercial" Blast Cleaning (SP-6 of NACE #3) Definition and Procedure: Commercial blast cleaning is a method of preparing metal surfaces for painting by removing mill scale, rust, rust scale, paint or foreign matter by the use of abrasive propelled through nozzles or by centrifugal wheels. Heavy deposits of grease or oils shall be removed by No. 1 "Solvent Cleaning" prior to blasting. "Commercial" blast cleaning entails the removal of practically all rust, mill scale and other detrimental matter from the surface. The surface will not necessarily be uniform in color, nor will all surfaces uniformly clean since the original condition of the surface will affect the final result. (If surface, prior to cleaning, is in such bad condition that the cleaning, when done according to this specification, results in a surface unsatisfactory to the
Owner or suitable for very severe service, the No. 10 Blast Cleaning to "Near White Metal" shall be specified.) Less than 30% light shadow shall be visible.

Procedure:

a. Remove heavy deposits of grease or oil by detergent cleaning.

b. The sand shall be 20-40 mesh, unless otherwise specified, fresh water washed, dried, properly graded and delivered to the job site in vapor proof bags, or bulk. Sand shall not be re-used.

c. Compressed air shall be delivered at a minimum nozzle pressure of 90 psi, not to exceed 100 psi. This shall be free of condensed water and oil (use moisture traps).

d. Blow or sweep off the excess blast products from the surface.

e. Prime the blasted surface within 8 hours.

f. Blasting shall not be conducted when relative humidity is in excess of 85% or surfaces are less than 5 above the dew point, unless approved by the Engineer.

4. Removal of Oil and Grease: Remove oil and grease with approved solvents such as Naptha, or by steam combined with approved detergent. USE OF GASOLINE OR KEROSENE NOT PERMITTED.

5. Scraping, Grinding and Chipping: Scrapers or other suitable grinding and chipping tools may be used for removal of existing paint coating prior to repainting, or for cleaning before application of secondary coats only when approved by the Engineer.

6. Sandblasting: Clean such surfaces by "Near White" or "Commercial" sandblasting and leave clean, dry, and ready to receive prime coat. River sand must be graded and washed to insure removal of clayey material. Remove all dust and sand from surfaces before painting. Take care to remove all sand and grit around and between joints of connecting members. Schedule operations to avoid settling of dust or grit on freshly painted surfaces and adequately protect machinery or other equipment in vicinity of sandblasting work. Contractor to clean up site and remove all debris.

1.4 STORING AND MIXING OF PAINT

A. The Contractor shall use one convenient location for storing and mixing of paint materials and keep an approved type fire extinguisher available in this area. The Contractor shall protect areas where paint is stored or painting is done and he shall remove all oily rags and waste from building at close of each day.

1.5 WEATHER AND SITE CONDITIONS

A. Temperature: Painting shall not be accomplished when either the surface or ambient temperatures are less than 50 or when temperature drop of 20 F, or below 50 Fahrenheit, is forecast.
NOTE: Material shall be stored in area where the extreme cold or heat will not greatly affect viscosity. Coatings apply much better when product temperature is held within 60 - 90 F range (77 F is optimum).

B. Humidity: Painting shall not be accomplished during misty or rainy weather, or on surfaces that have any frost or moisture. Painting shall not be permitted at temperatures less than 5 F above the dew point.

C. Wind and Dust: Painting shall not be accomplished in dusty rooms or on the exterior during excessive wind. The Engineer shall be the sole judge as to what constitutes excessive wind.

1.6 APPLICATION PROCEDURES

A. General: Paint shall be applied by skilled workmen. Paint may be applied with brush or spray equipment. Protect all equipment prior to painting. Paint shall be applied in even and thorough coats, without runs, sags or other blemishes. Contractor shall properly sand paint surfaces between coats of enamel, paint or shellac when applied to any surface other than masonry. Apply paints in accordance with manufacturer's recommendations. Do not apply finish field painting to machinery, equipment, or piping until operational testing has been completed.

B. Driving Time: Allow thorough drying time of each coat before succeeding coat is applied, except when manufacturer recommends otherwise, or as specified herein.

C. Coverage: Shall be as recommended by manufacturer.

D. Delivery of Paint: Contractor shall deliver paint to the site in original, unbroken, sealed containers, with manufacturer's label attached.

E. Thinners and Solvents: Contractor shall use only those thinners and solvents specified in paint formulas of paint being used and mix in proportions as recommended by paint manufacturer.

F. Brush Application: Contractor shall apply paint in uniform thickness consistent with specified coverage and with sufficient cross brushing to insure filling of surface irregularities. He shall exercise particular care in painting around rivet heads, bolt heads and nuts, in corners, restricted spaces, and on irregular concrete surfaces.

G. Spray Application: Contractor shall apply paint with adjustable air gun equipped with suitable water trap to remove moisture from compressed air, and with paint pot having hand or air driven agitator. Application of paint by suitable airless spray equipment is acceptable. Paint shall be applied with the width of spray not less than 6 inches nor more than 18 inches, and with suitable pressure for particular type of paint being used. Contractor shall make frequent checks to insure correct spreading rate and coating, and apply without sags, runs or "orange peel" effect. Correct all such imperfection. The Contractor shall take special care to cover edges, corners, and rivet head without bridging over of paint film.

H. Application of Protective Coating: When applying coats designed to prevent corrosion due to liquids and gases, the coating must be complete and absolutely free of the slightest pinhole, air pocket or other defect which would allow the entrance of either liquid or gas.
I. Painting Shop Coated Metal Surfaces:

1. Prior to Installation: After delivery to site of work, and prior to installation, keep all shop coated metal work clean and free from corrosion. When directed, clean and re-touch damaged areas with additional primer.

2. After Installation: After erection or installation of shop coated metal work, clean, and re-touch all rust spots, all places where paint has been rubbed or scraped off, and all field rivet boat head nuts. After previously applied paint has hardened, and when surfaces to receive succeeding coats of paint have been perfectly cleaned and dried, apply paint as set out elsewhere in these specifications. Allow interval of not less than 48 hours, or as recommended by manufacturer, between coats, and if surface is to be submerged in water, allow 5 days or more for hardening of final coat before placing in water.

3. Machinery and Electrical Equipment: After installation of machinery and electrical equipment, check base coats carefully and retouch all damaged surfaces. Do not paint nameplates, serial number bases, chrome or bronze trim, or any rotating parts. Clean off any excess paint that impairs convenient removal of covers or gauges, instrumentation or other equipment fitted with doors or covers.

4. Bolted and Imbedded Surfaces: All surfaces to be bolted together, to concrete or to be imbedded in concrete or grouted, to have prime and complete finish coats applied and dried before erecting in place.

J. CLEANING: Upon completion of painting operations, the Contractor shall clean off all paint spots, oil, and stain from all surfaces and leave entire project in perfect condition as far as painting work is concerned. Remove from premises all containers and debris resulting from painting operations.

1.7 PAINTING EQUIPMENT, MACHINERY AND METAL WORK

A. INTERIOR - SHOP PAINTED PUMPS, MACHINERY AND MOTORS:

**Prime Coat:**

1. 1 coat - Briners #2810 Durapon Red Primer - Minimum 2 D.M.T., or
2. 1 coat - Koppers 621 Rust Inhibitive Primer - Minimum 2 D.M.T., or
3. 1 coat - PPG Multi-Prime 4360 Minimum 2 D.M.T., or
4. 1 coat - Tnemec Series 37K-77 Chem-Prime-Minimum 2 D.M.T., or
5. an approved equal.

**Intermediate Coat:**

1. 1 coat - Briners #2800 Series Durapon Enamel Epoxy - Minimum 2 D.M.T., or
2. 1 coat - Koppers Ponkote 300 Enamel - Minimum 2 D.M.T., or
3. 1 coat - PPG Fast Dry 35 finish - Minimum 2 D.M.T., or
4. 1 coat - Tnemec Series 2H Hi-Build Tnemec-Glass - Minimum 2 D.M.T., or
5. an approved equal.

**Top Coat:**
1. 1 coat - Briners #2800 Series Durapon Enamel Epoxy - Minimum 2 D.M.T., or
2. 1 coat - Koppers Ponkote 300 Enamel - Minimum 2 D.M.T., or
3. 1 coat – PPG Fast Dry 35 Finish - Minimum 2 D.M.T., or
4. 1 coat - Tnemec Series 2H Hi-Build Tnemec-Glass - Minimum 2 D.M.T., or
5. an approved equal.

**B. EXTERIOR - SHOP PAINTED PUMPS, MACHINERY, AND MOTORS:**

**Prime Coat:**
1. 1 coat - Briners #4805 Versatile Red Prime - 2.5 - 3 D.M.T., or
2. 1 coat - Koppers 654 Epoxy Primer 2.5 - 3 D.M.T., or
3. 1 coat – PPG Amerlock Sealer 1 - 2 D.M.T., or
4. an approved equal.

**Intermediate Coat:**
1. 1 coat - Briners #4817 Versatile Tan Primer - Minimum 3 D.M.T., or
2. 1 coat - Koppers Glamorglaze 200 Epoxy - Minimum 3 D.M.T., or
3. 1 coat – PPG Amercoat 385PA - Minimum 5 D.M.T., or
4. an approved equal.

**Top Coat:**
1. 1 coat - Briners ACRA-CLAD (Acrylic Urethane) - Minimum 2.5 D.M.T., or
2. 1 coat - Koppers Polyrethane - Minimum 2.5 D.M.T., or
3. 1 coat - PPG Pitthane Ultra (Polyurethane) - Minimum 2.5 D.M.T., or
4. an approved equal.

**1.8 PAINTING EXPOSED AND SUBMERGED METAL PIPING**

**A. EXPOSED VALVES, FITTINGS, AND PIPES:** (Sandblast "Commercial Grade" SP-6 or NACE #3)

**Prime Coat:**
1. 1 coat - Briners #4805 Versatuke Red Primer - Minimum 3 D.M.T., or
2. 1 coat - Koppers 654 Primer - Minimum 2.5 D.M.T., or
3. 1 coat - PPG Amerlock 400 MIO - Minimum 6 D.M.T., or
4. an approved equal.

**Intermediate Coat:**
1. 1 coat - Briners #4817 Versatile Tan Primer - Minimum 3 D.M.T., or
2. 1 coat - Koppers H.B. Epoxy - Minimum 6 D.M.T., or  
3. 1 coat – PPG Amerlock 400 Minimum 6 D.M.T., or  
4. an approved equal.  

**Top Coat:**  
1. 1 coat - Briners ACRA-CLAD (Acrylic Urethane) - Minimum 2.5 D.M.T., or  
2. 1 coat - Koppers Polyurethane - Minimum 2.5 D.M.T., or  
3. 1 coat – PPG Pitthane Ultra Optional if exposed to UV light (Polyurethane) - Minimum 2.5 D.M.T., or  
4. an approved equal.  

**Color Coding:**  
Piping shall be color coded as shown on the drawings. When coding is not shown on the drawings, the following shall apply:  

<table>
<thead>
<tr>
<th>Line Type</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sludge Line</td>
<td>Brown</td>
</tr>
<tr>
<td>Gas Line</td>
<td>Red</td>
</tr>
<tr>
<td>Potable Water Line</td>
<td>Blue</td>
</tr>
<tr>
<td>Non-Potable Water Line</td>
<td>Purple</td>
</tr>
<tr>
<td>Chlorine Line</td>
<td>Yellow</td>
</tr>
<tr>
<td>Sewage Line</td>
<td>Gray</td>
</tr>
<tr>
<td>Compressed Air Line</td>
<td>Green</td>
</tr>
<tr>
<td>Heating Water Lines for</td>
<td>Blue w/6” red band</td>
</tr>
<tr>
<td>Digesters or Buildings</td>
<td>@ 30’ O.C.</td>
</tr>
</tbody>
</table>

*Dry Mils Thick*  

1.9 RESPONSIBILITY FOR PAINT SYSTEMS  

A. The intent of this specification is to provide the Contractor with several manufacturers' paint systems on which to base his bid. The Contractor is responsible for verifying with the paint manufacturer before he purchases any material, that the paint system is suitable for use on this project and that application rates, etc., are in compliance with the manufacturer's recommendations.  

1.10 MEASUREMENT AND PAYMENT  

A. Measurement and Payment for this item will be as indicated within the PROPOSAL FORM. If this item is not indicated within the PROPOSAL FORM then it is to be considered subsidiary to the applicable sections(s).  

B. Payment shall fully compensate the Contractor for all required labor, materials, equipment, supervision, insurance, maintenance, codes, laws, statues, or regulations, and all incidental
expenses which are required to complete the work in place, ready-to-use and in accordance with the Drawings, Specifications, and all OSHA and TCEQ regulations and requirements.

END OF SECTION
SECTION 11 00 02

CHLORINATION EQUIPMENT

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required to install, test, and make ready for operation chlorine gas feed equipment including all appurtenances required for proper operation of the chlorination system as shown on the drawings and as specified herein.

1. System accessories are also specified and to be enclosed in an existing concrete block building. Remove and replace existing equipment, as required.

B. All necessary accessory equipment and auxiliaries, whether specifically mentioned in these specifications or not, shall be furnished and installed as required for a complete and operational system in conformance with the standards of the Chlorine Institute, Inc.

C. All equipment and installations must comply with OSHA and TCEQ regulations and requirements.

D. Contractor to coordinate removal of existing equipment and installation of new equipment with the City of Laredo to assure compliance with TCEQ Wastewater Permit Discharge Effluent Requirements.

1.2 QUALITY ASSURANCE

A. REFERENCE:

2. ASTM D2737 -- Polyethylene Plastic Tubing.
5. ASTM D2855 -- Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings

1.3 DEFINITIONS

A. Ejector, also injector, an apparatus using a venturi to create a vacuum to draw and combine gas and water into solution.
1.4 SYSTEM DESCRIPTION

A. The equipment specified in this Section will have one supplier, supplying a fully coordinated system in accordance with this Section.

B. The chlorination equipment has one function:
   1. Disinfect plant effluent discharge to meet all TCEQ permit requirements.

1.5 SUBMITTALS

A. Submit as required by the Engineer.

B. Product Data:
   1. Submit product data for approval. As a minimum, include the following:
      a. Materials of Construction.
      b. Rated capacity and performance ranges.

C. Shop Drawings:
   1. Submit shop drawings in accordance with the Engineer. As a minimum, include the following:
      a. Overall dimensions and piping connection sizes for all units.
      b. Total weight for each unit.
      c. Wiring diagrams and electrical requirements as appropriate.

D. Submit complete manufacturers installation operation and maintenance instructions for each component and the system. Instructions shall include illustrative figures to adequately illustrate the procedures.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Superior
B. Capital Controls
C. Macaulay Controls
D. Wallace and Tiernan
E. Engineer approved equal

2.2 MATERIALS

A. Polyethylene tubing meeting, ASTM D-1693 with a required outside diameter. Manufacturer to review pressure drop in polyethylene tubing for chlorine under vacuum. Supply larger tubing at no extra cost to Owner if required.
B. PVC Schedule 80, Type I, piping various sizes.

C. Plastic conduit, Type II, Schedule 80 PVC with required diameter. All chlorination equipment and piping will be comprised of materials suitable for handling chlorine gas and solution, including all connections to yard piping and injection point as shown on the plans.

2.3 EQUIPMENT

A. Dual Platform 150-lb Cylinder with Digital Scales (Scaletron Industries, Force Flow or Approved Equal):

1. Supply dual platform 150-lb cylinder scales as shown on the Drawings.
2. Each dual platform scale shall be capable of accepting two standard 150-pound chlorine cylinders.
3. The anti-corrosion scales shall be of the electronic strain gauge, load-cell type equipped with two separate weighing platforms and built-in stops to prevent overload damage.
4. Each side of the platform shall have a gross weight capacity of 0-300 pounds and a tare weight capacity of 0-180 pounds.
5. Each display shall provide 3-1/2-digit, LCD characters. Electronics shall be housed in a NEMA 4X enclosure.

B. Chlorinators:

1. Provide two vacuum regulators rated at 100 pounds per day, maximum, with all components mounted within a self-contained cylinder-mounted unit. Also include one spare vacuum regulator.
2. Furnish and install one adjustable gas flow indicator (“rotometer“)/ Mount flow indicator on 3/8-inch PVC plate to be installed on wall of chlorine building. Provide 0-100 pound per day calibration on flow indicator vial.
3. Furnish and install one ejector to create a vacuum for drawing chlorine gas from the vacuum regulators.
4. Vacuum regulators to be equipped with automatic switchover function and separate venting system.
5. Each manual flow meter assembly shall contain a manually operated valve for controlling the chlorine feed rate from 0 to 100 percent of scale.
   a. Provide vertical manifold mounted to each vacuum regulator. Manifold capacity shall be 2 cylinders.
   b. Provide automatic switchover unit connected to vacuum regulators.
   c. Provide chlorine flow rate indicator with manual adjusting valves to split pre- and post-chlorine flows.
C. Ejector:
   1. Provide (duty) anti-syphon-type ejector, each to dissolve a maximum of 100 ppm of chlorine gas in water. Also include one shelf spare ejector.
   2. Components of the ejector will include a high-pressure check valve, a low-pressure check valve, and a tapered-diameter throat to produce a vacuum for the gas supply.
   3. Provide wall-mounted units suitable for continuous service with chlorine gas and water at 100 pounds per square inch gauge (psig).

D. Diffuser (N/A):
   1. Provide and install chlorine assembly capable of evenly distributing the solution into receiving pipeline.

E. Chlorine Gas Detector:
   1. Provide a wall-mounted chlorine gas detector housed in a NEMA-4 enclosure that is a Factory Mutual-approved device suitable for monitoring the air in a chlorine area.
   2. Include in the chlorine gas detector a self-contained sample blower for positive air sampling to avoid chlorine build-up in stagnant areas, and an easy-to-read flowmeter to indicate the sample is reaching the measuring cell.
   3. Supply the detector with the necessary electronic circuits to trigger an alarm condition when the chlorine concentration in the sample exceeds 1 ppm.
   4. Fix an alarm level by design to avoid unauthorized adjustments which may be harmful to personnel above the current OSHA limit.
   5. Provide the alarm with a flashing light on the front of the unit and a change in state of the relay contacts for actuation of remove devices.
   6. Include a plug-in type relay with a 120 VAC DPDT contacts rated at 10 amperes.
   7. Provide with the detector unit a chlorine gas detected warning alarm reset switch for alarm acknowledgment and a test switch to permit simple checking of the circuits.
   8. Include in the detector electrical connections to a high-level switch, a remote alarm and a remote warning light.
   9. Provide adequate ventilation and forced air according to TCEQ regulations and requirements.

F. Self-Contained Breathing Apparatus:
   1. Provide one (1) complete 30-minute supply self-contained breathing apparatus unit.
   2. Breathing apparatus shall meet N10SH/MSHIA certification TC-13F-146.
3. Provide indoor/outdoor wall case for SCBA. Case shall be yellow ABS plastic with markings indicating breathing apparatus inside.

G. Room Wall Heater: Per TCEQ Section 217.275, install a room heater to produce 65°F ambient temperature. Heater to be 220 V, commercial duty, cut into CMU wall, and meet all City building/electrical codes.

PART 3 PRODUCTS

3.1 INSTALLATION

A. Provide submittal drawings to install the chlorination equipment in accordance with the manufacturer's written instructions. Manufacturer’s Factory Authorized Representative to certify installation and operation, including operator training at startup.

B. Contractor to supply a full-face self-contained breathing apparatus or supplied air respirator that meets Occupational Safety and Health Administration (OSHA) standards for construction and operation, and a small bottle of fresh ammonia solution (or approved equal) for testing for chlorine leakage shall be readily accessible outside the chlorinator room and immediately available to the operator in the event of an emergency in accordance with 30 TAC §290.42(c)(4)(A).

C. Adequate ventilation, which includes both high level and floor level screened vents, shall be provided for all enclosures in which gas chlorine is being stored or fed. Enclosures containing more than one operating 150-pound cylinder of chlorine shall also provide forced air ventilation which includes: screened and louvered floor level and high level vents; a fan which is located at and draws air in through the top vent and discharges to the outside atmosphere through the floor level vent; and a fan switch located outside the enclosure. Contractor to perform all building modifications to meet TCEQ and City of Laredo requirements.

**Chemical Feed (Chlorination Sizing)**

\[ \text{CL}_2 \text{ Gas} \]

Max. Dose = \( \frac{1000 \text{ GPM} \times 8.34 \times 8.0 \text{ mg/L} = 96.1 \text{ lb./day}}{694 \text{ GPM/mg}} \)

Min. Dose = \( \frac{80 \text{ GPM} \times 8.34 \times 4.4 \text{ mg/L} = 3.8 \text{ lb./day}}{694 \text{ GPM}} \)

**Storage Requirements (Chlorine Cylinders)**

LBS, \( \text{CL}_2 \) GAS = 96.1 LBS/DAY x 15 DAYS = 1441.5 LBS

\( \frac{1441.5}{150\# \text{ cylinder}} \) = 9.6 cylinders (10 required)
Note: City of Laredo will provide Cl₂ gas cylinders

3.2 FIELD QUALITY CONTROL

A. Tests:
   1. Test all vacuum piping at 23 inches Hg vacuum for 4 hours.
   2. Test all solution piping with water at a minimum of 100 psi maintained for 4 hours.
   3. Subject the entire chlorination system to field operational test after installation.
   4. System operation will be satisfactory for a minimum of 48 consecutive hours.

3.3 TRAINING AND STARTUP

A. Contractor to provide Manufacture’s Factory Authorized Representative start up.

B. Provide one (1) training session for operations personnel.

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT AND PAYMENT

A. Measurement and payment for this item will be as indicated within the PROPOSAL FORM. If this item is not indicated within the PROPOSAL FORM, then it is to be considered subsidiary to the applicable sections(s).

B. Payment shall fully compensate the Contractor for all required labor, materials, equipment, supervision, insurance, maintenance, codes, laws, statues, or regulations, and all incidental expenses which are required to complete the work in place, ready-to-use and in accordance with the Drawings, Specifications, and all OSHA and TCEQ regulations and requirements.

END OF SECTION
SECTION 15 10 20

CHECK VALVES

PART 1 GENERAL

1.1 DESCRIPTION

A. This specification shall govern all work necessary for the furnishing and installation of all check valves required for liquid applications to complete the project.

B. Refer to Technical Specification 40 00 00 Positive Displacement Blower for high heat resistant check valve requirements for Air Piping.

1.2 GENERAL

A. The check valves shall be in accordance with AWWA C508 and prevent the return of fluid through the valve upon pump shut-off. It shall be Mueller Type A-2600-6-01 or an approved equal. It shall have a heavy cast, iron body with bronze clapper disc seated by a bronze clapper arm against a bronze seat ring. The clapper shall be secured to a stainless-steel shaft which turns in bronze bushings. The valve shall have 125 lb. flanged ends. The valve shall be of lever and weight operation. Prior to shipping, the contractor shall submit detailed drawings, specifications, installation instructions and maintenance instructions for the Engineer's review and approval.

1.3 FIELD SERVICE

A. The manufacturer’s field representative shall check the installation, adjust valves, and be on-hand for initial start-up of the system.

1.4 PAINTING

A. Valves shall be painted in accordance with Section 09 90 20 and manufacturer’s recommendation.

1.5 MEASUREMENT AND PAYMENT

A. Measurement and Payment for this item will be as indicated within the PROPOSAL FORM. If this item is not indicated within the PROPOSAL FORM then it is to be considered subsidiary to the applicable sections(s).

B. Payment shall fully compensate the Contractor for all required labor, materials, equipment, supervision, insurance, maintenance, codes, laws, statues, or regulations, and all incidental expenses which are required to complete the work in place, ready-to-use and in accordance with the Drawings, Specifications, and all OSHA and TCEQ regulations and requirements.

END OF SECTION
SECTION 15 10 30

PLUG VALVES

PART 1 GENERAL

1.1 DESCRIPTION

A. This specification shall govern all work necessary for the furnishing and installation of all plug valves required to complete the project. All plug valves must conform with City of Laredo standard requirements and be either Mueller, Clow American or approved equal. System accessories are also specified and to be enclosed in an existing concrete block building. Remove and replace existing equipment, as required.

1.2 GENERAL

A. All plug valves shall be non-lubricated resilient seated, quarter-turn type and provided with flanged or mechanical joint ends as required. Valves shall have a minimum nominal port area of 80% of the pipe. The valve body shall be cast-iron (ASTM-126, Grade B) providing a full circle seat area. Disc shall be ductile-iron (ASTM S-536) with upper and lower shaft integrals. The valves must provide bi-directional sealing at 175 psi differential in sizes up to 12" and 150 psi differential for sizes 14" and larger. All surfaces are to be protected, both internally and externally, with a factory coated heat fused thermostet epoxy of thermoplastic nylon. These corrosion resistant coatings shall provide protection for corrosion in the shaft areas. Valves shall be of the bolted bonnet, top entry design, capable of repacking without removing the bonnet or valve from the pipeline.

1.3 FIELD SERVICE

A. The manufacturer’s field representative shall check the installation, adjust valves, and be on-hand for initial start-up of the system

1.4 PAINTING

A. Valves shall be painted in accordance with Section 09 90 20 and manufacturer’s recommendation.

1.5 MEASUREMENT AND PAYMENT

A. Measurement and Payment for this item will be as indicated within the PROPOSAL FORM. If this item is not indicated within the PROPOSAL FORM then it is to be considered subsidiary to the applicable sections(s).

B. Payment shall fully compensate the Contractor for all required labor, materials, equipment, supervision, insurance, maintenance, codes, laws, statues, or regulations, and all incidental expenses which are required to complete the work in place, ready-to-use and in accordance with the Drawings, Specifications, and all OSHA and TCEQ regulations and requirements.

END OF SECTION
SECTION 15 43 00

EMERGENCY EYE/FACE WASH AND SHOWER EQUIPMENT

PART 1 GENERAL

1.1 DESCRIPTION

A. This specification shall govern all work necessary for the furnishing and installation for an emergency shower and eye wash station.

1.2 GENERAL

A. REFERENCE:

American National Standards Institute (ANSI):

1. Z358.1 - Emergency Eyewash and Shower Equipment

B. DEFINITIONS

NEMA:

1. Type 4 enclosure in accordance with NEMA 4X 316 Stainless Steel

C. SUBMITTALS

1. Provide Manufacturer’s Certificate of Source Testing
2. Provide Manufacturer’s Certificate of Installation and Functionality Compliance
3. Shop Drawings
4. Product Data
   a. Submit manufacturer’s product literature information for products specified
   b. Manufacturer’s installation instructions
5. Operation and Maintenance Data

D. QUALITY ASSURANCE

1. Manufacturer qualifications: Show evidence that the firm has been engaged in producing such materials and products for at least 5 years and that the product submitted has a satisfactory performance record of at least 5 years.

2. Installer qualifications: Installer shall have 3 years’ experience in installing these materials for similar projects and shall be approved by the manufacturer prior to bidding of the project.
3. Regulatory requirements: As applicable, equipment of this Section shall comply with requirements of public agencies of the State of Texas and OSHA.

B. DELIVERY, STORAGE, AND HANDLING

1. Packing and shipping: Deliver to the job site in manufacturer’s original containers.

2. Delivery: After wet operations in building are completed.

3. Storage and Protection:
   a. Store materials in original, unopened containers in compliance with manufacturer’s printed instructions.
   b. Keep materials dry until ready for use.
   c. Keep packages of material off the ground, under cover, and away from sweating walls and other damp surfaces.
   d. Protect finished surfaces from soiling and damage during handling and installation. Keep covered with a protective covering.

PART 2 PRODUCTS

2.1 PRODUCTS

A. EMERGENCY SHOWERS AND EYE/FACE WASHES

1. Combination unit emergency shower with eye/face wash:
   a. Floor mounted fixture consisting of pipe standard, showerhead assembly, and eyewash assembly.
   b. Provide stanchion and floor flange, with interconnecting piping. Provide shower/eyewash unit with integral controls to alarm the system is in use.

   i. Flow switch:
      a) Construction:
         • NEMA Type 4X.
         • Brass or Type 316 Stainless Steel.
      b) Type: Magnetic proximity switch.
      c) Alarm Contacts: Double pole, double throw contacts rated at 2.0 Amps at 120VAC configurable for either Normally Open or Normally Closed.

   ii. Control panel:
      a) Construction:
         • NEMA Type 4X.
         • Cast aluminum or 316 Stainless Steel with 3 conduit hubs.
         • Stainless steel cover plate.
      b) Silence/On - Off switch:
         • NEMA Type 4X.
• Maintain position, black, with nameplate.
• 1 set of auxiliary contacts.
  c) Power: 0.6 Amps at 120VAC

iii. Strobe:
   a) Construction:
   • NEMA Type 4X.
   • 120VAC, AMBER Flashing LED

iv. Horn:
   a) Construction:
   • NEMA Type 4X.
   • 90dB at 10 feet Audible alarm.

2. Showerhead flow: 20.0 gallons per minute flow, minimum.
3. Eye/face wash flow: 3.0 gallons per minute flow, minimum.
4. Meet or exceed all requirements of ANSI Z358.1.
5. Provide ANSI compliant identification sign and markings.

B. FREEZE RESISTANT COMBINATION UNIT EMERGENCY SHOWER AND EYE/FACE WASH

1. Manufacturers: One of the following or equal:
   a. HAWS, Model No. 8317CTFP.
   b. Guardian Equipment, Model No. GFR3100.
   c. Bradley, Model No. S19-300T.

2. Pipe standard:
   a. 1-1/4-inch 316 stainless steel pipe and fittings, wrapped with self-regulating heat cable.
   b. Encase piping and fittings in UV resistant ABS plastic jacket with internal foam insulation; 5-inch diameter floor flange.

3. Shower head:
   a. Material and size: ABS plastic, 10-inch diameter with 20 GPM flow control.
   b. Valve and actuator: Chrome plated brass stay open steel ball valve actuated by rigid stainless-steel pull rod.

4. Eye/face wash:
   a. Valve and actuator: Stay open chrome plated brass ball valve with stainless steel ball and stem operated by a stainless steel or epoxy coated aluminum push handle.
b. Heads: Twin ABS plastic or polypropylene soft-flow eye/face wash type heads, with integral flip top protective dust covers releasing with water pressure.

C. SAFETY SHOWER TESTER
   1. Manufacturers: One of the following or equal:
      a. HAWA, Model No. 9010 with No. 9009.
      b. Guardian Equipment, Model No. AP250-005.
      c. Bradley, Model No. S19-330ST.
      d. Or Approved equal
   2. Kit includes:
      a. Minimum 5-gallon plastic bucket.
      b. 7-foot-long watertight 12-gallon translucent vinyl plastic bag for attaching over drench showerhead.
         i. Bag shall have drawstring at top and be hemmed at bottom.
      c. Testing record card.

PART 3 EXECUTION

3.1 INSTALLATION
   A. Install products in accordance with manufacturers’ recommendations.
   B. Install products in accordance with code requirements and ANSI Z358.1.
   C. Install fixed equipment in accordance with manufacturer’s instructions.
   D. Plumbing and mechanical work per specifications.
   E. Electrical connections and distribution as detailed.

3.2 COMMISSIONING AND PROCESS START-UP REQUIREMENTS
   A. As specified in this Section.
   B. Manufacturers service from each Manufacturer:
   C. Provide Manufacturer’s Certificate of Source Testing.
   D. Provide Manufacturer’s Certificate of Installation and Functionality Compliance.
   E. Provide Manufacturer’s on-site services.
3.3 MEASUREMENT AND PAYMENT

A. Measurement and Payment for this item will be as indicated within the PROPOSAL FORM. If this item is not indicated within the PROPOSAL FORM then it is to be considered subsidiary to the applicable sections(s).

B. Payment shall fully compensate the Contractor for all required labor, materials, equipment, supervision, insurance, maintenance, codes, laws, statues, or regulations, and all incidental expenses which are required to complete the work in place, ready-to-use and in accordance with the Drawings, Specifications, and all OSHA and TCEQ regulations and requirements.

END OF SECTION
SECTION 15 95 60

PIPING SYSTEM TESTING

PART 1 GENERAL

1.1 DESCRIPTION

A. Section includes Test requirements for piping systems. Only Section 3.5 Testing Low-Head Pressure Piping will be applicable for this project.

1.2 QUALITY ASSURANCE

A. Meet all TCEQ and OSHA Regulations.

1.3 TESTING REQUIREMENTS

A. General Requirements:

1. Testing requirements are stipulated in Codes and Regulation

2. Requirements in Codes and Regulations supersede other requirements of Contract Documents, except where requirements of Contract Documents are more stringent, including higher test pressures, longer test times, and lower leakage allowances.

3. Test plumbing piping in accordance with Laws and Regulations, the plumbing code, as specified in Section 01410, and UL requirements.

a. For 125 pounds per square inch gauge or greater working pressure, test per ASME 831.3 or ASME 831.8, whichever is more stringent.

4. When testing with water, the specified test pressure is considered to be the pressure at the highest point of the piping section under test. Lower test pressure as necessary to prevent testing the lowest point above a safe test pressure.

B. Furnish necessary personnel, materials, and equipment, including bulkheads, restraints, anchors, temporary connections, pumps, water, pressure gauges, and other means and facilities required to perform tests.

C. Water for Testing, Cleaning, and Disinfecting:

1. Water for testing, cleaning, and disinfecting will be provided by the Owner.

D. Pipes to be Tested: Test only those portions of pipes that have been installed as part of this Contract. Test new pipe sections prior to making final connections to existing piping. Furnish and install test plugs, bulkheads, and restraints required to isolate new pipe sections. Do not use existing valves as test plug or bulkhead.
E. Unsuccessful Tests:
   1. Where tests are not successful, correct defects or remove defective piping and appurtenances and install piping and appurtenances that comply with the specified requirements.
   2. Repeat testing until tests are successful.
   3. All testing is subsidiary to the contract.

F. Test Completion: Drain and leave piping clean after successful testing. Follow all regulations for disposal of any liquids used for testing.

G. Test Water Disposal: Dispose of testing water in accordance with requirements of federal, state, county, and city regulations governing disposal of wastes in the location of the Project and disposal site.

1.4 SUBMITTALS

A. Submit in accordance with specifications.

B. Schedule and Notification of Tests:
   1. Submit a list of scheduled piping tests by noon of the working day preceding the date of the scheduled tests.
   2. Notification of Readiness to Test: Immediately before testing, notify ENGINEER in writing of readiness, not just intention, to test piping. Have personnel, materials, and equipment specified in place before submitting notification of readiness.

1.5 SEQUENCE

A. Clean piping before pressure or leak tests.

B. Test gravity piping underground, including sanitary sewers, for visible leaks before backfilling and compacting.

C. Underground pressure piping may be tested before or after backfilling when not indicated or specified otherwise.

D. Backfill and compact trench or provide blocking that prevents pipe movement before testing underground piping with a maximum leakage allowance.

E. Test underground piping before encasing piping in concrete or covering piping with slab, structure, or permanent improvement.
PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 TESTING ALIGNMENT, GRADE, AND DEFLECTION

A. Alignment and Grade:
   1. Visually inspect the interior of gravity piping with artificial light, reflected light, or laser beam.
   2. Consider inspection complete when no broken or collapsed piping, no open or poorly made joints, no grade changes that affect the piping capacity, or no other defects are observed.

B. Deflection Test:
   1. Pull a mandrel through the clean piping section under test.
   2. Perform the test not sooner than 30 days after installation and not later than 60 days after installation.
   3. Use a 9-rod mandrel with a contact length of not less than the nominal diameter of the pipe within one percent plus or minus.
   4. Consider test complete when the mandrel can be pulled through the piping with reasonable effort by 1 person, without the aid of mechanical equipment.

3.2 AIR TESTING METHOD FOR PRESSURE PIPING (N/A)

A. Air test piping, indicated with "AM" in the Piping Schedule, with air or another nonflammable or inert gas.

B. Test gas, air, liquefied petroleum gas, liquid chlorine, and chlorine gas piping by the air test method:
   1. Test chlorine piping with dry air or nitrogen having a dew point of minus 40 degrees Fahrenheit or less. Supply temporary air dryers as necessary.

C. Test at pressure required to meet City Standards:
   1. Provide temporary pressure relief valve for piping under test. Set at the lesser of 110 percent of the test pressure or 50 pounds per square inch gauge over the test pressure.
   2. Air method test pressures shall not exceed 110 percent of the piping maximum allowable working pressure calculated in accordance with the most stringent of ASME B31.1, ASME B31.3, ASE B31.8, or the pipe manufacturer's stated maximum working pressure.
3. Gradually increase test pressure to an initial test pressure equal to the lesser of one-half the test pressure or 25 pounds per square inch gauge.

4. Perform initial check of joints and fittings for leakage.

5. Gradually increase test pressure in steps no larger than the initial pressure. Check for leakage at each step increase until test pressure reached.

6. At each step in the pressure, examine and test piping being air tested for leaks with soap solution.

7. Consider examination complete when piping section under test holds the test pressure for 15 minutes without losses.

3.3 TESTING GRAVITY FLOW PIPING (N/A)

A. Test Gravity Flow Piping, as required to meet City Standards as Follows:

1. Unless Specified Otherwise, Subject Gravity Flow Piping to the Following Tests:
   a. Alignment and grade.
   b. For plastic piping test for deflection.
   c. Visible leaks and pressure with maximum leakage allowance, except for storm drains and culverts.

2. Inspect piping for visible leaks before backfilling. Provide temporary restraints when needed to prevent movement of piping. Pressure test piping with maximum leakage allowance after backfilling.

3. With the lower end plugged, fill piping slowly with water while allowing air to escape from high points. Keep piping full under a slight head for the water at least 24 hours.
   a. Examine piping for visible leaks. Consider examination complete when no visible leaks are observed.
   b. Maintain piping with water, or allow a new water absorption period of 24 hours for the performance of the pressure test with maximum leakage allowance.
   c. After successful completion of the test for visible leaks and after the piping has been restrained and backfilled, subject piping to the test pressure for minimum of four hours while accurately measuring the volume of water added to maintain the test pressure.

1) Consider the test complete when leakage is equal to or less than the following maximum leakage allowances:
   a) For Concrete Piping with Rubber Gasket Joints: 80 gallons per day per inch of diameter per mile of piping under test.
      (1) Advise manufacturer of concrete piping with rubber gasket joints of more stringent than normal maximum leakage allowance.
   b) For Vitrified Clay and Other Piping: 500 gallons per day per inch of diameter per mile of piping under test.
1.2 TESTING HIGH-HEAD PRESSURE PIPING (N/A)

A. General:

1. Test connections, hydrants, valves, blowoffs, and closure pieces with the piping.
2. Do not use installed valves for shutoff when the specified test pressure exceeds the valve's maximum allowable seat differential pressure. Provide blinds or other means to isolate test sections.
3. Do not include valves, equipment or piping specialties in test sections if test pressure exceeds the valve, equipment or piping specialty safe test pressure allowed by the item's manufacturer.
4. During the performance of the tests, test pressure shall not vary more than plus or minus 5 pounds per square inch gauge with respect to the specified test pressure.
5. Select the limits of testing to sections of piping. Select sections that have the same piping material and test pressure.
6. When Test Results Indicate Failure of Selected Sections, Limit Tests to Piping:
   a. Between valves,
   b. Between a valve and the end of the piping,
   c. Less than 500 feet long.
7. Test piping for minimum 2 hours for visible leaks test and minimum 2 hours for the pressure test with maximum leakage allowance.

B. Testing Procedures:

1. Fill piping section under test slowly with water while venting air. Use potable water for all potable waterlines and where noted on the Piping Schedule.
2. Before pressurizing for the tests, retain water in piping under slight pressure for a water absorption period of minimum 24 hours.
3. Raise pressure to the specified test pressure and inspect piping visually for leaks. Consider visible leakage testing complete when no visible leaks are observed.

C. Pressure Test with Maximum Leakage Allowance:

1. Leakage allowance is zero for piping systems using flanged, National Pipe Thread threaded and welded joints.
2. Pressure test piping after completion of visible leaks test.
3. For piping systems using joint designs other than flanged threaded or welded joints, accurately measure the makeup water necessary to maintain the pressure in the piping section under test during the pressure test period.
d. Consider the pressure test to be complete when makeup water added is less than the allowable leakage and no damage to piping and appurtenances has occurred.

e. Successful completion of the pressure test with maximum leakage allowance shall have been achieved when the observed leakage during the test period is equal or less than the allowable leakage and no damage to piping and appurtenances has occurred.

f. When leakage is allowed, calculate the allowable leakage by the following formula:

\[
L = S \times D \times \frac{P}{2} \times \frac{133,200}{2}
\]

wherein the terms shall mean:

- \( L \) = Allowable leakage in gallons per hour.
- \( S \) = Length of the test section in feet.
- \( D \) = Nominal diameter of the piping in inches.
- \( P \) = Average observed test pressure in pounds per square inches, gauge, at the lowest point of the test section, corrected for elevation of the pressure gauge.
- \( \times \) = The multiplication symbol.

1.3 TESTING LOW-HEAD PRESSURE PIPING

A. General:

1. Test pressures shall be as required to meet City Standards.

2. During the performance of the tests, test pressure shall not vary more than plus or minus 2 pounds per square inch gauge with respect to the specified test pressure.

3. Test connections, blowoffs, vents, closure pieces, and joints into structures, including existing bell rings and other appurtenances, with the piping.

4. Test piping for minimum 2 hours for visible leaks test and minimum 2 hours for the pressure test with maximum leakage allowance.

B. Visible Leaks Test:

1. Subject piping under test to the specified pressure measured at the lowest end.

2. Fill piping section under test slowly with water while venting air. Use potable water for all potable waterlines and where noted on the Piping Schedule.
3. Before pressurizing for the tests, retain water in piping under slight pressure for the water absorption period of minimum 24 hours.

4. Raise pressure to the specified test pressure and inspect piping visually for leaks. Consider testing complete when no visible leaks are observed.

C. Pressure Test with Maximum Leakage Allowance:

1. Pressure test piping after completion of visible leaks test.

2. Accurately measure the makeup water necessary to maintain the pressure in the piping section under test during the pressure test period.
   a. Consider the pressure test to be complete when makeup water added is less than the allowable leakage of 80 gallons per inch of nominal diameter, per mile of piping section under test after 24 hours and no damage to piping and appurtenances has occurred.
   b. Successful completion of the leakage test shall have been achieved when the observed leakage is equal or less than the allowable leakage and no damage to piping and appurtenances has occurred.

D. Optional Joint Test:

1. When joint testing is allowed by note in the piping schedule, the procedure shall be as follows:
   a. Joint testing will be allowed only for low head pressure piping.

2. Joint testing may be performed with water or air.

3. Joint test piping after completion of backfill and compaction to the top of the trench.

4. Joint Testing with Water:
   a. Measure test pressure at the invert of the pipe. Apply pressure of 4 feet plus the inside diameter of the pipe in water column within 0.20 feet in water column.
   b. Maintain test pressure for one minute.
   c. Base the allowable leakage per joint on 80 gallons per inch nominal diameter, per mile of piping, per 24 hours equally distributed to the actual number of joints per mile for the type of piping.
   d. Consider the pressure test to be complete when makeup water added is less than the allowable leakage.
   e. Successful completion of the joint test with water shall have been achieved when the observed leakage is equal or less than the allowable leakage.
5. Joint Testing with Air:
   a. Apply test pressure of 3 pounds per square inch gauge with a maximum variation
      of plus 0.20 and minus 0.00 pounds per square inch.
   b. Maintain test pressure for 2 minutes.
   c. Consider the pressure test to be complete when the test pressure does not drop
      below 2.7 pounds per square inch for the duration of the test.

1.4 TEST PROCEDURE

A. Adhere to all requests of TCEQ chapter 290 and AWWA C600 and C605 latest edition. Tests
   shall be made only after completion of backfill as specified, and not until at least thirty-six (36)
   hours after the last concrete thrust block has been cast. Contractor shall coordinate hydrostatic
   testing with the proposed construction sequencing and phasing.

B. Each section of pipeline shall be slowly filled with water and the specified test pressure,
   measured at the point of lowest elevation, shall be applied. During the filling of the pipe and
   before applying the specified test pressure, all air shall be expelled from the pipeline.

C. During the test, all exposed pipe, fittings, valves, hydrants and joints shall be carefully
   examined. If found to be leaking, they shall be corrected immediately by the Contractor. If the
   leaking is due to cracked or defective material, the defective material shall be removed and
   replaced by the Contractor with sound material.

D. All pipes shall be subjected to two hydrostatic tests. The first hydrostatic test shall be a two-
   hour test at a pressure of 150 psi. The second test shall be no less than 48 hours after successful
   completion of the first hydrostatic test. The second hydrostatic test shall be for a 24-hour period
   at City operating pressure for waterlines or at 50 psi for sanitary sewer force mains and effluent
   lines.

E. Coordinate with City and Engineer for all required inspections and approvals prior to and during
   testing.

The maximum allowable leakage shall be as follows:

Ductile Iron Pipe, AWWA C600

\[ L = \frac{S \cdot D \cdot (P)^{\frac{1}{5}}}{148,000} \]

PVC Pipe – AWWA C605

\[ Q = \frac{L \cdot D \cdot (P)^{\frac{1}{5}}}{148,000} \]
WHERE:

L = Testing Allowable (makeup water) (gallons/hour)
S = Length of Pipe Tested (feet)
N = Number of Joints in Tested Line (pipe and fittings)
D = Nominal Diameter of Pipe (inches)
P = Average Test Pressure (psi)
Q = Quantity of makeup water (gallons/hour)

If the pressure system fails to meet the leakage requirements, the Contractor shall make the required repairs to the system and the system shall be retested. This procedure shall be repeated until the system complies with leakage requirements. The cost of each retest shall be paid as required by the City.

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT AND PAYMENT

A. Measurement and payment for this item will be as indicated within the PROPOSAL FORM. If this item is not indicated within the PROPOSAL FORM, then it is to be considered subsidiary to the applicable section(s).

B. Payment shall fully compensate the Contractor for all required labor, materials, equipment, supervision, insurance, maintenance, codes, laws, statues, or regulations, and all incidental expenses which are required to complete the work in place, ready-to-use and in accordance with the Drawings, Specifications, and all OSHA and TCEQ regulations and requirements.

END OF SECTION
SECTION 22 32 19
RETURN ACTIVATED SLUDGE PUMPS

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required and install, complete and ready for operation one (1) Return Activated Sludge centrifugal pump (RASP 3) as shown on the Drawings and specified herein.

1.2 EQUIPMENT TAGS

A. RASP-01: (existing)
B. RASP-02: (existing)
C. RASP-03: Return Activated Sludge Pump No. 3 (RASP 3 – This contract)

1.3 RELATED WORK

A. Concrete foundation pad
B. Tie-in at existing RAS pipeline
C. RAS suction buried pipeline and suction header
D. RAS discharge header and flow meter
E. RAS pipeline to discharge at Aeration Basin and Digester
F. Electrical wiring and controls

1.4 SUBMITTALS

A. Submit copies of all materials required to establish compliance with the specifications. Submittals shall include the following:

1. Certified shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations.

2. Descriptive literature, bulletins, and catalogs of the equipment.

3. Data on the characteristics and performance of the pump. Data shall include guaranteed performance curves, based on actual shop tests of duplicate units, which show that they meet the specified requirements for head, capacity, efficiency,
allowable NPSH, allowable suction lift, and horsepower. Curves shall be submitted on 8 1/2-in by 11-in sheets.

4. The total weight of the equipment including the weight of the single largest item.

5. A complete total bill of materials for all equipment.

6. A list of the manufacturer's recommended spare parts with the manufacturer's current price for each item. List all bearings by the bearing manufacturer's numbers only.

7. A statement indicating bearing life.

8. Complete data on motors.


10. In the event that it is impossible to conform to certain details of the specifications because of different manufacturing techniques, describe completely all nonconforming aspects.

1.5 OPERATION AND MAINTENANCE MANUALS

A. Furnish operation and maintenance manuals for the equipment in accordance with the Contact Documents. As a minimum, the following information shall be included:

1. Certified shop and erection drawings showing all important details of construction, dimensions, and anchor bolts locations.

2. Descriptive literature, bulletins, and/or catalogs of the equipment.

3. The total weight of the equipment including the weight of the single largest item.

4. Materials of construction of all parts.

5. A complete total bill of materials for all equipment.

6. A list of the manufacturer’s recommended spare parts.

1.6 REFERENCE STANDARDS

A. American Bearing Manufacturers Association (ABMA).

B. American Iron and Steel Institute (AISI):

1. Type 316 Stainless Steel.

2. Type 1045 Carbon Steel.
C. ASTM International (ASTM):

D. Hydraulic Institute Standards (HIS).

E. Institute of Electrical and Electronics Engineers (IEEE): 112, Standard Test Procedure for Polyphase Induction Motors and Generators.

F. National Electrical Manufacturer’s Association (NEMA): MG 1, Motors and Generators.

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

1.7 QUALITY ASSURANCE

A. All pumps shall be manufactured in accordance with all applicable standards of the Hydraulic Institute.

1.8 MANUFACTURERS

The Horizontal Screw Centrifugal Pump shall be furnished by:

   1. Hidrostal USA with pump assembly, HVES, D3K-S non-regulable wet end, hi-chrome construction, MAT 4, D0M bearing frame MAT 1, flushless tandem seal, Hidrostal Type M, D0M D3K-S4+D0M1), and a premium efficiency TEFC motor, 213 frame, 208-230/460.

   2. Engineer approved equal/

1.9 DESCRIPTION OF SYSTEMS

A. All the equipment specified herein is intended to be standard equipment for pumping sludge as described below:

   1. Pumping return activated sludge from RAS pump suction header to the Aeration Basin.

B. The pumps shall have the following operating criteria:
Return Activated Sludge Service (variable speed)

<table>
<thead>
<tr>
<th>Design Condition</th>
<th>Flow GPM</th>
<th>TDH FT</th>
<th>Solids Passage Sphere</th>
<th>Suction Diameter</th>
<th>Discharge Diameter</th>
<th>Motor Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aeration Basin A</td>
<td>188</td>
<td>15.3</td>
<td>2.25&quot;</td>
<td>3&quot;</td>
<td>3&quot;</td>
<td>3 hp</td>
</tr>
<tr>
<td>Aeration Basin B</td>
<td>188</td>
<td>10.6</td>
<td>2.25&quot;</td>
<td>3&quot;</td>
<td>3&quot;</td>
<td>3 hp</td>
</tr>
</tbody>
</table>

Note: The RAS pumps will be driven by Variable Frequency Drive (VFD)

1.10 DELIVERY, STORAGE, AND HANDLING

A. Delivery, storage and handling of equipment shall be as specified herein.

B. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the unit and equipment are ready for operation.

C. All equipment and parts shall be properly protected against any damage during shipment. The Contractor shall store equipment in accordance with the manufacturer's instructions.

D. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.

E. The finished surfaces of all exposed flanges shall be protected by wooden or equivalent blank flanges, strongly built and securely bolted thereto.

F. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

G. For protection of bearings during shipment and installation, the bearing shall be properly processed. Anti-friction bearings, if pre-lubricated, shall be protected in accordance with the bearing manufacturer's recommendations against formation of rust during a long period of storage while awaiting completion of installation and start-up of the machine in which they are used. Anti-friction bearings which are not pre-lubricated shall be properly treated in accordance with the bearing manufacturer's recommendation against formation of rust during along period of storage while waiting completion of installation and start-up by the application of Exxon Rust-Ban No. 392, or equal treatment.
1.11 WARRANTY

The equipment supplier shall warrant that its equipment shall be free from defects in material and workmanship; and that it will replace or repair any part or parts shown to have failed under normal use and service by the user within 18 months following initial shipment or 12 months following operation start up, whichever occurs first.

1.12 DESCRIPTION

A. The specifications in this section include all components of the Diffused Aeration System Assemblies including the individual diffuser units. These assemblies are to be installed in the Unitec existing wastewater treatment facility Aeration Tank No.1 and No.2 and also the modified Clarifier zone.

B. The complete lift-out manifold assembly shall be supplied by the Aeration Diffuser Manufacturer to maintain single source responsibility for the system. The complete assembly shall be defined as beginning at the top RX roll groove of the air supply drop pipe section through all submerged piping, wall brackets, cradle supports, diffusers and any other equipment specified within this section of the specifications. The assemblies shall include a Victaulic butterfly valve Series 461 at the top of each drop pipe. The approved manufacturer for this system to be included within the Base Bid shall be manufactured by Tideflex Technologies (A Division of Red Valve Company), Pittsburgh, PA (412-279-0044) and supplied by Newman Regency Group, Austin, Texas (512-656-1587).

B. The Aeration Diffuser Manufacturer shall have at least ten installations using the equipment in a similar treatment process and have ten years of installation experience with the proposed diffuser equipment and system. Manufacturers not meeting this requirement will be rejected.

1. These diffuser assemblies are to be installed in wastewater process tanks and will be subjected to loads produced by lateral hydraulic flows containing solids, debris, grit and fibrous accumulations. It is the intent of these specifications to define equipment capable of withstanding the forces and conditions subject to occurring within these structures. Thermoplastic components will not be allowed on any portion of the assembly including diffuser units.

2. These specifications outline the equipment used in the design basis as well as requirements of alternate equipment. The Engineer reserves the right to request certified tests results of a complete manifold assembly tested to the conditions specified within this section and or sample diffusers of all alternate equipment submittals. Alternate submittals failing to comply with the requirements defined within these specifications shall be rejected. Rejected alternate submittals shall not be resubmitted nor shall any extensions in project completion schedule be granted in reference to resubmittal approvals.

3. Alternate diffusers, even if listed by name, shall comply with the performance specifications in this section, specifically backflow prevention of liquids and solids through the discharge orifice(s) of the diffuser.
4. Design Requirements: The aeration system manufacturer shall provide the airflow distribution design calculations, within the submittal documents, for the submerged portion of the distribution piping and the associated orifice port sizing in reference to the applied duckbill style diffuser.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. General

1. The equipment covered by this section is intended to be standard pumping equipment of proven ability as manufactured by reputable concerns having long experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods, and shall operate satisfactorily when installed as shown on the Drawings.

2. All parts shall be so designed as to have liberal strength, stability and stiffness and to be especially adapted for the work to be done. Ample room and facilities shall be provided for inspection, repairs, and adjustment.

3. Pump bases shall be rigidly and accurately anchored into position and all necessary foundation bolts, plates, nuts, and washers shall be furnished by the equipment manufacturer and installed by the Contractor. Anchor bolts, nuts, and washers shall be of Type 316 stainless steel.

4. Stainless steel nameplates giving the name of the manufacturer, the rated capacity, head, speed, and any other pertinent data shall be attached to each pump.

5. The nameplate ratings for the motors shall not be exceeded, nor shall the design service factor be reduced when its pump is operating at any point on its characteristic curve.

6. The manufacturer shall supply all motors and factory mount them on a common base plate with the pumps.

7. Pumps and pump bases shall have suitable provisions to collect leakage and permit it to be drained away.

8. All pump assembly bolts shall be 304 stainless steel.

B. Pumps

1. The pumps shall be of the horizontal, direct driven, heavy duty, non-clogging, single suction, helical screw, dry pit centrifugal type.
2. The pumps shall incorporate an impeller which combines the action of a positive displacement screw and a single vane centrifugal impeller. The design shall permit low liquid velocities and gradual acceleration and change of flow direction of the pumped media. The impeller/casing design shall result in a single helical passage free of surfaces to which solid or fibrous material can adhere. The overall pump design shall combine high efficiency, low required NPSH, large passage ways, and the ability to efficiently handle high concentrations of fibrous soft solids.

3. The impeller flange or impeller shall contain a spiral groove on the rear face so that any solids in the pumped media are discharged from the space between the back plate and the rear of the impeller.

4. The pump casing shall be of closed-grained cast iron, ASTM A 48-CL30. The casing shall be end type suction and vertical up discharge. Suction and discharge shall have ANSI 125 lb. standard flanges. The casing shall be equipped with all necessary vent and drain connections. The casing and bearing frame shall be of the back pull-out design to allow disassembly of the pump without disturbing the piping. The suction casings shall incorporate a replaceable suction liner of minimum 450 Brinell Hi-Chrome iron, ASTM A532, Class III Type A1. The clearance between the impeller and liner or casing shall be externally adjustable. The geometry of the impeller and housing or liner shall be conical, so that axial adjustment will adjust the clearance uniformly along the entire length of the impeller.

5. The impeller shall be 450 Brinell hardness hi-chrome Iron, ASTM A 532-CL.III Type A1, statically and dynamically balanced. The impeller shall be mounted on an impeller flange by means of a pinned and registered fit at the periphery. The impeller shall be secured by an impeller bolt. The impeller flange shall be secured to the shaft by a nut and woodruff key. The impeller flange shall have a machined eccentric spiral groove on the rear face such that any solids in the pumped media are discharged from the space between the bearing housing and the rear of the impeller.

6. The pump shaft shall be 316 stainless steel, amply proportioned for all thrusts and moments which may occur during operation at all speeds. The shaft shall be protected throughout the packing area by a removable 11 to 13 percent chrome hardened stainless steel shaft sleeve. An O-ring or other approved means shall be used to prevent leakage between the shaft and sleeve. The shaft sleeve shall be easily removable, snug fitting, and positively secured to the shaft so as to prevent relative rotation.

7. The bearing housing shall be of cast grey iron, ASTM A48, Class 30. The pump shaft shall be supported on radial and thrust bearings, designed for an American Bearing Manufacturer’s Association B-10 life of 50,000 hours. Bearings shall be grease lubricated, and suitable provisions shall be made for regreasing, unless bearings are permanently sealed. Bearings shall be enclosed in a dust and moisture proof housing.

C. Shafting Seal
Shaft sealing shall be by independently-mounted, tandem mechanical seals contained in an oil chamber that is formed as an intrinsic part of the bearing frame and allows the seals to be completely submerged in and lubricated by the oil bath. Externally-mounted oil reservoirs are not acceptable.

1. The mechanical seal nearest the bearing shall utilize carbon/ceramic face, and shall isolate the seal cooling oil from the bearing frame. When mounted in a vertical configuration, this shall allow the pump to operate continuously when submerged within 4” of the upper bearing cap.

2. To prevent fouling from hair and other fibers, the mechanical seal nearest the impeller shall shield the stainless steel spring which loads the seal face from the pumped fluid. The seal faces shall be a solid tungsten carbide rotating face running against a solid silicon carbide stationary face. Seals with both faces of similar materials, or seals with bonded, soldered, or converted face surfaces are not equal or acceptable.

3. The mechanical seal nearest the impeller shall be contained in a seal chamber formed by the impeller flange and a recess cast into the bearing frame. To prevent debris from entering the chamber and to prolong the mechanical seal life, a flush port shall be provided so that an optional external water flush can be supplied directly into the seal chamber.

4. “Back to back" mounted double mechanical seals are not acceptable unless the contractor provides an approved seal pressurization system that guarantees the fluid between the seals is always pressurized to at least 1-1/2 times the maximum shut-off head of the pump.

5. Each pump shall be supplied complete with a plastic tube mounted such that the oil level in the seal chamber can be viewed from the outside of the pump. The tubing shall run from the fill port of the oil chamber to the drain port of the oil chamber, around the periphery of the seal chamber case such that it can be viewed from the outside of the oil case. The fittings at the fill port and drain port shall be of a ‘T’ configuration such that one leg of the T is threaded into the case, one leg of the T shall be connected to the clear tubing using compression type fittings, and one leg of the T shall be capped so that it can be utilized to fill or drain the oil chamber. The tubing shall be clear ¼ inch plastic or nylon tubing. The fittings shall be plastic. All components shall be resistant to petroleum based oil in the oil chamber.

D. Pump Drive Units

1. A side mount V-belt drive assembly between the pump and motor shall be furnished as shown on the Drawings. The pump manufacturer shall provide a common pump and motor base constructed of a minimum of 3/8 inch thick fabricated steel, suitably reinforced to support the full weight of the motor, pump, belt drive and guard. The fabricated steel base shall be hot dipped galvanized after fabrication.
2. No sheaves allowed. VFD required for speed adjustment.

3. An approved fiberglass belt guard shall be provided to safely enclose the belt drive.

E. Motors

Each return sludge pump shall be driven by a single speed 3 HP, totally enclosed fan-cooled, constant torque, premium efficiency motor wired for 460 volt, 60 cycle, 3 phase current and suitable for VFD application. The motors shall be rated at 40°C ambient with Class F insulation and shall have a Class B temperature rise at full load. The motor shall have a service factor of 1.15 service factor on VFD supplied power and shall comply with the applicable provision of the Standards of NEMA. The minimum AFBMA B₁₀ bearing life shall be 50,000 hours. The nominal motor speed shall be 1800 rpm. The motor to be inverter rated.

2.2 CONTROLS

A. The pump supplier shall furnish a NEMA 4X stainless steel control panel with a three point latch to operate the return sludge pumps. No controls, switches or indicator will be on the exterior of the panel. These will be on the interior swing out door inside of the panel. The panel shall include all accessories and controls for VFD that will be installed in and supplied for RASP 3.

B. The pump control panel shall include a main disconnect switch, control transformer, phase monitor, auxiliary contacts to remotely monitor run/off status and a side mounted air conditioner sized for an ambient air temperature of 105 degrees F. The panel shall include for each pump a Start and a Stop Push Buttons, as well as Red “OFF” and Green “ON” lights to indicate whether or not the pump is running. An alarm beacon shall be mounted on top of the panel. The control panel shall be factory wired with clearly identified industrial type terminal strips for all external field connections. The panel shall include a lightning arrestor, enclosure light and a GFCI receptacle.

C. The Panel shall house the pumps VFDs, line reactors, as well as a NEMA rated combination starter for bypass, appropriately sized for the pump motor. A VFD potentiometer, a selector switch between “VFD” and “Bypass”, as well as a Green light for “Pump XX VFD”, a Red light for Pump XX ACL Bypass”, an Amber light for “Pump XX VFD Fault” and a Red light for “Pump XX Bypass Overload” shall be supplied for each pump.

2.3 GAUGES

Contractor to provide indicating gauges and its accessories as required by the plans and at a minimum it shall include a discharge liquid filled pressure gauge (for pressure ranges of 0 to 15 psi. The gauge shall be installed with:

A. Pressure Snubber: Sintered stainless steel snubber threaded into gauge socket or in external stainless steel housing with 1/4-inch NPT male and female connections.
B. Process Isolation: Provide non-blowout stem, adjustable packing gland, quarter turn, full port Bronze Body ball valve.

2.4 PAINTING

A. The sludge pumps shall be factory prime painted prior to shipping with one (1) coat, 6.0 to 8.0 dry mils of Tnemec Series N69 Hi-Build Epoxoline II or equal.

B. Finish painting will be done in the field with one (1) coat, 3.0 to 5.0 dry mils of Tnemec Series 1074 Endura-Shield II or equal.

C. All DI piping and fittings will be field coated with the same coating system.

2.5 ACCESSORIES

A. Lifting Lugs: required for all equipment weighing over 100 pounds.

B. Anchor Bolts: Type 316 stainless steel, sized and provided by equipment manufacturer, 1/2 – inch minimum diameter.

2.6 FACTORY INSPECTION AND TESTS

Factory performance testing shall be conducted in the manufacturer's shop, to show satisfactory mechanical operation of pumps. Each pump shall be tested to show operation of the unit and hydraulic performance in strict accordance with the specifications. Tests shall be performed in accordance with the latest edition of the Hydraulic Institute Standards.

A. Each pump shall be tested through the full range of flow and shall extend at least to pump maximum flow capacity. Pumps shall be run at shut-off. Test data shall be taken at a sufficient number of points to determine curves for head, capacity, efficiency, and brake horsepower. During each test, the pump shall be run at each head condition for sufficient time to accurately determine discharge, head, power input, and efficiency. The tested pump shall be modified until the foregoing conditions are met.

B. All test procedures shall be in accordance with factory test procedures specified above, and four copies of certified results of tests shall be submitted to the Engineer.

C. A failure of the pump meeting the operating requirements specified for any reason shall be considered an incomplete test. Upon correction of the problem causing failure, the pump shall be retested.
PART 3 EXECUTION

3.1 INSTALLATION

A. Installation shall be in strict accordance with the 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 by the Contractor in accordance with the manufacturer's recommendations.

B. The pump bases shall be installed on concrete pads and shall be securely attached thereto. During installation, the pump bases shall be supported on temporary supports and non-shrink grout shall be placed under the equipment base. After cure of the grout, the temporary supports shall be removed, and the nuts on the anchor bolts shall be tightened securely. Nuts placed on the anchor bolts below the pump base plate shall be backed off such that the grout will bear the full weight of the pump.

C. Submit a certificate from the manufacturer stating that the installation has been found to be in complete accordance with the manufacturer's requirements, that the equipment is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication, and care of the equipment.

3.2 SERVICE

The equipment manufacturer shall provide a factory trained field service representative to inspect the installation and operation of the sludge pumps. In addition, the field service representative shall instruct the owner's personnel in the proper operation and maintenance of the equipment. As a minimum, the manufacturer's field service representative must be available for Two (2) days of service in two (2) separate trips.

END OF SECTION
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NON-POTABLE WATER PUMP STATION

PART 1 GENERAL

1.1 Work under this section includes, but is not limited to, furnishing and installing a non-potable pump station as indicated on the project drawings and herein specified for proper and complete system performance.

1.2 REFERENCES

A. Publications listed below form part of this specification to extent referenced in the text by basic designation only. Consult latest edition of publication unless otherwise noted.

1. American National Std. Institute (ANSI) / American Water Works Assoc. (AWWA)
   a. ANSI B16.1 Cast iron pipe flanges and flanged fittings.
   b. ANSI/AWWA C115/A21.51 Cast/ductile iron pipe with threaded flanges.
   c. ANSI 251.1 Safety Color Code for Marking Physical Hazards.
   d. ANSI B40.1 Gages, Pressure and Vacuum.
   e. AWWA C508 Single Swing Check Valves.

   a. ASTM A48 Gray iron castings.
   b. ASTM A126 Valves, Flanges, and Pipe Fittings
   c. ASTM A307 Carbon Steel Bolts and Studs.

3. Institute of Electrical and Electronics Engineers (IEEE)
   a. ANSI/IEEE Std 100 Standard Dictionary of Electrical Terms.

   b. NEMA Std MG1 Motors and Generators.

5. Miscellaneous References
   a. Hydraulic Institute Std for Centrifugal, Rotary and Reciprocating Pumps.

1.3 SYSTEM DESCRIPTION

A. Contractor shall furnish and install one automatic non-potable pump station (NPW). The station shall be complete with all equipment specified herein.

B. Principal items of equipment shall include two horizontal, self-priming, centrifugal non-potable water pumps, motors, piping, valves, motor control panel, automatic pump control system, and integral wiring with 500 usable Gallon bladder tank, concrete foundation and magnetic meter.

1.4 PERFORMANCE CRITERIA

A. Pumps must be designed to handle screened and treated domestic sanitary sewage for Plant NPW use. Piping shall include 3” pvc Bronze Saddle (double strap) suction connection, and 2” schedule 80 pvc discharge connection. Each pump shall be selected to perform under following operating conditions.
1. Capacity (GPM) 80
2. Pressure (PSI/TDH) 60/143.7

B. Contractor to furnish site power to pump station and shall be 3 phase, 60 hertz, 460 volts, 4 wire. Voltage tolerance shall be plus or minus 10 percent. Phase-to-phase unbalance shall not exceed 1% average voltage as set forth in NEMA Standard MG-1. Control voltage shall not exceed 132 volts.

C. All above ground Header Piping to be flanged Ductile Iron (D.I.) class 52.

1.5 SUBMITTALS
A. Product Data
1. Prior to fabrication, pump station manufacturer shall submit 2 copies of submittal data for review and approval.

2. Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: Catalog cuts sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor and v-belt drive data, pump characteristic curves showing the design duty point capacity (GPM), head (FT), net positive suction head required (NPSHr), and hydraulic brake horsepower (BHP).

B. Shop drawings shall provide layout of mechanical equipment. Contractor piping connections and station access clearances shall be dimensioned. The electrical ladder logic drawings shall illustrate motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.

C. Operations Maintenance Manuals
1. Installation shall be in accordance with written instructions for the system. Include O&M procedure for pumps, motors, hydro-pneumatic tank, piping, valves, and all other equipment.

2. Documentation shall be specific to the pump station equipment supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects the NPW station.
   a. Functional description of each major component, complete with operating instructions.
   b. Instructions for operating pumps and pump controls in all modes of operation.
   c. Calibration and adjustment of equipment for initial start-up, level control components, as required for operation.
   d. Electrical schematic diagram of the pump station circuits shall be in accordance with electrical standards. Schematics shall illustrate, control and alarm system
circuits including interconnections. Wire numbers and legend symbols shall be shown.

e. Mechanical layout schematic of the pump station and components, provide installation dimensions and location of all pumps, motors, valves, tank and piping.

3. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

1.6 QUALITY ASSURANCE

A. Performance

1. Consideration shall be given to the NPW sanitary sewage service anticipated, in which debris may lodge between the suction check valve and its seat, resulting in the loss of the pump suction leg, and siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal, and the pump must be capable of automatic, unattended operation with an air release line installed.

2. During unattended operation, the pump shall retain adequate liquid in the casing to insure automatic re-priming while operating at its rated speed in a completely open system.

3. Pump must re-prime approximately six (6) vertical ft. at the required speed and impeller diameter. Reprime lift is defined as the static height of the pump suction above the liquid, while operating with only one-half of the liquid remaining in the pump casing. The pump must reprime and deliver full capacity within five minutes after the pump is energized in the reprime condition. Reprime performance must be confirmed with the following test set-up:

a. A check valve to be installed down stream from the pump discharge flange. The check valve size shall be equal (or greater than) the pump discharge diameter.

b. Air release valve shall be installed between pump and the discharge check valve.

c. Impeller clearances shall be set as recommended in the pump service manual.

d. Repeatability of performance shall be demonstrated by testing five consecutive reprime cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle.

e. Liquid to be used for reprime test shall be water.

B. Certified Pump Performance Test

Unitec WWTP – Phase I Expansion – FY 2020
Laredo, Texas
Non-Potable Water Pump Station

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Tests shall be conducted in accordance with Hydraulic Institute Standards 14.6.3.4 Acceptance Grade 2B at the specified head, capacity, rated speed and horsepower. The performance tests will validate the correct performance of the equipment at the design head, capacity and speed.

1. Tests shall be conducted in accordance with Hydraulic Institute Standards, at the required head, capacity, rated speed and horsepower.

2. The operational test shall be witnessed by the Engineer, and/or representatives and provide 72 hours notice prior to testing.

PART 2 PRODUCT

2.1 RESPONSIBILITY

A. For proper operation of the NPW Pumping Station, it is the intent of these Specifications that all system components furnished that work to produce a complete NPW System.

2.2 MANUFACTURER

<table>
<thead>
<tr>
<th>Pumps</th>
<th>Tank (500 usable gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Crane</td>
<td>1. Bill &amp; Gossett</td>
</tr>
<tr>
<td>2. Gorman Rupp</td>
<td>2. Amtrol</td>
</tr>
<tr>
<td>3. Grunfus-PACO</td>
<td>3. Approved Equal</td>
</tr>
<tr>
<td>4. Barnes (Model TS7)</td>
<td></td>
</tr>
<tr>
<td>5. Approved Equal</td>
<td></td>
</tr>
</tbody>
</table>

2.3 PUMP DESIGN

A. Pumps shall be horizontal, self-priming centrifugal type, designed specifically for handling Non-Potable Water. Pump performance criteria shall be in accordance with requirements for Wastewater Non-Potable Water Systems.

2.4 VALVES AND PIPING

A. Automatic air release valves:

1. An automatic air release valve shall be furnished to permit the escape of air to the atmosphere during initial priming or unattended repriming cycles. Upon completion of the priming cycle or repriming cycle, the valve shall close to prevent recirculation. Valves shall provide visual indication of valve closure, and shall operate solely on discharge pressure. Valves which require connection to the suction line shall not be acceptable.
2. All valve parts shall be constructed of stainless steel, or similar corrosion resistant materials.

3. A cleanout port shall be provided for ease of inspection, cleanout, and service.

4. Valves shall be field adjustable for varying discharge heads.

5. Connection of the air release valves to the station piping shall include stainless steel fittings.

B. Piping

1. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and class 52 thickness.

2. Flanges shall be cast iron class 125 and Comply with ANSI B16.1.

3. Pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.

4. Bolt holes shall be in angular alignment within 1/2 degrees between flanges. Flanges shall be faced with a gasket finish having concentric grooves a minimum of 0.01 inch deep by approximately 0.03 inch wide, with a minimum of three grooves on any given surface spaced a maximum of 1/4 inch apart.

C. Concrete Supports and Thrust Blocks

1. Contractor must insure all pipes connected to the pump station are supported to prevent piping loads from being transmitted to pumps or station piping. Pump station discharge force main piping shall be anchored with thrust blocks as required.

2.5 DRIVE UNIT

A. Pump motors shall be 7.5 HP, horizontal TEFC, NEMA design B with cast iron frame with copper windings, induction type, with normal starting torque and low starting current characteristics, suitable for continuous service. The motors shall not overload at the design condition or at any head in the operating range as specified.

B. Drive Transmission

1. Power to pumps transmitted V-belt drive assemblies. The sheave/belt combination shall provide the speed ratio needed to achieve the specified pump operating conditions.

2. Each drive assembly shall utilize at least two V-belts providing minimum a combined safety factor of 1.5. Single belt drives or systems with a safety factor of less than 1.5 are
3. Precise alignment tolerances of the drive assemblies shall be achieved by means of a belt/sheave laser alignment system resulting in the reduction of vibration, accelerated wear, and premature failure.

4. Belt guards
   a. Pump drives to be enclosed on all sides by a guard constructed of fabricated steel or combination of materials including expanded, perforated, or solid sheet metal. No opening to a rotating member shall exceed 1/2 inch.
   b. Guards shall be securely fastened and braced to the unit.
   c. Metal to be free from burrs and sharp edges. Structural joints shall be continuously welded. Rivet spacing on panels shall not exceed five inches.

2.6 Pumps, piping, and exposed steel framework shall be cleaned prior to coating using an approved solvent wipe cleaner. See Section 09 90 20 Painting for all requirements.

2.7 ELECTRICAL CONTROL COMPONENTS

   A. The control panel shall be tested with the pump station as a complete working system.

   B. Panel Enclosure

   1. Electrical control equipment shall be mounted within a NEMA 4X (316 Stainless Steel), control enclosure. Door shall be hinged and sealed with a neoprene gasket and equipped with captive closing hardware. Control components shall be mounted on a removable steel back panel secured to enclosure with collar studs.

   2. All control devices and instruments shall be mounted using threaded fasteners, and shall be clearly labeled to indicate function.

   C. Branch Components

   1. Circuit Breakers and Operating Mechanisms

       a. A properly sized heavy-duty circuit breaker shall be furnished for each pump motor.

       b. An operating mechanism installed on each motor circuit breaker shall penetrate the control panel door. A padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position.
2. An open frame, across the line, NEMA rated magnetic starter with under-voltage release, and overload protection on all three-phases, shall be furnished for each pump motor.

3. An overload-reset pushbutton, mounted through the control panel door, shall permit resetting the overload relays without opening the control panel door.

D. Control Circuit

1. A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.

2. Pump mode selector switches shall permit manual start or stop of each pump individually, or permit automatic operation under control of the pressure sensing system. Manual operation shall override all shutdown systems, except low suction pressure or the motor overload relays. Selector switches to be heavy duty, oil-tight design with contacts rated NEMA A300 minimum.

3. Six-digit elapsed time meter (non-reset type) shall be connected to each motor starter to indicate total running time of each pump in "hours" and "tenths of hours".

4. A duplex ground fault receptacle providing 115 VAC, 60 Hz, single-phase current, will be mounted on the side of the control enclosure. Receptacle circuit shall be protected by a 15-ampere thermal-magnetic circuit breaker.

5. UL Label Requirement: Pump station controls shall conform to third party safety certification. The panel shall bear a serialized UL label listed for "Enclosed Industrial Control Panels". The enclosure and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures.

6. Transient Voltage Surge Suppressor: The control panels shall be equipped with a transient voltage surge suppressor to minimize damage to the pump motors and control from transient voltage surges. The suppressor shall utilize silicon-oxide varistors encapsulated in a non-conductive housing. The arrestor shall have a current rating of 60,000 Amps, and a Joule rating of 1500.

7. Panel Heater: The control panels shall be equipped with a panel heater to minimize the effects of humidity and condensation. The heater shall include a thermostat.

8. Three-Phase Voltage Monitor: The control panel shall be equipped to monitor the incoming power and shut down the pump motors when required to protect the motor(s) from damage caused by phase reversal, phase loss, voltage unbalance, and low voltage. A time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart when power conditions return to normal.
9. Phase Monitor: The control panel shall be equipped to monitor the incoming power and shut down the pump when required to protect the motor(s) from damage caused by voltage less than 83% of nominal. The motor(s) shall automatically restart when power conditions return to normal.

10. Wiring

a. All wiring, workmanship, and schematic wiring diagrams shall comply with applicable standards and specifications of the National Electrical Code (NEC).

b. Control wires connected to door mounted components must be tied and bundled in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall allow the door to swing full open without undue stress or abrasion. Bundles shall be held on each side of hinge by mechanical fastening devices.

11. Conduit

a. Factory installed conduit shall conform to the following requirements:

   i. All conduit and fittings to be UL listed.

   ii. Liquid tight flexible metal conduit to be constructed of smooth, flexible, galvanized steel core with smooth abrasion resistant, liquid tight polyvinyl chloride cover.

   iii. Conduit to be supported in accordance with articles 346, 347 and 350 of the National Electrical Code.

   iv. Conduit shall be sized according to the National Electrical Code.

12. Grounding

a. Station manufacturer shall ground all electrical equipment.

b. The Contractor shall provide an earth driven ground connection to the pump station at the main grounding lug in accordance with the National Electrical Code (NEC).

13. Equipment Marking

a. Permanent corrosion resistant name plate(s) shall be attached to the control and include the following information:

   i. Equipment Serial Number

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ii. Supply Voltage, Phase and Frequency

iii. Current Rating of the Minimum Main Conductor

iv. Electrical Wiring Diagram Number

v. Motor Horsepower and Full Load Current

vi. Motor Overload Heater Element

vii. Motor Circuit Breaker Trip Current Rating

viii. Name and Location of Equipment Manufacturer

b. Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified.

c. Switches, indicators and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.

2.8 PRESSURE CONTROL

A. The digital pressure controller shall start and stop the pump motors in response to changes in system pressure, as set forth herein.

B. The digital pressure controller shall operate with a suction pressure transducer and a system pressure transducer.

C. The digital pressure controller shall be capable of pump alternation. The controller shall select which pump to be lead pump, with alternation occurring at the end of each pumping cycle.

1. The digital pressure controller shall be equipped with an electronic comparator and mechanical output relay to alert maintenance personnel to a low suction pressure situation. An output-energized indicator, visible on the front of the controller, shall indicate that a low suction situation exists. The alarm on and off pressure setpoints is set in PSI. The output and its associated indicator shall be maintained until the suction pressure has increased above the alarm off setpoint for a preset amount of time, at which time the output will automatically drop out. The low suction pressure alarm circuitry includes settable on and off delay timers.

PART 3 EXECUTION
3.1 EXAMINATION
A. Contractor shall off-load equipment at installation site and prevent injury or damage and follow written instruction for proper handling. Immediately after off-loading, Contractor shall inspect equipment and appurtenances for shipping damage or missing parts. Any damaged equipment will not be permitted to be installed and must be replaced.

3.2 INSTALLATION
A. Install, level, align, and lubricate complete system as indicated on project drawings. Installation must be in accordance with specifications.

B. Install all pipe connections to be tight and with supports/thrust blocks to prevent strain and vibration on pump station piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required.

C. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.

D. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

3.3 FIELD QUALITY CONTROL
A. Operational Test

1. Prior to acceptance by Owner, an operational test of all pumps, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

2. After construction debris and foreign material has been removed, Contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

B. Manufacturer’s Start-up Services
1. Coordinate station start-up with Manufacturer’s Authorized Factory Representative of equipment installed. Inspect the completed installation and calibrate/adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.

3.4 CLEANING

A. Prior to acceptance, inspect interior and exterior of pump station for dirt, splashed material or damaged paint. Clean or repair accordingly. Remove from the job site all tools, surplus materials, scrap and debris.

3.5 PROTECTION

A. The pump station should be placed into service upon approval. If operation is delayed, drain water from pumps and piping. Open motor circuit breakers and protect station controls and interior equipment from cold and moisture.

3.6 HYDRO-PNEUMATIC TANK

A. The Contractor shall supply a 500 usable Gallon Hydro-Pneumatic bladder tank as part of the non-potable system. The Bladder tank shall have a heavy duty Butyl Bladder and have a minimum max pressure rating of 125 PSIG

PART 4 MEASUREMENT AND PAYMENT

A. Measurement and Payment for this item will be as indicated within the PROPOSAL FORM. If this item is not indicated within the PROPOSAL FORM then it is to be considered subsidiary to the applicable sections(s).

B. Payment shall fully compensate the Contractor for all required labor, materials, equipment, supervision, insurance, maintenance, codes, laws, statues, or regulations, and all incidental expenses which are required to complete the work in place, ready-to-use and in accordance with the Drawings, Specifications, and all OSHA and TCEQ regulations and requirements.

END OF SECTION
PART 1 GENERAL

1.1 DESCRIPTION

A. Furnish and install two (2) submersible grinder sewage pump (s) with provisions for a 3rd future pump; each pump shall be capable of delivering the performance points at 60 Hertz. The Wastewater Pump Stations shall to comply with Texas Commission for Environmental Quality (TCEQ) - Design Criteria for Sewerage Systems, 30 TAC 217 and any revisions thereto as applicable. The Wastewater Pumping Station design shall also meet the criteria and standards listed within this item of the City of Laredo (COL) Specifications for Water and Sanitary Sewer Construction.

B. The two pumps together shall be designed to pump 2% abrasive slurries of wastewater grit, debris and organics solids without clogging at a flow rate of 150 gpm @ 45-feet of head. The pump shall be capable of passing 3” solids.

Note: When future third (3rd) Pump is installed – 225 US gpm 59’ TDH.

All guide rails, brackets, anchors, and supports to be 316 stainless steel (including base elbow and rails for future 3rd pump). The pump(s) shall be manufactured by a company regularly engaged in the manufacture and assembly of similar units for a minimum of twenty-five (25) years.

1.2 PUMPING STATION GENERAL INFORMATION

A. The pumping station shall be installed in a location as shown on the Plans and with access road as shown on Plans.

B. The Lift Station wet well and piping shall minimize grit accumulation by grouting the wet well floor per pump manufacturer recommendations.

C. The expected flow rate for this project is as follows:
   1. Number of Pumps – 2 as shown on Plans
   2. Leave space for third pump as shown on Plans
   3. Pumps shall be grinder type

D. Provide full length 316L SS lifting chains and chain grip eye. Pumps shall have minimum 3” diameter suction and discharge openings. Provide non-clogging impellers.

E. All guide rails, brackets, anchors, and supports shall be 316 LSS.

F. All motors shall have a minimum 1.15 service factor.

G. All equipment shall have elapsed time meters.
H. Provide guide rail and base elbow for 3rd (future) pump.

I. Wet well hatch Double Door Assembly with Lift Assist shall be aluminum with frames, fall protection safety grates, and covers rated for 300 PSF live load. Covers shall be equipped with padlock staples. Hardware, fasteners, and hinges shall be 316 SS. Hatch assemblies shall be EJ Safe hatch, Bilco or City/Engineer approved equal. Provide 2 each hatch keys. Hatch to be nominal 4’ x 6’ double door unit to accommodate access to three (3) pumps.

J. Pressure gauge assemblies shall include the following items:
1. Stainless steel full port isolation ball valve
2. Pressure diaphragm seal and plain end bbb sampling valve, both stainless steel.
3. 4” Pressure gauge, complying with ASME B40.1, Grade 1A, with 1% full scale accuracy, stainless case and stainless steel wetted parts, glycerin filled.
4. Gauges shall read in both ftH₂O and PSI. Select range for normal working pressure to be mid-range.
5. The entire assembly shall be Type 316 stainless steel.

K. Allowable Manufacturers (Reference: Barnes Submersible Grinder Pump – Model XSGV or equal)
1. Groundfus – PACO
2. Flygt
3. KSB
4. Crane
5. Barnes
6. Gorman Rupp
7. Vaughn
8. Approved Equal

1.3 PUMPING STATION

A. PUMP DESIGN

Each pump shall be capable of handling raw, unscreened domestic sewage consisting of water, fibrous materials, need to say something about the grinder mechanism/assembly. Also must be capable of pumping process waste from the Aeration Basin and Digester with Mixed Liquor Suspended Solids (MLSS), up to 13,000 mg/l. The pump(s) shall be capable of handling liquids with temperatures to 104 degrees F continuous. Bearings shall be designed for 100,000 hours operating at minimum flow. Product shall be furnished with oil filled Motors per NEMA MG-1, Part 31 with stator winding of the open type with Class H spike resistant magnet wire and a minimum 1.15 service factor.

B. PUMP REQUIREMENTS (BEP 40% - 60%)

The volute, seal plate, adapter, motor housing and motor housing cap shall be constructed of high quality, ASTM A-48 Class 30B/35 B cast iron. Pump(s) shall be coated with two coats of epoxy with a total 8 mil minimum thickness in the manufacturer’s standard color. All exposed hardware shall be 316 stainless steel including the lifting bail. The pump construction shall contain no points of critical clearance nor require periodic adjustment or replacement to maintain operating efficiency. The pump shaft shall be 416 stainless steel with a tapered impeller fit to reduce rotor imbalance and minimize stress risers associated with stepped shafts. All gaskets shall be of the angular gland compression o-ring type eliminating critical slip fits and
the possibility of damage during service associated with sliding o-ring sealing arrangements. The impeller shall be of the single vane design with pump out vanes on the back side.

The tandem mechanical shaft seals shall be of the single spring design operating in an intermediate oil-filled seal cavity. Pump-out vanes in the back of the impeller shroud shall be large enough to efficiently expel solids away from the seal area. The materials of construction shall be carbon vs. ceramic for the pump-end seal and carbon vs. ceramic for the motor-end seal, lapped and polished to a tolerance of one light band, 300 series stainless steel hardware, and Buna-N elastomeric parts. The pump-end seal shall be pinned in place to prevent rotation of the stationary seat and shall seal to the pump housing via an o-ring to maximize heat transfer. Cup mounted seats shall not be considered equal. The seal shall be commercially available and not a pump manufacturer’s proprietary design. A moisture sensor detection system consisting of two probes shall be integrated within the oil-filled seal chamber which is isolated from the motor chamber. Units sensing moisture within the motor chamber are not considered acceptable. Moisture sensing devices utilizing one probe and grounding through the pump case or utilizing a float device are not acceptable. The leads for the moisture detector shall be contained within the power cable.

The pump motor shall be sized to be non-overloading throughout the entire pump curve. The rotor and stator assembly shall be of the standard frame design and the stator pressed into the motor housing for mechanical stability. The motor shall be constructed with the windings operating in a sealed environment containing clean dielectric oil. Manufacturer to supply submergence requirements for continuous operation.

Motors shall be air or oil filled for optimal thermal management and maximum bearing life. Air-filled motors shall be supplied with oil-filled bearings. The motor windings shall be of Class H, spike-resistant insulation. The motor shall meet the NEMA Design B standard and be Rated per NEMA MG1, part 31.

The pump shaft shall be of 416 stainless steel, keyed and tapered for the matching impeller. The lower bearing shall be of the double row ball type, locked in position to accept radial and axial thrust loads, and the upper bearing of the single ball type for radial loads. Bearings shall operate in an oil bath environment for superior lubrication, cooling and life.

The Contractor shall furnish and install the pumps, discharge elbows, the stainless steel rail system including the 2” guide rails, upper brackets, lower brackets, and intermediate brackets from a single manufacturer for respective lift station.

C. Each pump shall have individual discharge lines to the proposed header. Individual shutoff and check valves will be installed on the discharge line of each pump and shall not be installed within the lift station wet well.

D. Check valves shall be swing type and not be installed on the vertical portion of the discharge piping. Individual shut off valves will be gate valves (not plug valves).

E. 45 degree cast iron elbows will be provided for pump discharge piping turns.

F. Discharge plumbing shall include 4” quick connect with valve and cap.
G. Air release valves shall be A.R.I. Model D-025. ARV vent piping to be 2” diameter schedule 80 PVC with 316 stainless steel anchors and strut supports. Install a PVC ball valve below air release valve. Install union in vent piping adjacent to ARV.

1.4 PUMP STATION INSTALLATION

A. All fasteners shall be Type 316 stainless steel (e.g. hardware, screws, anchor bolts, rods, bolts, nuts, etc. for piping, valves, pumps, motors, equipment, etc.) including those for factory assembly of components. All bolts and nuts shall be heavy hex. Stainless steel items shall not be painted.

1.5 PUMP/MOTOR ASSEMBLY

A. Discharge connection shall be a standard 125 pound 3-inch flange, slotted to accommodate 4-inch ANSI or 100mm ISO flanges.

B. Three thermal sensors (one per phase) shall be embedded in the end coil of the stator windings, wired in series and used to monitor stator temperatures. This shall be used in conjunction with an external motor overload protection device and wired to the control panel through the single power cable.

C. The pump shall be equipped with (50) ft. of a UL-qualified submersible power cable constructed and shall include the moisture and temperature sensor leads.

D. 30 Tac 317.3.c.4 requires submittal of a design report which will include system curves, pump curves and head calculations: Total Suction Lift or Total Suction Head, New Positive Suction Head available and required Total Discharge Head and Total Dynamic head including friction losses. Contractor to provide submittal from approval. Contractor to provide to City and Engineer for review and approval.

E. The following information will be submitted in the design report for review and approval in addition to the information in the above 216.5.b that is required by TCEQ.

1. Manufacturer(s) of the motor and pump; pump performance curves
2. Pump and motor serial numbers; catalog data
3. Suction pipe, discharge pipe and impeller sizes
4. Pump speed ratio
5. Motor rated horsepower
6. Motor rated speed
7. Motor characteristics: voltage, phase, frequency
8. Rated capacity for site conditions
9. Efficiency
10. Electrical Diagrams
11. Manufacturer’s Specifications; Installation And Operations Manual with parts list.
12. Control Panel data and wiring schematic

F. Pumps in Submersible Type Pumping Station shall be readily removed and replaced without dewatering the wet well or disconnecting any piping in the wet well.
G. The pump manufacturer shall perform the following inspections and tests in accordance with Hydraulic Institute type B standards before shipment from the factory:

1. A check of the motor voltage and frequency shall be made as shown on the name plate.
2. A motor and cable insulation test for moisture content or insulation defects shall be made per CSA and FM criteria.
3. The pump shall be run to determine that the unit meets five pre-determined hydraulic performance points.
4. A performance curve from the production line test showing head versus flow shall be included in the Installation and Operation Manual shipped with each pump.
5. A written report shall be available showing the aforementioned tests have been performed in accordance with the specifications.

1.6 PUMP STATION WET WELL

A. A lockable aluminum hatch cover (nominal 4’ x 6’ – double door) shall be installed in the wet well cover for access unless shown otherwise on drawings. Provide an 10’ x 11’ x 12” reinforced concrete slab in the surface of the wet well per plans.

B. Fiberglass wall thickness shall be minimum ¾” thick unless project specific structural calculations sealed by a State of Texas Licensed Professional Engineer indicate a lesser thickness is adequate for projected design loads (1/2” min.).

C. The bottom of the excavated pit for wet or dry well structure must be leveled and native soils compressed with excavation equipment for the installation of a gravel bed to support the base of the structure (see plans).

D. A minimum of 6 inches of crushed stone shall be installed as bedding material in the finished bottom dry well and wet well excavations. Flowable fill will also be installed between the wet well and the excavation to an elevation of 1/3 the total depth of the structure as measured from the well bottom. Utilities Inspectors will make a site-specific decision regarding the need or amount of placement when the dry wet well is to be installed within rock.

E. Valve boxes, equipment, exposed piping and valves, and appurtenances shall be painted. Provide colors in accordance with TCEQ rules. Do not paint stainless steel, hot dip galvanized, brass, or aluminum items.

F. Lift station wet well and valve pad piping shall be Protecto 401 lined or approved equal flanged ductile iron.

G. Flange coupling adapters shall be Smith Blair Model 911. Flange adapters are not allowed with hydraulic structures.

H. All wall penetrations for the wastewater lift station shall be Tee penetrations as shown in the plans.
I. Wet wells shall have 4” minimum cast-in-place Class 51 D.I. Protecto 401 Lined or approved equal vents with welded waterstop rings on pipe at penetrations. Provide flange 316 SS screens located 24” above top of roof slab. Provide 1/4” 316 Stainless Steel Mesh with heavy duty gauge.

1.7 PUMP STATION CONTROLS (SEE SHEET C16 FOR OPERATION)

A. Controls systems shall be float type. The electrical equipment shall comply with the National Electrical Code requirements for Class 1, Group C and D, Division 1, locations.

B. High and low level floats shall also be installed with air bubble and ultrasonic system to operate in case of control system malfunction.

C. The control system float controls shall be placed in an area of the wet well which is removed from of the effects of the influent flow(s) being received.

D. Automatically alternate the pumps at the completion of each pumping cycle at all stations. An alternation stop switch shall be provided.

E. Pump “Lead-Lag” Operation:

One pump will be adequate to deliver all anticipated peak flows. The “lead” pump is turned on at the first on control elevation with the “lag” pump started with a rising liquid level at the second on control elevation. The “lead” and “lag” pumps will both continue to operate until the pump off control elevation is attained. The “lead” and “lag” shall be automatically alternated between the pumps at the completion of each pumping cycle. The “lag” pump shall start if the “lead” pump fails to start at the beginning of a cycle. A means of alternation via a realy shall be provided within the control panel.

F. Additional support shall be provided for the rear of the communication box cabinet to bear the weight and prevent leaning.

G. A control system float shall also be installed to signal the operation of the 3rd pump (future installation).

1.8 PUMP INSTRUMENTATION AND MONITORING

A. The existing telemetry alarm system shall be of equal brand or compatible to current system used by the City of Laredo in the area and shall be installed with battery backup and an automatic dialing capacity.

The alarm level elevation shall also be annunciated locally at the lift station with an audible and visual alarm to comply with 30 Tac 317.3.e.5.

B. All lift stations shall be equipped with hour meters for each pump to record pump motor running time, phase monitor, and lighting arrestor.

C. Pressure gauges shall be installed on the discharge line of each pump.
D. Flow measuring device with instantaneous rate indicators, totalizers and recorders designed specifically for sewage force mains shall be provided.

1.9 FORCE MAINS/HEADER PIPING

A. The force main will be installed at least 3 feet below the finished ground surface, but not at the same elevation as the gravity inlet line(s) in accordance with TCEQ 217.67.

B. Thrust blocking shall be provided on all buried force main piping in accordance with the most current version of the COL Specifications for Water and Sanitary Sewer Construction.

C. No segment of the force main shall have zero slope to limit the accumulation of gases. Low points should be avoided to prevent solids accumulation.

D. Force mains shall transition into a gravity line within a manhole in a manner that minimizes agitation of sewage. The crowns of the force main and outlet gravity line will match with bench grouting installed to direct flow into the outlet with a minimal change in the gravity flow angle.

E. Header piping to be epoxy-lined with Protecto 401 or approved equal.

F. Air release valves (one (1) each required) to be ARI model D-025 or approved equal. Vent piping to be schedule 80 PVC with 316 stainless steel anchors and strut supports. Install PVC ball valve below Air Release Valve.

1.10 VENTILATION (N/A)

A. There shall be no connection between wet well and dry well ventilation systems.

B. Permanently Mechanical ventilation is required for dry wells located below the ground surface and for wet wells having screens or mechanical equipment requiring regular maintenance or inspection.

C. Multiple air inlets and outlets are desirable in dry wells over 15 feet deep. Dampers should be not be used on exhaust or fresh air ducts. Fine screens other obstructions within air ducts should be avoided to prevent clogging.

D. Manual lighting/ventilation switches shall override automatic controls installed for intermittently operated lighting/venting equipment.

1.11 ELECTRICAL

A. Contractor supplied and installed electrical systems and components (i.e. motors, lights, cables, conduits, switchboxes, control circuits, etc.) in raw sewage wet wells, and in all enclosed or partially enclosed spaces where hazardous concentrations of flammable gases or vapors may be present, shall be designed by a State of Texas Licensed Professional Engineer in accordance with the national Electrical Code (NEC) and National Electrical Safety Code (NESC) requirements, for Class 1 Group C and D, Division 1 locations. In addition, equipment located in wet wells shall be suitable for use under corrosive conditions. Each flexible cable shall be
provided with watertight seal and separate strain relief. A fused disconnect switch located above ground shall be provided for all pumping stations. When such equipment is exposed to the weather, it shall meet the requirements of weatherproof equipment (NEMA 4X).

B. All electrical junction and control boxes for the motor hook up, electrical connections and cable extensions are to be located outside the wet well. Any conduit runs entering or leaving the hazardous zone as established by the Plans and Specifications shall have “Seal-Off” conduit filled with chico compound.

C. All underground conduits shall be PVC and have a cover depth of 18 to 24 inches beneath the finished surface.

D. Contractor shall provide wiring as detailed in the plans and specifications.

E. The float control junction box shall be made of 316 SS or as shown plans.

F. Special considerations for Submersible Pumping Stations
   1. Submersible pumping stations shall meet the applicable electrical requirements above, except as modified in this section.
   2. Electrical supply, control, and alarm circuits shall be designed to provide strain and to allow disconnection outside the wet well. Terminals and connectors shall be protected from corrosion by location outside the wet well in waterproof enclosure.
   3. The motor control center shall be located outside the wet well, be readily accessible and be protected by a conduit seal to meet the requirements of the National Electrical Code to prevent the atmosphere of the wet well to enter the control center. The seal shall be located that the motor may be electrically disconnected without disturbing the seal.
   4. Pump motor cables shall meet the requirements of the National Electrical Code Standards for flexible cords in wastewater pumping stations. The cable circuit shall be de-energized by ground fault interruption protection in the event of the inability of the cable to conduct electricity. Power cord terminal fittings shall be corrosion-resistant and constructed in a manner to prevent entry of moisture into the cable, shall be provided with relief appurtenances, and shall be designed to facilitate field construction.

1.12 EMERGENCY OPERATIONS (N/A)

A. There shall be an electrical connector installed on the above ground power service panel with an approved transfer switch to connect a standby generator if a permanent on-site unit is not required. This electrical connector shall be sized to allow connection of the properly sized generator to operate the pumping station.

B. All permanently installed engine driven generators shall be protected from operating conditions that would result in damage to the equipment. Protective equipment shall be capable of shutting down the engine and activating an onsite alarm. Protective equipment shall monitor for conditions of low oil pressure and overheating.
C. The generating unit of a permanently installed or portable generator shall be adequate to provide power for pump motor starting current, lighting, proper ventilation and other equipment necessary for safety and proper operation of the lift station.

D. The engine shall be located above grade with adequate ventilation of fuel vapors and exhaust gases.

PART 2 PRODUCTS

NOT USED

PART 3 MEASUREMENT AND PAYMENT

A. Measurement and Payment for this item will be as indicated within the PROPOSAL FORM. If this item is not indicated within the PROPOSAL FORM then it is to be considered subsidiary to the applicable sections(s).

B. Payment shall fully compensate the Contractor for all required labor, materials, equipment, supervision, insurance, maintenance, codes, laws, statues, or regulations, and all incidental expenses which are required to complete the work in place, ready-to-use and in accordance with the Drawings and Specifications.
SECTION 33 32 17
MLSS LIFT STATION (ALT#2)

PART 1 GENERAL

1.1 DESCRIPTION

A. Furnish and install two (2) submersible abrasion resistant pump(s). Work described in this Section includes furnishing all labor, equipment, materials, tools and appurtenances required for a complete and operable installation.

B. The two (2) pumps together shall be designed to pump 2% abrasive slurries of wastewater grit, debris and organics solids without clogging at a flow rate of 306 gpm @ 33-feet of head. The pump shall be capable of passing 3” solids.

C. The pumps shall be designed for continuous operation and will be operated continuously or intermittently under normal service.

D. The MLSS Pump Station shall to comply with Texas Commission for Environmental Quality (TCEQ) - Design Criteria for Sewerage Systems, 30 TAC 217 and any revisions thereto as applicable. The Wastewater Pumping Station components shall also meet the criteria and standards listed within this item of the City of Laredo (COL) Specifications for Water and Sanitary Sewer Construction.

1.2 PUMPING STATION GENERAL INFORMATION

A. The pump system shall be installed in a location as shown on the Plans and with accessories as shown on Plans and this specification.

B. Provide full length 316 SS lifting chains and chain grip eye. Pumps shall have minimum 3” diameter suction and discharge openings. Provide non-clogging impellers.

C. All guide rails, brackets, anchors, and supports shall be 316 SS.

D. All motors shall have a minimum 1.15 service factor.

E. All equipment shall have elapsed time meters.

F. Provide guide rail and base elbow for 3rd (future) pump.

G. Allowable Manufacturers
   1. Flygt
   2. KSB/Barnes
   3. Goulds
1.3 PUMP DESIGN

A. The pump(s) with accessories shall be capable of 2% slurries using an abrasion resistant through discharge connection shall be permanently installed in the wet well along with the connection elbow and discharge piping. The pump(s) shall be automatically connected to the discharge connection when lowered into place and shall be easily removed for inspection or service. There shall be no need for personnel to enter the pump well. Sealing of the pumping unit to the discharge connection shall be accomplished by a simple linear downward motion of the pump. A sliding guide bracket shall be an integral part of the pump unit. The entire weight of the pumping unit shall be guided by no less than two guide bars and pressed tightly against the discharge connection. No portion of the pump shall bear directly on the floor of the sump. The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.

1.4 PUMP REQUIREMENTS

A. General

1. Major pump components shall be of gray cast iron, ASTM A-48 Class 35B, with smooth surfaces devoid of blowholes and other irregularities.
2. Exposed nuts and bolts shall be AISI type 313 stainless steel construction.
3. All surfaces, other than stainless steel, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.
4. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Sealing will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.
5. No secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease or other devices shall be used.

B. Impeller

1. The impeller shall be wear resistant and made of high chromium cast iron with at least 24% chrome for protection against sand and grit which is expected to enter the pump station with the sewage or the storm water.
2. The impeller vane leading edges shall be mechanically self-cleaned upon each rotation as they pass across a machined spiral groove located on the stationary insert ring maintaining an unobstructed leading edge.
3. The impeller shall have induction hardened, screw shaped leading edges and shall be capable of handling solids, fiberous materials, heavy sludge and other matter found in wastewater.
4. Impellers shall impeller shall be capable of momentarily moving axially upwards a distance of 15mm/0.6-in. to allow larger debris to pass through and immediately return to normal operating position.
5. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw.
C. Volute

1. Pump volutes shall be single piece gray cast iron, Class 35B, non concentric design with smooth passages large enough to pass any solids that may enter the impeller.
2. The Pump volute shall be coated internally with a wear resistant coating like a Belzona 1321.
3. Minimum inlet and discharge size shall be as indicated herein.

D. Insert Ring

1. A replaceable insert ring shall be made from made of high chromium cast iron with at least 24% chrome having an integral machined spiral shaped groove shall be installed in the pump volute.
2. The clearance between the insert ring and the impeller shall be adjustable to provide effective sealing between the multi-vane semi-open impeller and the volute housing.

E. Motor

1. The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, water tight chamber.
2. The submersible motor shall be FM or UL Listed for Class I, Division 1, Groups C and D explosion-proof hazardous locations.
3. The stator windings shall be insulated with moisture-resistant Class H insulation for 180 degrees C.
4. The motor shall be designed for continuous duty while handling pumped media of up to 104 degrees F.
5. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of fastening devices used to hold or locate the stator and that penetrate the stator housing are not acceptable.
6. The motor shall be designed for continuous duty capable of fifteen (15) evenly spaced starts per hour.
7. The motor shaft shall be one-piece, extending through the pump and motor. Extension couplings shall not be acceptable. Shaft shall be constructed of 431 stainless steel. Shaft sleeves shall not be acceptable.
inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable.

3. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices.

4. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber.

5. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

6. A separate junction chamber shall be provided inside the pump for connection of power cables to stator leads. The chamber shall be sealed by a nonmetallic terminal board bolted to a machined surfaced and utilizing an O-ring to obtain a watertight seal.

G. Cooling System
1. Motors are sufficiently cooled by the surrounding environment or pumped media
2. A water jacket is not required.

H. Mechanical Seal
1. Pumps shall be provided with a mechanical seal system consisting of two totally independent seal assemblies operating in an oil chamber between the pump volute and motor chamber for seal lubrication and cooling. The oil shall be a white paraffin based oil meeting the standards of FDA 172.87B.
2. The lower seal shall act as the primary unit to prevent entry of pumped liquid to the oil chamber shall contain one stationary and one positively driven rotating, corrosion resistant tungsten-carbide ring.
3. The upper seal shall act as a secondary unit to prevent pumped liquid or oil from entering the stator housing shall contain one stationary and one positively driven rotating, corrosion resistant tungsten-carbide ring.
4. The seal system shall allow continuous pump operation with the motor exterior totally dry.
5. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing

I. Bearings
1. The motor bearings shall be permanently grease lubricated with a B-10 design life of 50,000 hours at any point along the pump curve at maximum speed. The upper bearings shall be roller bearings. The lower bearings shall be angular contact ball bearings.
2. Pump protection devices
   a. The pump manufacturer shall provide a pump monitoring unit which shall be mounted in the control panel or mounted on a dead front panel or swing out door and shall be wired to activate an alarm.
   b. Pump protective devices
      i. Three thermal switches in each of the stator windings which shall open at 125°C (260°F) to stop the motor and activate an alarm.
ii. A Float leakage sensor shall be placed in the stator housing to detect water intrusion into the chamber. When activated, the sensor will stop the motor and activate an alarm.

3. Accessories
   a. The pump manufacturer shall furnish all station hardware and accessories for use with the pumps furnished or for any future requirements or revisions as may be indicated in the Plans or other sections of the Contract Specifications.
   b. All items inside the wet well shall be stainless steel or aluminum as indicated below.
   c. To insure compatibility, all access covers in structures containing submersible pumps shall be provided by the supplier of the submersible pumps. See specification for access cover requirements.

4. Discharge Connections
   a. The cast iron straight through discharge connection shall be permanently installed in the wet well along with the connection elbow and discharge piping.
   b. discharge connection sleeve and connection elbow shall be constructed of high chrome materials for wear resistance.

1.5 STORAGE AND HANDLING OF EQUIPMENT

A. The Contractor shall store and temporarily support equipment prior to installation in strict accordance with the Manufacturer’s recommendations and instructions. Protect all exposed surfaces. Keep records of the storage parameters and the dates that storage procedures were performed. The Contractor shall be responsible for work, equipment, and materials until inspected, tested and finally accepted.

B. Handle during delivery, storage and installation in a manner to prevent damage of any nature in accordance with the manufacturer's approved instructions.

C. After hydrostatic or other tests at the factory, all entrapped water shall be drained prior to shipment, and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.

D. Factory assembled pumping units and components shall not be dismantled for shipment.

E. Finished surfaces of all exposed flanged pump openings shall be protected by wooden blanks, strongly built and securely bolted thereto.

F. The Contractor shall store and temporarily support equipment prior to installation in strict accordance with the Manufacturer’s recommendations and instructions. Protect all exposed surfaces. Keep records of the storage parameters and the dates that storage procedures were performed. The Contractor shall be responsible for work, equipment, and materials until inspected, tested and finally accepted.

G. Protect the equipment from being contaminated by dust, dirt, vibration and moisture. All equipment and parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed or during a
prolonged storage period at the site and the units and equipment are ready for operation. Pumps and equipment shall be stored in a clean, dry building or trailer, which shall have a concrete or wooden floor, a roof and fully closed walls on all sides, prior to installation.

H. Temporarily connect equipment with built in motor space heaters to a power source and keep heaters in operation. Rotate all shafts that have bearings on at least a monthly basis.

I. Each box, crate or package shall be properly marked to show its net weight in addition to its contents.

1.6 PUMP STATION CONTROLS

A. Controls systems shall be float type. The electrical equipment shall comply with the National Electrical Code requirements for Class 1, Group C and D, Division 1, locations.

B. High and low level floats shall also be installed with air bubble and ultrasonic system to operate in case of control system malfunction.

C. The control system float controls shall be placed in an area of the wet well which is removed from of the effects of the influent flow(s) being received.

D. Automatically alternate the pumps at the completion of each pumping cycle at all stations. An alternation stop switch shall be provided.

E. Pump “Lead-Lag” Operation:

One pump will be adequate to deliver all anticipated peak flows. The “lead” pump is turned on at the first on control elevation with the “lag” pump started with a rising liquid level at the second on control elevation. The “lead” and “lag” pumps will both continue to operate until the pump off control elevation is attained. The “lead” and “lag” shall be automatically alternated between the pumps at the completion of each pumping cycle. The “lag” pump shall start if the “lead” pump fails to start at the beginning of a cycle. A means of alternation via a relay shall be provided within the control panel.

F. Additional support shall be provided for the rear of the communication box cabinet to bear the weight and prevent leaning.

G. A control system float shall also be installed to signal the operation of the 3rd pump (future installation).

1.7 PUMP INSTRUMENTATION AND MONITORING

A. The existing telemetry alarm system shall be of equal brand or compatible to current system used by the City of Laredo in the area and shall be installed with battery backup and an automatic dialing capacity. The alarm level elevation shall also be annunciated locally at the lift station with an audible and visual alarm to comply with 30 Tac 317.3.e.5.
B. All lift stations shall be equipped with hour meters for each pump to record pump motor running time, phase monitor, and lighting arrester.

C. Pressure gauges shall be installed on the discharge line of each pump.

D. Flow measuring device with instantaneous rate indicators, totalizers and recorders designed specifically for sewage force mains shall be provided.

1.8 FORCE MAINS/HEADER PIPING

A. The force main will be installed at least 3 feet below the finished ground surface.

B. Thrust blocking shall be provided on all buried force main piping in accordance with the most current version of the COL Specifications for Water and Sanitary Sewer Construction.

C. No segment of the force main shall have zero slope to limit the accumulation of gases. Low points should be avoided to prevent solids accumulation.

D. Force mains shall transition into a gravity line within a manhole in a manner that minimizes agitation of sewage. The crowns of the force main and outlet gravity line will match with bench grouting installed to direct flow into the outlet with a minimal change in the gravity flow angle.

E. Header piping to be epoxy-lined with Protecto 401 or approved equal.

F. Air release valves (one (1) each required) to be ARI model D-025 or approved equal. Vent piping to be schedule 80 PVC with 316 stainless steel anchors and strut supports. Install PVC ball valve below Air Release Valve.

1.9 ELECTRICAL

A. Contractor supplied and installed electrical systems and components (i.e. motors, lights, cables, conduits, switchboxes, control circuits, etc.) in raw sewage wet wells, and in all enclosed or partially enclosed spaces where hazardous concentrations of flammable gases or vapors may be present, shall be designed by a State of Texas Licensed Professional Engineer in accordance with the national Electrical Code (NEC) and National Electrical Safety Code (NESC) requirements, for Class 1 Group C and D, Division 1 locations. In addition, equipment located in wet wells shall be suitable for use under corrosive conditions. Each flexible cable shall be provided with watertight seal and separate strain relief. A fused disconnect switch located above ground shall be provided for all pumping stations. When such equipment is exposed to the weather, it shall meet the requirements of weatherproof equipment (NEMA 4X).

B. All electrical junction and control boxes for the motor hook up, electrical connections and cable extensions are to be located outside the wet well. Any conduit runs entering or leaving the hazardous zone as established by the Plans and Specifications shall have “Seal-Off” conduit filled with chico compound.
C. All underground conduits shall be PVC and have a cover depth of 18 to 24 inches beneath the finished surface.

D. Contractor shall provide wiring as detailed in the plans and specifications.

E. The float control junction box shall be made of 316 SS or as shown plans.

F. Special considerations for Submersible Pumping Stations
   1. Submersible pumping stations shall meet the applicable electrical requirements above, except as modified in this section.
   2. Electrical supply, control, and alarm circuits shall be designed to provide strain and to allow disconnection outside the wet well. Terminals and connectors shall be protected from corrosion by location outside the wet well in waterproof enclosure.
   3. The motor control center shall be located outside the wet well, be readily accessible and be protected by a conduit seal to meet the requirements of the National Electrical Code to prevent the atmosphere of the wet well to enter the control center. The seal shall be located that the motor may be electrically disconnected without disturbing the seal.
   4. Pump motor cables shall meet the requirements of the National Electrical Code Standards for flexible cords in wastewater pumping stations. The cable circuit shall be de-energized by ground fault interruption protection in the event of the inability of the cable to conduct electricity. Power cord terminal fittings shall be corrosion-resistant and constructed in a manner to prevent entry of moisture into the cable, shall be provided with relief appurtenances, and shall be designed to facilitate field construction.

1.10 INITIAL STARTUP AND TRAINING

A. The Contractor shall provide the services of a factory-employed service technician who shall adequately inspect the installation, test the equipment furnished under this Contract and instruct the Owner’s operating personnel in its maintenance and operation. Factory personnel are required. Manufacturer’s representatives are not deemed acceptable to provide the start-up service. The services of the technician shall be provided for one trip as follows: One (1) trip of two (2) days of service to inspect and certify the installation prior to startup and instruct Owner's personnel in proper operation and maintenance of the equipment.

1.11 WARRANTY

A. Pump manufacturer will pay cost of parts and labor during the warranty period, provided that the pump, with cable attached, is returned prepaid to an authorized repair facility for repairs. Coverage of parts and labor will be provided for periods indicated below.

B. Warranty period shall be as follows (0 – 24 months warranty is 100%) and from the date of shipment from the factory or other manufacturer approved point in time.
PART 2 PRODUCTS

NOT USED

PART 3 MEASUREMENT AND PAYMENT

A. Measurement and Payment for this item will be as indicated within the PROPOSAL FORM. If this item is not indicated within the PROPOSAL FORM then it is to be considered subsidiary to the applicable sections(s).

B. Payment shall fully compensate the Contractor for all required labor, materials, equipment, supervision, insurance, maintenance, codes, laws, statues, or regulations, and all incidental expenses which are required to complete the work in place, ready-to-use and in accordance with the Drawings and Specifications.
SECTION 40 00 00

POSITIVE DISPLACEMENT BLOWERS

PART 1 GENERAL

1.1 DESCRIPTION
A. Furnish and install one (1) rotary lobe type, positive displacement blowers (AB-03), complete with outdoor sound enclosure, control panel and all accessories as specified herein and as shown on the Plans. Blower AB-03 shall be installed next to and tied into AB-01 and AB-02.

1.2 EQUIPMENT TAGS
A. Aeration Basin.
   AB-03: Aeration Basin Blower No. 3 WESTECH

1.3 APPROVED MANUFACTURERS
A. The rotary lobe, positive displacement blower shall match existing and be furnished by:
   1. Excelsior Gardner Denver Heliflow – 60 HP
   2. Engineer approved equal
B. All accessories identical to the existing blower units AB-01 and AB-02. Including 316 SS Sch 10 header and high heat resistant air valves and including installation of 316 SS Sch 10 header and high heat resistant air valves.

1.4 RELATED WORK
A. Concrete foundation pad, as required.
B. Stainless steel discharge header piping, valves and fittings, as required.
C. Connections to existing air piping at aeration basin, as required.
D. Electrical wiring and controls.

1.5 DESIGN CRITERIA

Each blower shall have a design rating as follows:

<table>
<thead>
<tr>
<th>Design flow:</th>
<th>1336 SCFM</th>
</tr>
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<tr>
<td>Inlet temperature:</td>
<td>43 degrees C/110 degrees F</td>
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</table>
Relative humidity: 60%
Total pressure: 6.59 psi
Maximum blower speed: 250 RPM
Maximum motor HP: 60 Hp
Maximum design noise level: 85 dba at 3 feet, free field
Site Elevation: 667 ft (approx.)

1.6 QUALITY ASSURANCE

A. All systems must meet TCEQ requirements and regulations.

B. All equipment and components specified herein shall be furnished by the blower manufacturer. The blower and accessories shall be factory assembled by the blower manufacturer. Each blower shall be run at the factory prior to delivery.

C. Provide Supplier/Manufacturer Authorized Factory Representative on-site to certify all installations per plans and specifications. Provide required start up and two days (8 hrs/day) City training on site after start-up has been successfully completed and approved by the Engineer.

1.7 SUBMITTALS

A. The manufacturer shall submit complete shop drawings of all equipment furnished including cut sheets describing purchased sub-components with the specific sub-components used for this project properly highlighted. All submitted information must include a certification that the submittal describes exactly the equipment to be provided.

B. The positive displacement blower manufacturer shall furnish as a minimum the following design and description information to establish compliance with these specifications:

3. Certified general arrangement drawings.

4. Blower descriptive data and drawings to include model number, assembly drawings, and materials list.

5. Complete performance curves showing capacity, pressure, efficiency and horsepower requirements.

6. Motor descriptive data to include name of manufacturer, type, model and frame size, horsepower, full load speed, enclosure construction, temperature rise and class of insulation system, voltage, frequency, number of phases, full load current, locked rotor current, allowable time at locked rotor, allowable phase imbalance, maximum in-rush current, and motor efficiency at 50, 75, and 100 percent of full load.

7. Silencer descriptive data and drawings to include name of manufacturer, type and model number, assembly drawing, materials list, outline dimensions, layout, weight, attenuation data at frequency bands at rated compressor capacity, pressure drop at rated compressor capacity, and design capacity of the silencer.
8. Instrumentation and Control System descriptive information and drawings to include control panel wiring diagrams, diagrams, and control schematics.

1.8 OPERATION AND MAINTENANCE MANUALS

A. Operation and maintenance manuals will be provided by the positive displacement blower manufacturer at least two weeks prior to shipment of all major equipment components. Each manual shall be a bound, indexed binder with drawings and pads lists prepared specifically for this project rather than general instructions that are not designed for this project.

B. As a minimum the manual shall contain:
   1. General arrangement and General arrangement detail drawings.
   2. Erection drawings.
   3. Motor descriptive data to include name of manufacturer, type, model and frame size, horsepower, full load speed, enclosure construction, temperature rise and class of insulation system, voltage, frequency, number of phases, full load current, locked rotor current, allowable time at locked rotor, allowable phase imbalance, maximum in-rush current, and motor efficiency at 50, 75, and 100 percent of full load.
   4. Silencer descriptive data and drawings to include name of manufacturer, type and model number, assembly drawing, materials list, outline dimensions, layout, weight, attenuation data at frequency bands at rated compressor capacity, pressure drop at rated compressor capacity, and design capacity of the silencer.
   5. Instrumentation and Control System descriptive information and drawings to include control panel wiring diagrams, diagrams, and control schematics.

1.9 DELIVERY

A. Fabricated assemblies shall be shop assembled and properly match marked for ease of field erection and then shipped in the largest sections permitted by carrier regulations.

B. All components shall be erected immediately upon receipt from the manufacturer or stored in strict conformance with storage recommendations provided by the manufacturer in the operation and maintenance manuals.

C. Units shall be lubricated in strict accordance with the instructions of the manufacturer's field service representative.

PART 2 PRODUCTS

2.1 BLOWER CONSTRUCTION

A. The blower shall be the rotary lobe positive displacement type, of the three-lobe involute design. The blower casing and end plates shall be fine-grained, high strength cast iron. The casing and
end plates shall be suitably ribbed for strength and to prevent distortion under operating conditions. The front and rear covers shall be removable for easy access to the bearings and gears for inspection and maintenance.

B. The ductile iron lobes shall be concentrically ground and shaped to precise involute form. The lobes shall operate in an oil-free environment without rubbing and shall be synchronized by a pair of precision-machined timing gears, shrunk fit to the shaft through conical coupling under pressure. The lobes shall be dynamically balanced by metal removal and not by adding counterweights. The lobes shall be pressed and pinned to the shaft.

C. The blower shaft shall be alloy steel, accurately machined and ground to size. The shaft shall be of ample size to carry the loads imposed under continuous service and startup.

D. The blower shall be provided with oil lubricated roller bearings of ample size to carry the loads imposed under continuous service without overheating. Bearings shall be of sufficient size to have a minimum B-10 life in accordance with AFBMA standards of 50,000 hours under normal conditions of operation. The bearing housing shall be designed with a retainer providing positive containment and with ground spacers to maintain permanent rotor clearances within the blower casing.

E. The rear bearing and gears shall run in a splash oil type housing. The front bearings shall be lubricated by a slash oil system, contained within one oil reservoir. Front and rear covers shall be removable for easy access for bearing and gear inspection. Grease lubricated bearing shall not be considered equal.

F. The seals on the drive end and driven end bearing housings shall be of the piston ring labyrinth type and shall have air vents incorporated in the end plates to prevent oil penetration into the air chamber and shall relieve excessive pressure on the seals.

2.2 MOTORS

A. The blowers shall be furnished with a maximum 60 HP motor. The electric motors shall be of the squirrel-cage induction type and shall be TEFC, suitable for 480 volts, 60 cycle, 3 phase power. The motors shall be 1800 RPM, horizontal with a 1.15 service factor. The motors shall have sufficient power to drive the blowers at their maximum required capacity and operating pressure. The motor shall have sufficient horsepower to discharge full blower capacity through the relief valve. The motor shall be furnished with 120 volt space heaters and thermostats for High Motor Winding Temperature Monitoring. The blower motor shall be inverter-duty.

B. The motor shall be built in accordance with the current NEMA standard in so far as it applies. Insulation of the motors shall be class "B". Bearings shall be of the grease lubricated ball type with a minimum AFBMA B-10 life of 100,000 hours.

C. Nameplates shall be stainless steel. Lifting lug or "O" type bolts shall be supplied on all motors.

2.3 BELT DRIVE

A. Each blower shall be furnished with a V-belt drive and an OSHA approved belt guard of sheet metal and expanded mesh conforming to applicable safety codes.
B. The V-belt drive shall be of the high capacity matched belt, multiple groove type, oil and heat resistance and static dissipating with a 1.4 service factor. The pulleys shall be of the split hub taper lock design and dynamically balanced.

C. The blower package drive system shall include an integral spring mechanism, which shall exert constant torque on the drive arrangement eliminating the need for periodic belt tightening and realignment.

2.4 ACCESSORIES

A. Inlet Filters Silencer

1. An absorptive type inlet filter-silencer will be provided to reduce noise. The inlet filter shall be situated inside the inlet silencer, and shall be designed to protect the blower from harmful dirt and foreign matter. The filter element shall be of the dry pleated media type. The filter shall be furnished with a filter differential pressure gauge which shall be flush mounted on the outside of the sound enclosure. The blower shall draw air from outside of the enclosure into the filter-silencer. Designs that draw inlet air from inside of the sound enclosure will not be considered.

B. Discharge Silencer

1. The blower package shall be provided with a reactive type discharge silencer composed of different expansion chambers, without the use of deadening material. Discharge silencers that utilize sound deadening material or insulation within the discharge silencer shall not be considered. The discharge silencer shall include a steel base plate designed to support the blower and all its appurtenances.

C. Pressure Relief Valves

1. The blower shall be provided with a spring-loaded pressure relief valve, set at 0.5 PSIG above the design working pressure. The pressure relief valve shall be capable of discharging the total blower output with 10% pressure accumulation. The pressure relief valve shall be external to the wall of the sound enclosure.

D. Check Valves

1. A 4” check valve shall be provided on the discharge side of the blower. The check valve shall consist of a stainless steel body, hinge post, hinge clamp and silicone seal for high temperature operation. The valve discs shall be designed such that when there is no flow, the discs shall be held tightly against the interior wall of the valve body and the flexible sealing shall provide an air tight seal to prevent reverse flow.

E. Butterfly Valves

1. The blower discharge shall be provided with a 4” lever operated flanged butterfly valve with EPDM seats and shall be capable of operating conditions at a temperature of 250 degrees F.

F. Flexible Connections
1. The blower package shall be provided with an outlet flexible connector. The flanged flexible connector shall be designed to alleviate stresses caused by thermal expansion and contraction in the piping system, and shall be capable of withstanding the pressure under all operating conditions at a temperature of 250 degrees F.

G. High Air Temperature Shutdown Switch

1. The blower shall be equipped with a high temperature safety switch housed in a NEMA 4X enclosure mounted on the sound enclosure which shall remove the motor power in the event of an unsafe blower temperature. The temperature switch shall include a stainless steel bulb and capillary with a stainless steel immersion stem mounted on the discharge piping of the blower.

H. Discharge Temperature Gauge

1. Each blower shall be furnished with one discharge temperature gauge. Thermometers shall have a 4” dial face with a range graduated from 80 degrees to 300 degrees F mounted on the sound enclosure and suitable for outdoor service. The case shall be resistant to moisture, dust and fumes and shall be mounted on the discharge pipe of the blower on the outside of the sound enclosure.

I. Discharge Pressure Gauge

1. Each blower shall be furnished with a stainless steel 0 – 15 psig liquid filled discharge pressure gauge. The gauge shall have a 4” dial face and shall be mounted flush on the acoustical housing.

2.5 SOUND ENCLOSURE

A. A sound enclosure shall be provided by the blower manufacturer to minimize the overall noise level. The enclosure shall be made of self-supporting epoxy-coated steel panels with noise dampening material. The noise dampening material shall be of the type design for maximum sound absorption. The base plate of the noise enclosure shall designed to support the blower and motor assembly and shall be epoxy-coated steel, and be designed to facilitate lifting with a forklift. An internal ventilation system shall be provided, operated by a 115 volt, single phase power supply. A ventilation fan attached to the blower shaft shall not be acceptable. The enclosure shall be designed to draw air into the enclosure to remove excess heat. Gauges shall be mounted flush on the acoustical housing and display discharge pressure, and inlet filter losses. All fasteners, machine and assembly bolts on the enclosure shall be type 304 stainless steel.

2.6 CONTROL PANEL

A. The pump control panel that was installed in a prior contract has all the wiring and control elements required for this blower, except for the addition of one VFD controller. The pump supplier will provide, and the contractor shall install within the existing panel a VFD controller unit identical to the existing VFD units for the other blowers, AB-10 and AB-02.
2.7 PAINTING

A. The blowers and fabricated steel accessories shall be cleaned by hand, SSPC-SP-2, or by power tools, SSPC-SP-3, to remove weld spatter and loose scale. The blowers and fabricated steel accessories shall be solvent cleaned, SSPC-SP-1, to remove dirt and oil prior to prime painting. All painted surfaces shall be primed with one coat of epoxy primer to a thickness of 0.8 to 1.2 mils. The primed surfaces shall be finished painted with one coat of epoxy paint to a thickness of 1.5 to 2.0 mils.

B. The air header discharge valves shall be factory prime painted prior to shipping with one (1) coat, 6.0 to 8.0 dry mils of Tnemec Series N69 Hi-Build Epoxoline II or equal.

C. Finish painting will be done in the field with one (1) coat, 3.0 to 5.0 dry mils of Tnemec Series 1074 Endura-Shield II or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. The blowers shall be installed in accordance with the manufacturer's recommendations as approved by the Engineer. Prior to start-up of the blowers, a field service representative shall inspect the equipment, make necessary final adjustments and certify the equipment ready for operation. Anchor bolts, nuts, and washers shall be of Type 316 stainless steel.

3.2 SERVICE

A. The equipment manufacturer shall provide a factory trained field service representative to inspect the installation and operation of the blowers. Field service representative must be available for a total of two (2) days to instruct the owner's personnel.

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT AND PAYMENT

A. Measurement and payment for this item will be as indicated within the PROPOSAL FORM. If this item is not indicated within the PROPOSAL FORM then it is to be considered subsidiary to the applicable sections(s).

B. Payment shall fully compensate the Contractor for all required labor, materials, equipment, supervision, insurance, maintenance, codes, laws, statues, or regulations, and all incidental expenses which are required to complete the work in place, ready-to-use and in accordance with the Drawings and Specifications, and all OSHA and TCEQ regulations and requirements.

END OF SECTION
SECTION 40 71 13

MAGNETIC FLOW METERS

PART 1 GENERAL

1.1 SCOPE

A. The Contractor shall furnish, test, install and place in satisfactory operation the magnetic flow meters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Control and Information System Scope and General Requirements

B. Powered Instruments, General

1.3 TOOLS, SUPPLIES, AND SPARE PARTS

A. Perform Work in accordance with TxDOT Standard Specification Item 110 "Excavation".

1.4 SUBMITTALS

A. Furnish one portable primary head simulator for calibration and testing of magnetic flowmeter signal converters. The calibrator shall be furnished complete with, test leads, carrying case and accessories. Calibrator shall be furnished by the flowmeter manufacturer and shall be fully matched to the instrumentation furnished.

PART 2 PRODUCTS

2.1 MAGNETIC FLOW METER SYSTEMS

A. Magnetic flow meter systems shall include a magnetic flow tube and a microprocessor-based "smart" transmitter that is capable of converting and transmitting a signal from the flow tube. Magnetic flow meters shall utilize the characterized field principle of electromagnetic induction, and shall produce DC signals directly proportional to the liquid flow rate. Meters shall be capable of bidirectional flow and totalize for forward, reverse and net totals.

B. Each meter shall be furnished with a stainless steel metering tube and carbon steel flanges with a polyurethane liner. Linerless designs are not acceptable. Liner shall have a minimum thickness of 0.125 inches. The inside diameter of the liner shall be within 0.125 inches of the inside diameter of the adjoining pipe. Liner protectors shall be provided on all flow tubes.

C. The flow tube shall be provided with Nickel Alloy (Hastelloy C) or 316 SS flush mounted electrodes. Ultrasonic electrode cleaning shall not be acceptable.

D. Grounding rings (2) shall be provided for all meters. The use of grounding electrodes are not acceptable.
E. All materials of construction for metallic wetted parts (electrodes, grounding rings, etc.) shall be minimum 316 stainless steel, but shall be compatible with the process fluid for each meter in accordance with the recommendations of the manufacturer.

F. Flow tube shall be rated for pressures up to 1.1 times the flange rating of adjacent piping. System shall be rated for ambient temperatures of -30 to +65°C. Meter and transmitter housings shall meet NEMA 4X requirements as a minimum. When mounted in a meter vault (or otherwise specified), flowtube shall be of IP 68 construction as installed by the factory (no field IP 68 installation allowed). When meter and transmitter are located in classified explosion hazard areas, the meter and transmitter housings shall be selected with rating to meet the requirements for use in those areas. Non-metallic transmitter housings shall not be acceptable.

G. The transmitter shall be remote mounted (or integrally mounted if shown on the plans) and have a polyurethane painted dual compartment aluminum, Nema 4X housing. Plastic housings are not acceptable. The transmitter shall utilize a 90-220 VAC power supply and have outputs including 4-20 mA (Hart), scalable frequency (0-10,000 Hz, pulse output, two (2) discrete outputs (to 30 VDC) and one (1) discrete input.

H. The transmitter shall provide a pulsed DC coil drive current to the flow tube and shall convert the returning signal to a linear, isolated 4-20 mA DC signal. The transmitter shall utilize "smart" electronics and shall contain automatic, continuous zero correction, signal processing routines for noise rejection, and an integral LCD readout capable of displaying flow rate and totalized flow. The transmitter shall continuously run self-diagnostic routines and report errors via English language messages. Standard diagnostics shall include transmitter hardware and software fault, flowtube sensor coil fault, tunable empty pipe, grounding and wiring fault and high process noise.

I. The transmitter's preamplifier input impedance shall be a minimum of 10^9-10^11 ohms which shall make the system suited for the amplification of low-level input signals and capable of operation with a material build up on the electrodes.

J. The transmitter shall provide an automatic low flow cutoff below a user configurable low flow condition (0-10%). The transmitter's outputs shall also be capable of being forced to zero by an external contact operation.

K. Each flow tube shall be factory calibrated in an ISO 9001 and NIST certified facility and assigned a calibration constant or factor to be entered into the associated transmitter as part of the meter configuration parameters. Manual calibration of the flow meter shall not be required. Meter configuration parameters shall be stored in non-volatile memory in the transmitter. An output hold feature shall be provided to maintain a constant output during configuration changes.

L. The transmitter shall be capable of communicating digitally with a remote configuration device via a frequency-shift-keyed, high frequency signal (Hart) superimposed on the 4-20 mA output signal. The remote configuration device shall be capable of being placed anywhere in the 4-20 mA output loop. A security lockout feature shall be provided to prevent unauthorized modification of configuration parameters.
M. Accuracy shall be 0.25% of rate over the flow velocity range of 1 to 30ft/sec. Repeatability shall be 0.1% of rate; minimum turndown shall be 100:1. Minimum required liquid conductivity shall not be greater than 5 uS/cm. Maximum response time shall be adjustable between 1 and 100 seconds as a minimum. Transmitter ambient temperature operating limits shall be -10 to +50°C. Power supply shall be 115 VAC, 60 Hz.

N. Flow tubes shall be 150-lb flange up to 24” mounted unless otherwise noted. For 30” and larger meter sizes, AWWA C207 Table 2 Class D flanges will be provided, unless otherwise noted.

O. The cables for interconnecting the meter and transmitter shall be furnished by the manufacturer.

P. Magnetic flow meter systems shall be as manufactured by Rosemount Model 8750W as represented by Macaulay Controls (281-282-0100) or equal.

PART 3 EXECUTION

3.1 REQUIREMENTS

A. Ground magnetic flow meter flow tubes and grounding rings in strict accordance with the manufacturer's recommendations.

B. The Magnetic Flowmeter system shall be verified and started-up by a factory trained representative. An Intelligent Device Manager Software shall be available to configure parameters, run diagnostics, and provide meter documentation. Calibration and service reports shall be provided to the contractor and City.

C. Refer to the specifications for further requirements.

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT AND PAYMENT

A. Measurement and payment for this item will be as indicated within the PROPOSAL FORM. If this item is not indicated within the PROPOSAL FORM then it is to be considered subsidiary to the applicable sections(s).

B. Payment shall fully compensate the Contractor for all required labor, materials, equipment, supervision, insurance, maintenance, codes, laws, statutes, or regulations, and all incidental expenses which are required to complete the work in place, ready-to-use and in accordance with the Drawings, Specifications, and all OSHA and TCEQ regulations and requirements.

END OF SECTION
SECTION 46 01 00

HEADWORKS SYSTEM
(SPIRAL SCREEN, COMPACTOR/BAGGER, DEGRITTER)

PART 1 GENERAL

1.1 SCOPE

A. The contractor shall furnish and install a complete, in-place and ready to use system. The system shall include integral fine screen, with compactor and bagger, grit removal equipment, flanged inlet and outlet connections, support frame, stairs and grating with handrails, electrical and controls, and all other appurtenances required or shown on the drawings. The fine screen shall consist of a tank assembly, with passive bypass system at peak flow, conveyor tube assembly, drive assembly, spiral assembly, and compactor/bagger assembly. The grit removal system shall consist of a settling tank, horizontal shaftless grit conveyor with drive, aeration and inclined shaftless grit dewatering conveyor with drive and chute.

1.2 APPROVED MANUFACTURERS

A. WESTECH
B. HUBER
C. LAKESIDE
D. ENVIRODYNE
E. Approved Equal

1.3 DESIGN CRITERIA

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg Daily Flow (ADF):</td>
<td>0.5 MGD</td>
</tr>
<tr>
<td>Peak Flow Rate:</td>
<td>2.0 MGD</td>
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<tr>
<td>Grit Capture @ Peak Flow Rate:</td>
<td>95 % of grit &gt; 50 mesh in size</td>
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<td></td>
<td>85% of grit 50-70 mesh in size</td>
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<tr>
<td></td>
<td>65% of grit 70-100 mesh in size</td>
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<td>Screen Basket Perforation Opening Size:</td>
<td>6 mm (nominal)</td>
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<tr>
<td>Grit Specific Gravity:</td>
<td>2.65</td>
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<tr>
<td>Screen and Grit Removal Spiral Angle of Inclination:</td>
<td>30-50 degrees</td>
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<tr>
<td>Inlet Pipe Connection Size:</td>
<td>16 inch flanged</td>
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<td>Outlet Pipe Connection Size:</td>
<td>16 inch flanged</td>
</tr>
<tr>
<td>Compaction Flush:</td>
<td>3 gpm @ 40 psi max</td>
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</table>

1.4 QUALITY ASSURANCE

A. All systems must meet TCEQ requirements and regulations.
B. The equipment supplier shall submit their quality system ISO 9001 certification, including sub-vendors. The quality system shall be audited by a third party independent inspector. Certification shall remain in effect throughout the project, including the two (2) year extended warranty period.

C. Provide Supplier/Manufacturer Authorized Factory Representative on-site to certify all installations per plans and specifications. Provide required start up and two days (8 hrs/day) City training on site after start-up has been successfully completed and approved by the Engineer.

1.5 WARRANTY

A. Performance Bond from City approved underwriter shall be provided for the equipment specified for this project. The warranty shall be for a period of two (2) years firm date of project acceptance. Such warranty shall cover all defects or failures of materials or workmanship which occur as the result of normal operation and service. Warranty shall cover all labor, supervision, equipment and repair as required for the two (2) year period following project completion and acceptance by the Engineer and the City. Testing requirements are stipulated in Codes and Regulation

1.6 SUBMITTALS

A. Three (3) copies of all materials required to establish compliance with these specifications shall be submitted for review. Submittals shall include at least the following:

1. Supplier/Manufacturer Engineer Certified drawings showing all details including materials of construction, dimensions, loads on supporting structures, and anchor bolt locations. Include certified changes to foundation.

2. Descriptive literature, bulletins and/or catalogs of the equipment.

3. Complete data on motors and gear reducers.

4. Wiring diagrams and electrical schematics for all control equipment to be furnished.

B. Supplier/Manufacturer to provide submittals for all engineered drawings/ specifications/ manuals for installation. The submittals shall include system design for tank design including all equipment weights and structural loads required for concrete foundation design. The manufacturer to provide a licensed Texas Professional Engineer to approve, seal and certify the submittals. Contractor shall include in his bid all stainless steel (316 L) metals, structural requirements, walkways/stairways, splitter box, piping, valves or any other items necessary for a complete and operable system. The system design (including hydraulic profile) is based upon the WesTech CleanFlo All-In-One packaged headworks system. Use of another listed or equivalent manufacturer is dependent upon submission and approval of adequate engineering design documents. All changes associated with the use of another listed or equivalent manufacturer are the responsibility of the Contractor. No additional compensation will be allowed for any modifications related to furnishing and installing another listed or equivalent manufacturer’s equipment.
1.7 REFERENCES

A. American Society of Mechanical Engineers:
   2. ASME B16.3 – Malleable Iron Threaded Fittings.

B. ASTM International:
   5. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

C. American Welding Society:
   1. AWS D1.1 – Structural Welding Code – Steel.

D. National Electrical Manufacturers Association:
   1. NEMA 250 – Enclosures for Electrical Equipment (100 Volts Maximum).

E. SSPC SP 10 – Near-White Blast Cleaning.

PART 2 PRODUCTS

2.1 GENERAL DESIGN

A. Functional Description: The combined headworks station shall be mounted as indicated by the contract drawings in an integral tank. Flow shall enter the unit through the inlet and material larger than the perforation opening size will be captured on the screen basket. The spiral screw then transports the material, conveying it to the compaction zone, where the material is washed and dewatered. The screenings are then pushed into the discharge section of the unit where it is released to the screening’s container below. The screen basket is self-cleaning via the interaction of the spiral screw brushes. Effluent from the screen enters the grit tank, where material settles to the bottom of the tank. A horizontal spiral collects the material and transports it to the front of the unit where the inclined grit classifier spiral is located. The inclined spiral carries the grit out of the grit tank through a second conveyor tube to the grit discharge of the unit. The
contractor to supply and install 2” diameter PVC SCH 80 Non-Potable Water Supply (NPW) to connect to the water connection points of the headworks system.

B. Materials of Construction: All wetted parts shall be constructed from type 316 (L) stainless steel. Bearings, electrical devices, motor and gear reducer shall be of the manufacturer’s standard materials, as approved by the Engineer.

C. Shop Surface Preparation/Coating: All welds shall be cleaned and passivated to remove weld spatter, slag and discoloration. Bearings, electrical devices, motor and gear reducer shall be provided with the manufacturer’s corrosion resistant coating system. Apply field preparation and coating after installation is completed and before start-up. Perform all welding in accordance with AWS D1.1 requirements.

D. Fine Screen:

1. **Tank Assembly:** The integral tank assembly encloses the screen basket.
   a. The tank shall be constructed from type 316 (L) stainless steel. The tank shall be designed to withstand the hydrostatic load from the process flow through the unit and provide support of the screening’s basket area. The tank is supplied with footings for anchoring the unit and lifting lugs for installation. The tank shall be supplied with 16-inch flanged inlet connection and lifting lugs.
   b. The screen tank shall be supplied with an integral passive bypass chamber to allow high level in front of the screen weir to overflow to bypass chamber. The bypass chamber shall be supplied with a required manual bar rack for 2.0 mgd peak flow and access door to allow inspection and cleaning. The tank and bar rack shall be manufactured from type 316 (L) stainless steel. Include liquid level sensor to alarm during overflow bypass condition.
   c. The top of the tank shall be enclosed by type 316 (L) stainless steel covers, including a hinged access door. A safety microswitch shall be installed to prevent the screen from running while accessing the tank area. Covers shall allow for mounting of the ultrasonic level sensor and vent connection.
   d. A separate support stand shall be constructed from type 316 (L) stainless steel and provide support of the conveyor tube extension.

2. **Basket Assembly:** The basket assembly filters solids from the wastestream.
   a. The screen basket shall be a semi cylindrical shape constructed from 11-gauge thick type 316 (L) stainless steel. The basket shall be perforated providing nominal 6 mm fine openings to allow water to pass through while capturing solid material in the influent stream. The base of the basket shall be a solid plate to provide adequate support for the base of the unit and to prevent bypass underneath the screen. At the top, the basket shall be fastened to the transition cone.
   b. To prevent bypass around the sides of the screen basket, neoprene seals shall be mounted on the upstream face of the screen basket extending to the tank sidewalls.
The seals shall be secured in place by backing plates constructed from type 316 (L) stainless steel.

c. All fasteners to be 316 (L) stainless steel.

3. **Conveyor Tube Assembly**: The conveyor tube assembly transports material from the screen basket to the compaction and discharge zones.

   a. The transition cone connects the screen basket to the conveyor tube. The transition cone shall be constructed from 1/8-inch-thick or greater type 316 (L) stainless steel. Wear bars constructed from 5/16-inch-thick or greater type 316 (L) stainless steel shall be mechanically fastened to support the spiral assembly and prevent rotation of the screenings within the cone. Wear bars shall be replaceable without requiring welding or replacement of the cone. The cone shall be constructed with mating flanges and stainless-steel hardware to allow for disassembly and ease of access for the replacement of the wear bars.

   b. The conveyor tube shall be nominal 12-inch OD and shall be constructed from 1/8-inch-thick or greater type 316 (L) stainless steel. Wear bars constructed from 1/8-inch-thick or greater type 316 (L) stainless steel shall be mechanically fastened to support the spiral assembly and prevent rotation of the screenings within the conveyor tube. Screws fastening the bars shall use seal washers and have their heads external to the unit to allow for periodic tightening or adjustment of the bars. Wear bars shall be replaceable without requiring welding or replacement of the conveyor tube.

4. **Drive Assembly**: The drive assembly transmits power generated by the motor to the spiral screw of the screen to clean the basket area and convey screenings up the transport tube to the discharge of the unit.

   a. The reducer shall be a helical gear type. The unit will be provided with a cast iron frame and be designed in accordance with AGMA recommendations for Class II service based on the horsepower required to operate the screen.

   b. The motor shall be TEFC with heaters, 1.5 Hp, 1800 RPM, 460 Volt, 3 phase, 60 Hz. The motor shall be NEMA design code B and be direct coupled to the reducer.

   c. The motor/reducer assembly shall be directly connected to the main drive. Chain and sprocket assemblies are not acceptable. All transition adaptor flanges shall be 316 (L) stainless steel or cast iron.

5. **Spiral Screw Assembly**: The spiral screw assembly cleans the screening basket, and directs material up the conveyor tube to the discharge of the unit.

   a. The spiral screw shall be shaftless with the exception of the compaction and discharge areas and be 316 (L). Additional flight length of type 316 (L) stainless steel is welded to the spiral to increase the screw OD in the basket and transition.
areas while maintaining a constant ID. The screw shall pass through the conic section of the frame in the conveyor tube at the screening basket.

b. The spiral flight shall terminate at the compaction zone of the unit, allowing for the compaction of the screenings, and free release of the compacted screenings in the discharge section.

c. The drive end of the spiral at the discharge location shall be shafted with a mounting flange to mate with the drive shaft connected to the motor/reducer assembly. This allows the screw to be replaced as an individual item without the need to disconnect the drive system from the unit or removing the shaft from the gearbox.

d. The spiral will be equipped with water resistant brushes in the screening basket area. The brush shall have nylon bristles molded into a plastic core. The brush shall be attached to the trailing edge of the spiral screw to clean material from the screening basket and push it onto the screw into the transport area. The brush will be sectioned, for ease of replacement, with each individual section covering 180° of the spiral, combining to form a continuous brush over the length of the basket. The sectioned brushes shall allow for individual replacement due to localized wear. Brushes supplied as a continuous length that require the entire brush to be replaced or that must be wrapped around several pitches of the spiral for installation are not acceptable. The brush will be attached to the screw with 316 (L) stainless steel fasteners.

6. **Compaction Zone Assembly:** The compaction zone shall be a two chambered rectangular section at the end of the transport tube to dewater the screened material.

a. The first chamber of the compaction zone shall be a cylindrical drum encased by the rectangular enclosure. The drum shall be constructed from 1/8-inch-thick or greater type 316 (L) stainless steel. The drum shall maintain the same ID as the conveyor tube and shall have perforations on its underside to allow water to drain from the pressed screenings. The enclosure shall be constructed from type 316 (L) stainless steel and shall be supplied with a pipe stub to provide drainage of the compaction zone. Direct the pressate back into the channel downstream of the screen.

b. A spray bar shall be installed inside the compaction enclosure to keep the compaction zone clear and rinse any residual solids from the drain area of the enclosure. The spray bar shall be constructed from type 316 (L) stainless steel pipe. The spray requires 3 gpm @ 40 psi max.

c. The second chamber of the enclosure shall be an open rectangular discharge section. The cross-sectional expansion of this area from the cylindrical compaction drum allows the dewatered material to freely fall away from the spiral shaft. Designs that require reversed flights or cutters to effectively discharge material from the unit are not acceptable.
d. A top mounted, hinged access door is provided to the compaction zone and discharge section for maintenance. The door shall expose the entire length and width of the compaction and discharge areas in order to provide complete unobstructed access to these areas. The door shall be constructed from type 316 (L) stainless steel and shall be mounted with 316 (L) stainless steel hinges. A safety microswitch shall be installed to prevent the screen from running while accessing the compaction zone and discharge section. Designs incorporating access from underneath the compaction zone or the vertical discharge section are not acceptable.

7. Bagging System: One (1) continuous bagger assembly shall be provided at the end of the end of the screening and grit discharge sections and will be equipped with a type 316 (L) stainless steel transition piece to a continuous bagging device to capture the dewatered screenings. The bagging device shall be supplied with a refillable magazine of continuous plastic hose per Supplier/Manufacturer and as approved by the Engineer.

E. Grit Removal System:

1. Grit Tank: After leaving the fine screen portion of the unit, the flow shall enter a settling chamber where the inorganic particles will settle out of the liquid.

   a. The chamber shall be constructed from type 316 (L) stainless steel and shall be provided with a type 316 (L) stainless steel support structure that provides complete support for the grit and screen chambers. The grit tank shall have an overflow weir with a 16-inch flanged effluent connection and a capped drain connection.

   b. The top of the tank shall be enclosed by type 316 (L) stainless steel covers. All covers shall be removable for full access to the grit tank.

   c. Along one side of the tank, coarse bubble diffusers will be supplied to aid in suspension of organic material to improve the grit quality. The system shall be constructed from type 316 (L) stainless steel and include horizontal headers and vertical drop legs to an external connection on the grit tank. Air must be supplied to the unit from the existing plant blower system through an air flow meter and air adjustment diamond port Valve. Provide required air supply at 25-60 scfm/2.6 psi pressure.

2. Grit Spirals: The grit tank is supplied with a horizontal grit collection spiral and an inclined grit removal spiral.

   a. The horizontal grit collection spiral shall be fabricated from stainless steel 316 (L) high strength alloy sections formed continuously into a spiral. The spiral shall be 7 inch or greater and, approved by the Engineer.
b. The inclined grit removal spiral shall be fabricated from 316 (L) stainless steel sections formed continuously into a spiral. The spiral shall be 11 inch or greater and shall be supplied with a protective epoxy primer, approved by the Engineer.

3. Drive Assembly: Separate drive assemblies transmit power generated by the motors to the spiral screws of the grit tank to collect and transport settled inorganic material to the discharge of the unit.

   a. Each reducer shall be a helical gear type. The unit will be provided with a cast iron frame and be designed in accordance with AGMA recommendations for Class II service based on the horsepower required to operate the screen.

   b. Each motor shall be TEFC (with heaters), 3/4 Hp, 1800 RPM, 460 Volt, 3 phase, 60 Hz. The motor shall be NEMA design code B and be direct coupled to the reducer.

   c. The motor/reducer assembly shall be directly connected to the main drive shaft via the reducer’s hollow shaft. Designs that incorporate additional chain and sprocket assemblies are not acceptable.

F. BLOWER/COMPRESSION PACKAGE

1. Grit Tank Aeration Blower: The manufacturer shall supply a blower/compressor package suitable for meet the grit tank aeration requirements. The package shall be furnished complete with a fabricated steel base, inlet filter, silencer, pressure relief valve, check valve, exhaust line flexible connector and motor. The unit motor shall be 5 HP, 1800 RPM, 460 Volt, 3 phase, 60 Hz.

G. BLOWER/COMPRESSION ENCLOSURE

1. Grit Tank Aeration Blower Enclosure: The manufacturer shall supply a fiberglass enclosure for installation of the blower package. The enclosure shall be lined with 1/2-inch-thick acoustic absorption foam and be supplied with louver to permit airflow. The enclosure exterior shall be provided with a UV resistant gel coat 10 mils thick.

C. ELECTRICAL

In addition to the drive motor, the equipment supplier shall furnish all electrical items specifically called for in this specification section and meet all City permit/code regulations and requirements. The contractor shall supply all other electrical items, and interconnecting wiring of proper size, including all conduit and supports required to place the equipment into service.

1. Dead Front Control Panel with a three (3) point exterior latch: A 480-volt primary control panel shall be provided in a NEMA 4X type 316 (L) stainless steel, enclosure suitable for wall mounting with the following components to provide proper operation of the equipment:

   a. Step down control transformer, and interior door for mounting all controls including disconnect.

   b. Branch circuit protection.
c. Screen and grit drive motor starters.
d. Emergency stop pushbutton.
e. Hand-Off-Auto selector switches for the drives and spray wash.
f. Current monitors shall provide overload protection of each motor by sensing motor current draw.
g. Hour meter for each motor.
h. Control power and run indicating lights.
i. Alarm light indicating over current, and starter overload and high level.
j. Alarm reset pushbutton.
k. Control relays and timers to provide necessary control logic and monitor equipment mounted electrical devices.
l. Run and alarm auxiliary contacts for use by the customer
m. Panel heater with thermostat
n. UL Label.

2. **Local Emergency Stop Pushbutton:** A local emergency stop pushbutton station will be provided in a NEMA 4X enclosure for field mounting at the screen unit.

3. **Safety Microswitch:** Two (2) 120V safety switches shall be factory mounted to the compaction/discharge zone, and screen tank access doors. Each microswitch shall prevent operation of the unit while the door is open. Each switch housing shall be rated NEMA 4X.

4. **Solenoid Valve:** One (1) solenoid valve shall be provided to control flow to the spray wash assembly. The brass body valve shall be 120 Volt, single phase, 60 Hz with a NEMA 4X housing.

5. **Ultrasonic Level Sensor:** An ultrasonic level sensor shall be provided for operation of the unit by upstream water level and high-level alarm. The level sensor shall utilize an ultrasonic beam for measurement of the liquid level and be provided with an LCD display and two C-form contacts corresponding to individual level settings.

**PART 3 EXECUTION**

3.1 **SEQUENCE OF OPERATION**

A. *Screen Hand Operation:* When the screen selector switch is in the Hand position, the screen will run continuously. Turning the screen selector switch to Off will stop the unit.

B. *Screen Automatic Operation:* When the screen selector switch is in the Auto position, the screen will cycle on demand by the level sensor or repeat cycle timer. After the level sensor condition has cleared, the screen shall continue to run for an off-delay time to prevent excessive starting and stopping of the unit. The repeat cycle timer shall reset after the screen is called to run by the level sensor.
C. Compaction Zone Spray Wash Hand Operation: When the spray selector switch is in the Hand position, the spray wash will run continuously. Turning the selector switch to Off will stop the spray wash.

D. Compaction Zone Spray Wash Automatic Operation: When the spray selector switch is in the Auto position, the spray wash will cycle on and off per the settings of the spray wash repeat cycle timer.

E. Horizontal Grit Collection Spiral Hand Operation: When the spiral selector switch is in the Hand position, the horizontal spiral will run continuously. Turning the selector switch to Off will stop the unit.

F. Horizontal Grit Collection Spiral Automatic Operation: When the spiral selector switch is in the Auto position, the spiral will cycle on and off per timer settings.

G. Inclined Grit Removal Spiral Hand Operation: When the spiral selector switch is in the Hand position, the horizontal spiral will run continuously. Turning the selector switch to Off will stop the unit.

H. Inclined Grit Removal Spiral Automatic Operation: When the spiral selector switch is in the Auto position, the spiral will cycle on and off per timer settings.

I. Fault Conditions:
   1. Excessive motor current will trip the starter overload relays, immediately stop the drive motor, and illuminate the alarm indicating light. This fault must be reset by depressing the motor starter overload reset internal to the control panel.
   2. Momentary motor over or under current will trip the current monitor, immediately stop the drive motor, and illuminate the alarm indicating light. Pushing the reset pushbutton will reset this fault.
   3. High level in from of fine screen will activate alarm light.

J. Anchorage and Fasteners:
   1. Anchor Bolts: All anchor bolts, nuts and washers shall be a minimum of 1/2 inch diameter and made of type 316 (L) stainless steel. The equipment supplier shall furnish all anchor bolts, nuts, and washers required for the equipment.
   2. Fasteners: All fasteners shall be type 316 (L) stainless steel. The equipment supplier shall furnish all fasteners required for the assembly of the equipment.

3.2 INSTALLATION

A. General: The foundation and equipment shall be designed and installed properly to provide a complete working system. Installation shall follow the Contractor supplied submittal certified and sealed by a licensed Professional Engineer (Texas).
B. Manuals: The equipment supplier shall furnish Four (4) hard copies of operation and maintenance manuals, including electronic version on C.D. with index which will be retained at the installation site to assist plant operators. The manual shall include the supplier’s erection and assembly recommendations, a complete parts list, and a list of recommended spare parts.

C. Shop Assembly: The equipment specified herein shall be completely factory assembled and inspected prior to shipment.

D. Field Service: The equipment supplier shall provide the service of a Factory Authorized Qualified Representative to inspect the equipment installation, assist in start-up, and instruct plant personnel in the proper operation and maintenance of the equipment as outlined under General Section 1.4.C The contractor is responsible for the startup plan and certification that the installation meets the Factory Authorized Representatives written approval.

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT AND PAYMENT

A. Measurement and payment for this item will be as indicated within the PROPOSAL FORM. If this item is not indicated within the PROPOSAL FORM then it is to be considered subsidiary to the applicable sections(s).

B. Payment shall fully compensate the Contractor for all required supervision, insurance, labor, materials, parts and all equipment, electrical wiring and conduits, piping/valves/fittings, lubrication/grease, field welding/erection, performance testing and start up, grating platforms, stairs, handrails, anchoring, concrete foundation, drains, startup on-site factory representative including training, submittals for all tanks, equipment, grating, platforms, and concrete foundations to be approved, certified and sealed by a Licensed Professional Engineer, all work installed meeting all local, state, and federal regulations, codes, laws, statutes and guidelines, and all incidental expenses which are required to complete the work in place, complete, ready-to-use and in accordance with the Drawings and Specifications, and all OSHA and TCEQ regulations and requirements.

END OF SECTION
SECTION 46 02 01
CIRCULAR SPIRAL SCRAPER CLARIFIER

PART 1 GENERAL

1.1 SCOPE

A. Furnished and install Concrete Structure, equipment, piping, walkways, and electrical requirements for a thirty-five foot (35’) circular spiral scraper shaft drive clarifier. The equipment shall include a center drive unit and torque control, access stairs with concrete landing and bridge walkway, platform with handrail, stationary influent pipe, center feedwell, rotating drive shaft, rake arms with spiral blades, anchor bolts, scum skimmer, scum box, effluent weir, launder weir brushes, scum baffle, foam/froth control system and all other appurtenances required or shown on the drawings. Total installation shall meet all TCEQ and plant permit parameters.

1.2 REFERENCES

A. American Society of Mechanical Engineers:
   2. ASME B16.3 - Malleable Iron Threaded Fittings.

B. ASTM International:
   5. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.

C. American Welding Society:
   1. AWS D1.1 - Structural Welding Code – Steel; AWS D1.6 – Stainless Steel

D. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment
1.3 QUALITY ASSURANCE AND MANUFACTURERS QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum ten (10) years documented experience.

B. Contractor specializing in performing work of this section with minimum ten (10) years documented experience.

C. Welders: AWS certified within previous 12 months.

D. Approved Manufacturers

   1. WESTECH
   2. WALKER PROCESS
   3. LAKESIDE
   4. ENVIRODYNE
   5. Approved Equal

1.4 DESIGN CRITERIA

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<th>Influent flow rates per clarifier (MGD)</th>
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<tbody>
<tr>
<td><strong>Peak (flow):</strong></td>
<td>0.72 (4Q)</td>
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<tr>
<td><strong>Tank diameter (ft.):</strong></td>
<td>35 feet</td>
</tr>
<tr>
<td><strong>Side water depth (ft.):</strong></td>
<td>12 feet (Total depth 15.9 feet)</td>
</tr>
<tr>
<td><strong>Freeboard (ft.):</strong></td>
<td>1.0 foot min.</td>
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<tr>
<td><strong>Bottom slope (in./ft.):</strong></td>
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</tr>
</tbody>
</table>

1.5 SUBMITTALS

A. Three (3) copies of all materials required to establish compliance with these specifications shall be submitted for review. Submittals shall include the following:

   1. Adhere to City of Laredo requirements for submittals.

   2. Shop Drawings:

       a. Submit detailed shop drawings for system materials and component equipment, including detailed wiring and control diagrams.

       b. Show complete information concerning fabrication, installation, anchoring, fasteners and other details.

   3. Descriptive literature, bulletins, and/or catalogs of the equipment.

   4. Complete data on motors and speed reducers.
5. Wiring diagrams and electrical schematics for all control equipment to be furnished.

6. Complete descriptive information and electrical schematic for the torque overload device.

7. Complete sludge transport calculations substantiating the rake blade design, rake tip speed, and floor slope.

8. The submittal shall include data from a minimum of five (5) successfully operating installations that verify the experience of the manufacturer.

1.6 SHOP ASSEMBLY AND INSPECTION

A. The equipment specified herein shall be factory assembled as far as practical to verify that all mating parts can be field assembled. All mating parts shall be trial fit and match-marked. The manufacturer shall submit certification of shop trial assembly and photographs of assembly before shipment. The customer and installing contractor shall be given the opportunity to witness the shop assembly.

B. Shop inspection shall be performed by a qualified inspector and certified by the manufacturer. The inspection shall be documented, and all deficiencies noted, corrected, re-inspected and final completion formally authorized. Final shipment authorization shall be by the manufacturer to ensure completion of all fabrication, assembly, and inspection requirements. Inspection records and evidence of inspector qualification shall be submitted to the owner upon request.

PART 2 PRODUCTS

2.1 GENERAL DESIGN

A. Description

1. The clarifier mechanism shall be of the center drive type, mounted on a walkway which spans the tank and bears on the wall at each end. Flow shall enter the inlet through an influent pipe. The clarifier shall be designed to remove settled sludge from the bottom of the tank and floating scum from around the periphery of the tank.

a. The clarifier shall perform the following integrated functions:

1) Dissipate energy and control localized currents.
2) Separate solids form the clear liquid.
3) Evenly withdraw the clear liquid.
4) Transport and thicken settled sludge.
5) Remove scum from the clarifier surface.
B. Materials

1. All structural steel shall conform to AISC – Steel Construction Manual latest edition. All steel plates shall conform to ASTM A36. All structural steel shape series of M, MT, S, ST, C, MC, L shall conform to ASTM A36. Structural steel shapes W, WT, HP shall conform to ASTM A992/A572. All pipes shall be ASTM A53, Grade B. All square and rectangular tubing shall be ASTM A500, Grade B, unless otherwise noted. Steel members in contact with liquids, either continuously or intermittently, shall have a minimum thickness of 1/4 inch unless otherwise noted. All aluminum shall be type 5052, 6061, 6063, or 2014 alloy unless noted. All stainless steel shall be type 316 unless noted.

C. Fabrication

1. Shop fabrication and welding of structural members shall be in accordance with the latest edition of the "Structural Welding Code", AWS D1.1, (AWS D1.2-Aluminum, AWS D1.6-Stainless Steel), of the American Welding Society. All welded connections shall develop the full strength of the connected elements and all joined or lapped surfaces shall be completely seal welded with a minimum 3/16” fillet weld. Intermittent welding shall not be allowed, except on non-ferrous metals.

D. Edge Grinding

1. Sharp projections of cut or sheared edges of ferrous metals shall be ground to a radius by multiple passes of a power grinder as required to ensure satisfactory coating adhesion.

E. Shop Surface Preparation/Coating

1. All iron and steel surfaces, except the drive unit, shall be Hot Dip Galvanized (HDG), after fabrication.

F. Structural Design

1. All steel design shall be in accordance with the AISC Manual of Steel Construction, latest edition and the International Building Code (IBC), latest edition.

2.2 DRIVE UNIT

A. Design Parameters

1. The drive unit shall be designed and manufactured by the clarifier equipment supplier to ensure unit responsibility. The drive unit shall be designed for the torque values previously listed. It shall turn the mechanism at the design collector tip speed. The drive main bearing shall be designed for the total rotating mechanism loads with a minimum L-10 life of 50 years or 438,000 hours. The drive unit shall be capable of producing and withstanding the previously listed momentary peak torque while starting. The drive main gear shall be designed to a minimum AGMA 6 rating when rated in accordance with the latest AGMA standard. Gear teeth shall be designed for proper load distribution and sharing. Stub tooth design and surface hardening of the main gear shall not be allowed. The main bearing shall be capable of withstanding the
listed overturning moment without the aid of any underwater guides or bearings to ensure correct tooth contact for AGMA rating of the main gear.

B. Physical Characteristics

1. The drive unit shall consist of a motor, secondary speed reducer, and support base. The drive shall be mounted on the walkway and support the entire rotating load of the mechanism. All speed reducers shall be fully enclosed and running in oil or grease. Support base for the drive shall be of welded steel to assure rigidity. Lubricant and dust seals shall be provided. Lubrication fittings shall be readily accessible.

C. Overload Protection

1. An overload device shall be provided in a stainless steel, weatherproof enclosure. The device shall be actuated by torque generated from the main drive, which shall operate two independently adjustable switches (the alarm switch at 100 percent of design running torque and the motor cutout switch at 120 percent of design running torque). Devices that require the worm to float and measure the thrust of the worm gear shall not be acceptable. These two switches shall be factory adjusted to accurately calibrate the alarm torque value and the overload position. A visual torque indicator shall be provided and oriented so that it may be read from the walkway. It shall be calibrated from 0 to 160 percent of design running torque.

D. Speed Reducing Unit

1. The speed reducing unit shall consist of cycloidal, helical, or planetary speed reducers directly connected to a motor without the use of chains or v belts.

2. The main ring gear of cycloidal drives shall be made of high carbon chromium bearing steel and be fixed to the drive casing. An eccentric bearing on the high-speed shaft shall roll cycloidal discs of the same material around the internal circumference of this main ring gear. The lobes of the cycloid disc shall engage successively with pins in the fixed ring gear. The movement of the cycloid discs shall be transmitted then by pins to the low speed shaft. Speed reducer efficiency shall be a minimum of 90% per reduction stage.

3. Speed reducer helical or planetary gearing shall be manufactured to AGMA standards and shall provide at least 95% power transmission efficiency per stage. The speed reducer shall have a minimum service factor of 1.25 based on the output torque rating of the drive.

4. The reducers shall be fitted with radial and thrust bearings of proper size for all mechanism loads and be oil or grease lubricated. As a safety feature, the speed reducer shall be back drivable to release any stored energy as the result of an over torque condition.

E. Motor

1. The motor shall be a squirrel cage, induction type, TEFC, ball bearing heavy duty unit of ample power for starting and operating the mechanism without overload, with a minimum service factor of 1.15.
F. Drives shall utilize SEW Eurodrive gear motors.

2.3 WALKWAY AND PLATFORM

A. Walkway

1. One (1) 36 inch wide walkway and platform with OSHA approved handrails shall be supported by the tank wall at its outer ends, and shall be designed to safely withstand a live load of 50 pounds per square foot. Deflection shall not exceed L/360 when both the dead load and live loads are applied. It shall consist of two trusses or beams with 1-1/4 inch aluminum I-bar grating between the trusses or beams. The walkway shall be diagonally braced against lateral movement, and provided with handrails 42 inches high, of double-row 1-1/2 inch diameter horizontal aluminum pipe, and 4 inch high kickplates on both sides. Walkway trusses may serve as the handrail if the top chord is 3 feet-6 inches above the walking surface. Provide tank across stairway and concrete landing.

   a. Stainless steel bearing plates, UHMW-PE slide plates, and anchor bolts for the wall support shall be provided by the equipment supplier and installed by the contractor. Bearing plate dimensions and anchor bolt diameter, length, quantity, and arrangement shall be per the equipment supplier. The contractor shall block out or otherwise modify the tank or support structure to accommodate walkway and supports, if required.

B. Center Drive Platform

1. A center drive platform shall be provided which allows 24 inches clearance outside the center drive components. It shall consist of 1/4 inch aluminum checkered plate with necessary stiffeners and supports, resting on the drive unit and center column, and provided with connections to the walkway. The entire platform shall be surrounded by handrails 42 inches high of double-row 1-1/2 inch diameter horizontal aluminum pipe with 4 inch high kickplates.

C. Foam/Froth Control System

1. Furnish factory installed and tested foam/froth control system, with necessary, nozzles, piping, valving and controls, capable of controlling frothing or foaming in the clarifier.

2. Nozzles:

   a. Introduce pumped water from the NPW System into aeration chamber through spray nozzles attached to spray header, and attached along half of the clarifier bridge.

   b. Nozzles: Flat, hard spray pattern discharging NPW entire length of clarifier bridge (approximately 17’).
2.4  INFLUENT AND SLUDGE REMOVAL

A.  Rotating Center Drive Shaft and Cone Scraper

1.  A rotating steel drive shaft of 1/4" minimum wall thickness shall be provided. The shaft shall be suspended vertically from and receive its rotational power from the center drive unit mounted on the operating platform. The shaft shall extend down to a sludge cone in the center of the tank floor.
   a.  The shaft shall have a steel cone scraper attached to its lower end to prevent deposit of solids in the sludge cone.
   b.  The shaft shall be provided with connections for the two sludge rake arms and feedwell supports. The shaft shall be bolted to the drive unit which shall rotate the shaft with the attached arms and feedwell. The shaft and each arm shall be designed to withstand 150 percent of the design running torque of the drive without over stressing the members. Loading to develop the torque shall be considered as uniform loads applied to each arm individually.
   c.  The rotating shaft shall have adequate structural strength to support the entire rotating mechanism, including rake arms, cone scraper, scum scraper and support, scum skimmer, and feedwell. Design shall accommodate dead load plus live load and torque with an adequate factor of safety to eliminate deflection or vibration.

B.  Feedwell

1.  The flocculating feedwell shall be located to diffuse the liquid into the tank without disturbance or formation of velocity currents. Baffled openings shall be provided near the water surface to allow scum to exit the feedwell.
   a.  The supports for the feedwell shall be located above the liquid extending from the shaft. The depth of the feedwell shall be such as to provide proper detention time and an exit velocity at maximum flow that will not scour the settled sludge. The diameter, depth, detention time, and exit velocities shall match the process application calculations as evidenced by the required successful operating installations.
   b.  The feedwell shall be made of not less than 3/16 inch HDG thick steel plate with necessary stiffening angles.

C.  Influent Pipe

1.  A 12” Ductile Iron influent pipe with Protecto 401 lining or approved equal shall be provided for delivering influent into the feedwell. The pipe shall discharge vertically into the EDI and be supported from the tank wall.
D. Sludge Rake Arms

1. The mechanism shall include two long sludge rake arms of steel truss construction with spiral-shaped steel scraper blades and adjustable stainless steel squeegees. Squeegees shall be fastened to the rake blades with stainless steel fasteners.
   
a. Scraper blades shall be designed for sufficient sludge transport capacity to handle the design solids loading rate, with the depth of the blade varying from a minimum at the tank periphery to a maximum at the tank center.

b. Scraper blades shall be designed for sufficient sludge transport capacity to handle the design solids loading rate, with the depth of the blade varying from a minimum at the tank periphery to a maximum at the tank center.

c. The blades shall rake the sludge to a center sludge cone. The arms shall be adjustable at the shaft to assure an even grout thickness over the tank bottom.

d. The rake speed shall be sufficient to transport the necessary volume of sludge to the sludge outlet, but shall not re-suspend settled sludge.

2.5 SCUM REMOVAL

A. General

1. The clarifier manufacturer shall furnish one (1) skimming device as part of each clarifier mechanism. Each skimming mechanism shall be arranged to sweep the surface of the sedimentation compartment, automatically removing scum and floating material to a scum box at the periphery of the tank.

B. Skimmer Construction

1. The rotating scum skimmer shall include a horizontal steel plate skimmer stainless steel blade supported by vertical steel members extending up from the rake arms. The blade shall extend from a point 6 inches away from the influent feedwell to the hinged scum skimmer assembly at the tank periphery.

C. Scum Skimmer Assembly

1. A hinged scum skimmer assembly shall be mounted on the outer end of the skimmer blade. The hinged scum skimmer assembly shall be designed to form a pocket for trapping the scum. The hinged arrangement shall insure continual contact and proper alignment between wiper blade, scum baffle, and ramp as the blade travels up the scum box ramp. The wiper blade shall have a wearing strip on its outer end which contacts the scum baffle and a neoprene strip on its lower and inner edge. The neoprene wipers shall be a minimum 1/4 inch thickness. The scum is trapped as the wiper blade meets the ramp and is raised up the ramp to be deposited into the scum trough for disposal.

D. Scum Box

1. The scum box shall be of the required size, supported from the tank wall and connected to the scum withdrawal piping. It shall be made of 1/4 inch thick welded 316 stainless steel plate. The box shall have a scum trough, vertical steel sides, and a sloping approach.
A ramp that extends from 1-1/2 inches above water level to 5-1/2 inches below. A similar ramp shall be provided at the opposite end to allow the skimmer blade to lower back to the operating position. A flexible connector shall be provided for connection to the contractor supplied scum withdrawal piping in the tank wall.

E. Scum Flushing Valve
   1. A valve shall be attached to the scum box which automatically opens and allows clarified liquid into the scum box to flush out solids. The valve shall actuate at every pass of the scum skimmer over the scum box, allowing sufficient delay after deposit of the solids before flushing begins. Delay and flush duration shall be adjustable. The opening and closing of the scum flushing valve shall be one smooth continuous movement. The valve shall provide 2 to 5 gallons of flush water per each pass of the skimmer assembly.

F. Scum Baffle
   1. The baffle shall consist of 1/4 inch thick x 12 inches deep fiberglass sections. In the area of the scum box the scum baffle shall extend to 24 inches starting approximately 6 feet before and ending 2 feet after the scum box. The baffle sections shall be curved and fastened to the launder wall with adjustable FRP support brackets, stainless steel fasteners, and anchor bolts.

2.6 EFFLUENT REMOVAL

A. Launder
   1. A rectangular concrete effluent launder shall be provided around the perimeter of the tank. The launder shall be formed as part of the concrete wall. A drop-out box shall be provided in the bottom of the launder at one point for collection and discharge of the clarified effluent.

B. Weir
   1. An adjustable weir shall be provided around the periphery of the tank at the water surface for removal of clarified effluent.
      a. The weir shall consist of 1/4 inch thick x 9 inches deep fiberglass sections with 2-1/2 inch deep 90 degree v-notches at 6 inch intervals. The weir sections shall be curved and fastened to the launder wall with special large washers, anchor bolts, and hex nuts to allow vertical adjustment.

2.7 ELECTRICAL

A. The equipment supplier shall furnish all electrical items specifically called for in this specification section. The contractor shall supply and install all other electrical items required to place the equipment into service.

B. The contractor shall supply and install all field wiring required including but not limited to proper size wire, conduit, fittings, and supports.
2.8 ANCHORAGE AND FASTENERS

A. Anchor Bolts
   1. All anchor bolts shall be a minimum of 1/2 inch diameter and made of type 316 stainless steel. The equipment supplier shall furnish all anchor bolts, nuts, and washers required for the equipment.

B. Fasteners
   1. All structural fasteners shall be a minimum of 1/2 inch diameter and made of type 316 stainless steel. The equipment supplier shall furnish all fasteners required for the assembly of the equipment.

PART 3 EXECUTION

3.1 GENERAL

A. The equipment shall be installed properly to provide a complete working system. Installation shall follow the supplier’s recommendations.

3.2 MANUALS

A. The equipment supplier shall furnish an electronic copy of the operation and maintenance manual, which will be retained at the installation site to assist plant operators. The manual shall include the supplier’s erection and assembly recommendations and a complete list of recommended spare parts.

3.3 FIELD SERVICE

A. The equipment supplier shall provide the service of a qualified representative for one trip and one day per mechanism to inspect the mechanism installation, assist in start-up, and instruct plant personnel in the proper operation and maintenance of the mechanism.

3.4 FIELD TESTING

A. Torque Tests
   1. The entire sludge collector mechanism shall be statically load tested by loading the rake arm with 150 percent of the specified design running torque. The test shall verify the torque overload control device settings for alarm and motor cutout. One truss arm shall be anchored and the load measured to demonstrate the rake arms’, shaft’s, and drive unit’s ability to withstand the specified torque. Sketches and calculations shall be submitted illustrating how the torque will be applied prior to the test taking place.

B. Operation Tests (Provide Factory Authorized Representative for successful start-up)
   1. The contractor shall operate the mechanism in a dry tank for a minimum of 4 continuous hours before flow is allowed to enter the system. There shall be no binding, jerky, or
unusual motion exhibited during this run-in period. Motor amperage shall be checked at least hourly for any unusual or higher than normal figures. After the unit has successfully passed this initial test, flow shall be introduced into the tank and the same 4-hour observation test run. If the unit should fail under any of these conditions, the test shall be halted and the problem corrected. If, after several attempts, the unit does not successfully pass the field test, the faulty portion of the equipment shall be repaired or replaced and the test re-run.

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT AND PAYMENT

A. Measurement and payment for this item will be as indicated within the PROPOSAL FORM. If this item is not indicated within the PROPOSAL FORM then it is to be considered subsidiary to the applicable sections(s).

B. Payment shall fully compensate the Contractor for all required labor, materials, equipment, supervision, insurance, maintenance, codes, laws, statues, or regulations, and all incidental expenses which are required to complete the work in place, ready-to-use and in accordance with the Drawings and Specifications, and all OSHA and TCEQ regulations and requirements.

END OF SECTION
SECTION 46 51 46

FINE AND COARSE BUBBLE AERATION SYSTEM
(ALT # 1)

PART 1 GENERAL

1.1 SCOPE

A. This section includes the design, manufacture, installation and start-up of a flexible membrane, Fine Pore Aeration system and Coarse Bubble Aeration System including in-basin aeration components as shown on the Drawings and as specified herein.

B. The aeration system manufacturer shall provide submittals for approval for the complete aeration system including in-basin piping, diffuser assemblies and support components.

C. All piping to be 316 Stainless Steel Schedule 10, and all valves and fittings shall be for high heat applications.

1.2 DEFINITIONS

A. **Tank**: Vertical walled reactor within which aeration occurs.

B. **Diffuser Unit**: Fabricated unit including diffuser support frame and flexible membrane which releases air to the water.

C. **Diffuser Assembly**: Fabricated assembly including disc holder, Clik lock wedge, flexible membrane, backer plate and retainer ring.

D. **Air Drop Pipe**: Vertical piping section from out-of-basin header stub to in-basin aeration system.

E. **Subheader Piping**: Air distribution piping from drop pipe to air laterals.

F. **Air lateral Piping**: Air distribution piping from air manifold and diffuser assemblies

G. **Air Header Piping**: Out-of-basin air distribution stainless steel piping from the blower to the header stubs

H. **Blower Manifold Piping**: Air distribution piping between the blower discharge and air header piping.

I. **Aeration Grid**: Associated piping and diffuser components connected to a single drop pipe.

J. **Standard Cubic Feet per Minute (scfm)**: Air at 68°F, 14.7 psia and 36% relative humidity.

K. **Maximum Pressure**: Pressure in blower manifold piping at the specified airflow rate.
L. **Oxygen Transfer Efficiency:** Percent of oxygen in the air stream that is dissolved to the wastewater under specified conditions of temperature, barometric pressure, airflow rate, and dissolved oxygen concentration.

M. **Standard Oxygen Transfer Efficiency:** Percent of oxygen in the air stream that is dissolved to clean water under conditions of 68°F, 14.7 psia, and zero dissolved oxygen.

N. **Air Distribution Uniformity:** Variation in air distribution between diffuser assemblies.

1.3 **SYSTEM DESCRIPTION**

A. Design in-basin air piping and diffusers to diffuse air throughout the aeration tank(s) in accordance with the specifications.

B. Design each diffuser assembly to provide uniform air release over the specified airflow range.

C. Design the aeration system to provide the minimum specified oxygen transfer efficiency at the specified airflow and operating pressure.

1.4 **APPROVED MANUFACTURERS**

A. EDI

B. EVOQUA

C. AQUARIUS

D. SSI

E. Engineer Approved Equal

1.5 **DESIGN CRITERIA**

A. **FINE BUBBLE AERATION**

<table>
<thead>
<tr>
<th>SOTE:</th>
<th>23.9%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airflow:</td>
<td>2.0 scfm (max)</td>
</tr>
<tr>
<td>Discharge Pressure:</td>
<td>7.6 psig</td>
</tr>
<tr>
<td>Design Diffuser Submergence:</td>
<td>Side water Depth – 15ft</td>
</tr>
<tr>
<td>Air Flux Rate:</td>
<td>4.88 scfm/ ft² of active diffuser surface area at the design airflow</td>
</tr>
<tr>
<td>Active Surface Area:</td>
<td>49.2 ft² (min.) *</td>
</tr>
</tbody>
</table>

* Active surface area shall be defined as the net perforated area of the media or membrane and shall reflect only that portion of the membrane which can be demonstrated to produce uniform air discharge under the full operating range proposed for the diffuser.
B. COARSE BUBBLE AERATION

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Airflow:</strong></td>
<td>311 scfm (max)</td>
</tr>
<tr>
<td><strong>Design Diffuser Submergence:</strong></td>
<td>Side water Depth 15 ft</td>
</tr>
</tbody>
</table>

Note: Coarse Bubble diffuser system shall employ a minimum of nine (9) long diffuser units.

1.2 QUALITY ASSURANCE

A. All systems must meet TCEQ requirements and regulations.

1.3 SUBMITTALS

A. General:

1. A detailed engineering submittal package for approval shall be provided in sufficient detail and scope to confirm compliance with the requirements of this section. Submittals shall be complete for all required components. Partial submittals will not be accepted.

B. Shop Drawings

1. Contractor to prepare and submit for approval detailed layout drawings for in-basin aeration components. Layout drawings shall include:
   
   a. Layout and configuration of aeration system.
   b. Detail drawings of diffuser assemblies showing components, method of construction, and attachment mechanism to air header distribution piping.
   c. Detail drawings of all piping connections including drop to manifold, manifold to header and inline connections for manifold and headers.
   d. Detail drawings of pipe support components.

C. Product Data:

1. Detailed listing of materials and materials of construction.

2. Product literature.

D. System Design and Performance Data:

1. Design calculations showing oxygen transfer based on guaranteed performance.

2. Include complete air headloss calculations for the aeration equipment from the top of the dropleg to the farthest diffuser bubble release point.
3. Design calculations showing uniformity of air distribution (+10% maximum variation) through lateral piping and diffuser orifice and diffuser media.

4. Design calculations for piping and support components.

5. Product Experience:
   a. The supplier shall have experience in the design, manufacture, supply and commissioning of fine pore, flexible membrane aeration systems for a period of ten years.

E. Installation Instructions
   1. Installation requirements and guidelines for all proposed equipment shall be provided and approved prior to shipment.

2. Information on the aeration system shall include but not be limited to:
   a. Diffuser unit assembly.
   b. Diffuser assembly attachment.
   c. Piping components and assembly
   d. Piping support components.

F. Operation and Maintenance Manuals:
   1. Operation and Maintenance Manuals for all proposed equipment shall be provided and approved prior to shipment.

2. Information on the aeration system shall include but not be limited to:
   a. Air flow balancing.
   b. Diffuser assembly maintenance and membrane replacement.
   c. Operational troubleshooting guidelines.

G. A Factory Authorized Representative shall review and approve all installations and provide a certified written report that the installation meets all manufacturer’s requirements.

PART 2 PRODUCTS

2.1 MATERIALS

A. Stainless Steel Materials and Fabrication

1. Welded Stainless Steel
   a. All welded parts and assemblies shall be fabricated from sheets and plates of Type 316 stainless steel conforming to the requirements of ASTM A240. Welds shall conform to the requirements of ASTM A774.
2. All non-welded parts and assemblies shall be fabricated from sheets and plates of Type 316 stainless steel conforming to the requirements of ASTM A240.

3. All stainless-steel pipe shall be fabricated from Type 316 material conforming to the requirements of ASTM A240. Stainless steel pipe fabrication shall conform to the requirements of ASTM A530, ASTM A554, and ASTM A778.

4. All stainless-steel pipe fittings shall be fabricated from Type 316 material conforming to the requirements of ASTM A240. Stainless steel pipe fitting fabrication shall conform to the requirements of ASTM A774.

5. Stainless steel bolts shall be 316 stainless steel.

6. Stainless steel nuts shall be 316 stainless steel.

7. Stainless steel washers shall be fabricated from Type 316 material conforming to the requirements of ASTM A240. Stainless steel pipe fabrication shall conform to the requirements of ASTM A774.

8. Field welding of stainless-steel pipe, fittings, fabrications or assemblies will not be permitted. When field repairs are required, field welding may be permitted on a case review basis.

2.2 FINE BUBBLE AERATION

A. Welded Stainless Steel Components

1. Sheets and plates of Type 316 stainless steel conforming to ASME SA240 and ASTM A240.

2. Limit carbon content to 0.03% maximum.

B. Non-welded Stainless Steel Components:
1. Sheets and plates of Type 316 stainless steel conforming to ASME SA240 and ASTM A240.

C. Fasteners and Anchorage Components:
   1. 316 stainless steel.

D. PVC Pipe and Fittings
   1. Base material shall be ASTM D-1784.
   2. Pipe shall be manufactured in accordance with ASTM D-1785 and ASTM D-2665.

E. Disc Diffuser Assembly:
   1. The FlexAir Integral Saddle Mount (ISM) Disc diffuser assembly shall be furnished and installed.
   2. Each disc diffuser assembly shall include flexible membrane, retainer ring, disc holder with mounting saddle, Clik lock wedge and o-ring seal.
   3. Diffuser media shall have nominal dimensions of 9.0 inches in diameter with 59 square inches of perforated area.
   4. The diffuser assembly with membrane media shall be fully supported over the full diameter with a 20% glass-filled polypropylene backer plate.
      1) Use of a non-fully supported diffuser membrane is not acceptable.
   5. The diffuser membrane shall be held in place by a threaded retainer ring.
   6. The diffuser mounting connection shall allow installation of diffusers on PVC, CPVC, ABS, or metal lateral IPS sized piping of 3 inch or 4 inch diameter.
   7. Diffuser mounting connection shall allow installation at the manufacturer’s facility or in the field.
   8. Diffuser mounting connection shall allow for installation of additional diffusers, removal of diffusers, or change in location of diffusers without solvent welding in the field.
   9. Mechanical Saddle attachment shall include air inlet port and positive locking mechanism to locate and lock the assembly to the air distributor piping.
   10. Diffuser assemblies shall be shipped to the jobsite properly crated and protected for shipment and handling.
   11. Diffuser saddle mount shall be 20% glass-filled polypropylene construction and shall be capable of withstanding an external force of 200 pounds without structural failure of the air distribution piping or diffuser assembly connection.
a. Small diameter threaded connections to attach diffusers to the air distribution header are not acceptable.

b. Saddle mount shall fully encompass the air distribution header and reinforce the pipe section at the diffuser assembly connection.

c. An O-ring gasket shall be provided to ensure an airtight seal between the mounting saddle and air header.

F. Flexible Membrane:

1. Membrane material for the diffuser unit shall be EPDM rubber.
   a. Alternate membrane materials are not acceptable.

2. Membrane shall be molded in a single piece with the following characteristics.
   a. Membrane shall be 9 inch inside diameter.
   b. Perforated area on diffuser membrane shall be 0.41 square feet.
   c. Non-perforated membrane section shall be provided to seal off air distribution orifices on the diffuser support structure.

3. The diffuser unit with membrane media shall be fully capable of operating under continuous or intermittent conditions and shall be designed with check valve capabilities to prevent entry of mixed liquor into the diffuser unit or air piping on air shutdown or interruption of air supply. A minimum of three (3) integral check valve features shall be provided, not limited to the following:
   a. Membrane shall be elastic and allow openings to close when the air supply is interrupted.
   b. Membrane shall contract and shall seat on backer plate.
   c. Membrane shall employ a non-perforated section that is aligned and seals against the air distribution orifices.
   d. Use of independent or internal check valve components is not acceptable.

G. Aeration System Piping:

1. Out-of-basin air piping including blower manifold, air header, and header stubs are required and are to be supplied and installed by the Contractor.
   a. Header stubs shall extend to the inside top of the wall and terminate with a full diameter horizontal flange.
   b. Out-of-basin piping shall be 316 SS Sch 10.
   c. The Contractor shall provide an isolating/balancing valve for control and distribution of air to the aeration grid and to allow isolating of the grid for inspection and maintenance on the header stub.
d. Isolation/balancing valve shall be positioned for accessibility from the top of the tank.

e. Each aeration grid shall have a moisture removal assembly (purge) located in the horizontal PVC piping at the base of the drop pipe. Purge shall consist of an ejector tube, removal hose and terminates at the top of the aeration tank with a manual valve. Purge line diameter will be \( \frac{3}{4} \) inches. Purge system proposed shall be submitted to the Engineer for review and approval.

2. Drop pipe shall be provided with a flanged top connection and bottom stub end.

   a. Drop pipe shall extend from the top connection to within 2 feet of the air manifold.
   b. Material of construction for the drop pipe shall be schedule 10, stainless steel.
   c. Drop pipe shall connect to air manifold or subheader piping by means of a wrap-around clamp adapter constructed of 316 SS with elastomeric sleeve.
   d. All welds shall have local passivation as a minimum.

3. All submerged subheader distribution piping components shall be Schedule 80 PVC. All air lateral piping shall be SDR 26 minimum.

   a. Use of PVC piping shall only be employed when the expected mean wall temperature is less than 140°C. If temperature exceeds this limit, alternate materials shall be used or cooling loops added until the temperature is at the appropriate level.
   b. Use of PVC piping shall only be employed when diffuser mounting system reinforces pipe wall at each mounting location.
   c. Use of non-reinforced diffuser connections including threaded diffuser mounts is not acceptable.
   d. Air piping sections shall have adjustable angle PVC positive locking flanges with stainless steel flange bolts
   e. Systems employing soft couplings are not acceptable.

H. Pipe supports

1. Supports shall accommodate longitudinal movement in the piping components due to the thermal expansion and contraction over a temperature range of 100°F.

2. Supports shall be 316 stainless steel or glass filled polypropylene construction.

3. Fixed supports shall restrain the axial and rotational movement of the piping.

4. Simple supports shall allow unrestrained longitudinal movement of the in-basin piping.

5. All threaded connections shall be double-nutted.

6. Pipe straps shall be minimum 0.5 inch in width.
7. Supports shall allow leveling of the air piping with 2-inch minimum vertical adjustment at each support.

8. Pipe support spacing shall limit lateral deflection to 0.25 inch maximum.

9. Each pipe support shall be connected to basin floor by stainless steel anchor bolts.

10. The integrated pipe support assembly shall be designed to withstand the associated uplift force of the piping and diffuser assemblies with a minimum design factor of safety equal to four (4).

11. Glass Filled Polypropylene (GFPP) supports shall incorporate the following features:
   a. Retainer strap to secure pipe to pipe support.
   b. GFPP base to be mounted to floor with one anchor bolt.
   c. Threaded base to allow bottom cradle of support to adjust in height.
   d. Diameter of support base to be minimum 2.5 inches (63mm) outer diameter.

I. Spare Parts:

12. The Contractor shall furnish the following spare parts and store as directed:
   a. One percent of the total number of EPDM flexible membranes.
   b. One set of special tools needed for installation or maintenance.

2.3 COARSE BUBBLE AERATION

A. Stainless Steel Coarse Bubble Diffusers:

1. Each single drop air diffuser shall be of one piece construction with no moving parts and shall consist of a tapered deflector and air release tube. The diffusers must be of proven structural design without inherent structural deficiencies or weaknesses. The material must be highly heat and impact resistant and must retain its physical properties at elevated temperature.

2. The air release tube shall transport air flows from the top pipe connection at the top of the diffuser, down through the deflector to the air release slots. The tube shall have an inside diameter equal to or greater than that of the drop pipe throughout its length and shall terminate with a full diameter opening. This is to allow positive cleaning of the airway of each diffuser by allowing a brush or rod inserted at the top end of the drop pipe to pass completely through the diffuser.

3. The bottom of the tube shall contain vertical slots at least ¼” wide to insure the distribution of air flows to all six (6) sections of the deflector. The slots shall begin to release air at a point no closer than 2” below the deflector shear plane to create an initial upward direction of air bubble travel before the bubbles hit the deflector shear plane. The slots shall extend to full width openings at the open bottom of the air release tube to facilitate cleaning.
4. The multi-plane deflector portion of the diffuser shall breakup the coarse bubbles generated at the release tube slots into the fine bubbles required for efficient oxygen transfer. The shear edge shall provide sharp discontinuity in the air/water flow, generating high shear forces on the coarse bubbles causing bubble breakup.

5. Two inch (2”) Diffuser Assemblies:
   a. Each air drop and diffuser assembly shall consist of a 2-inch diffuser, individual drop pipe of schedule 40 - 316 stainless steel, a 316 stainless steel cleanout tee, a 2-inch stainless steel ball valve, orifice assembly and pipe nipple for connection to the air distribution header.
   b. Each vertical drop pipe shall extend from the above-water orifice assembly to the air diffuser located at the required air release elevation. The top of the drop pipe shall be fitted with a 316 stainless steel tee with a plug to provide accessibility to the drop and diffuser. The tee assembly shall include a 316 stainless steel orifice plug. The orifice shall consist of an attached plug upper body and cylindrical lower body. The side outlet of the stainless steel tee shall be fitted with a type 316 stainless steel nipple.
   c. Each air drop pipe shall be rigidly secured in place by the top tee assembly and by a structural steel support furnished by the equipment manufacturer. The drop pipes shall be secured to the support with 316 stainless steel hardware. Structural steel supports shall be constructed from 2” x 2” x ¼” structural steel angle. Provide stainless steel bolts as necessary to connect supports together and to anchor them to the concrete floors or walls. Fabrication drawings of structural supports shall be included with submittal data for review by the Engineer.

B. Aeration System Piping:
   1. Out-of-basin air piping including blower manifold, air header, and header stubs are required and are to be supplied and installed by the Contractor.
   2. Air supply mains shall be fabricated from 316 stainless steel piping.
   3. The air headers shall be tapped and provided with a welded-in horizontal run-out coupling at the location of each individual air diffuser.

PART 3 EXECUTION

3.1 INSTALLATION
   A. Contractor shall furnish, inspect, store, and install aeration system in accordance with manufacturer’s written instructions and approved submittals.
   B. Diffuser assemblies on a common grid shall be installed within an elevation tolerance of ±1/2 inches.
C. Contractor shall provide all valves, air header piping, wall sleeves with seals, wall pipes, and concrete pedestals as necessary to complete the system as shown on the plans.

D. Air piping including blower manifold, header, and in-basin piping must be clean prior to delivering air up the diffusers.

E. Contractor shall be responsible for cleanliness of piping and may be required to manually clean pipe, or air or water flush piping as required.

3.2 START-UP AND MANUFACTURERS FIELD SERVICES

A. After installation is completed, the Contractor shall perform the following field tests in the presence of the Engineer and the Owner.
   1. Fill the reactor to the bottom of the diffuser assemblies.
   2. Adjust the pipe supports and diffuser assemblies such that all diffuser units are installed within ±1/2 inches of the design diffuser elevation.
   3. Fill the reactor to a level of 2 feet above the top of the diffusers.
   4. Release air to the system and inspect the system for air leaks at all piping or diffuser connections.
   5. Adjust any piping or diffusers that show leaks or disproportionate amount of airflow.
   6. Operate the blowers at the design air rate and observe air release and air distribution patterns.
   7. All water, air, power and labor associated with testing and adjustment of diffuser assemblies are to be supplied by Contractor

B. A Factory Authorized Manufacturer’s Representative shall be present at the job site to inspect the installation of the equipment, start-up the system, and train operations and maintenance personnel on the supplied equipment. Authorized Representative to provide a written report to certify that the installation meets all manufacturer’s requirements.

C. Provide a written report to certify that the installation meets all manufacturer’s requests.

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT AND PAYMENT

D. Measurement and payment for this item will be as indicated within the PROPOSAL FORM. If this item is not indicated within the PROPOSAL FORM then it is to be considered subsidiary to the applicable sections(s).

E. Payment shall fully compensate the Contractor for all required supervision, insurance, labor, materials, parts and all equipment, electrical wiring and conduits, piping/valves/fittings, lubrication/grease, field welding/erection, performance testing and start up, grating platforms, stairs, handrails, anchoring, concrete foundation, drains, startup on-site factory representative including training, submittals for all tanks, equipment, grading, platforms, and concrete
foundations to be approved, certified and sealed by a Licensed Professional Engineer, all work installed meeting all local, state, and federal regulations, codes, laws, statutes and guidelines, and all incidental expenses which are required to complete the work in place, complete, ready-to-use and in accordance with the Drawings and Specifications, and all OSHA and TCEQ regulations and requirements.

END OF SECTION
SECTION 46 51 47

OLD PACKAGE PLANT DIFFUSED COARSE BUBBLE AERATION
(ALT NO 2)

PART 1 GENERAL

1.1 DESCRIPTION

A. The specifications in this section include all components of the Diffused Aeration System Assemblies including the individual diffuser units. These assemblies are to be installed in the Unitec existing old package wastewater treatment facility Aeration Tank No. 1, No. 2, No. 3, and also the modified Clarifier zone.

B. The complete lift-out manifold assembly shall be supplied by the Aeration Diffuser Manufacturer to maintain single source responsibility for the system. The complete assembly shall be defined as beginning at the top RX roll groove of the air supply drop pipe section through all submerged piping, wall brackets, cradle supports, diffusers and any other equipment specified within this section of the specifications. The assemblies shall include a stainless steel ball valve Series 461 at the top of each drop pipe. Manufacturer to be Tideflex Technologies or approved equal.

C. The Aeration Diffuser Manufacturer shall have at least ten installations using the equipment in a similar treatment process and have ten years of installation experience with the proposed diffuser equipment and system. Manufacturers not meeting this requirement will be rejected.

1. These diffuser assemblies are to be installed in existing wastewater process tanks and will be subjected to loads produced by lateral hydraulic flows containing solids, debris, grit and fibrous accumulations. It is the intent of these specifications to define equipment capable of withstanding the forces and conditions subject to occurring within these structures. Thermoplastic components will not be allowed on any portion of the assembly including diffuser units.

2. These specifications outline the equipment used in the design basis as well as requirements of alternate equipment. The Engineer reserves the right to request certified tests results of a complete manifold assembly tested to the conditions specified within this section and or sample diffusers of all alternate equipment submittals. Alternate submittals failing to comply with the requirements defined within these specifications shall be rejected. Rejected alternate submittals shall not be resubmitted nor shall any extensions in project completion schedule be granted in reference to resubmittal approvals.

3. Diffusers submitted shall comply with the performance specifications in this section, specifically backflow prevention of liquids and solids through the discharge orifice(s) of the diffuser.

4. Design Requirements: The aeration system manufacturer shall provide the airflow distribution design calculations, within the submittal documents, for the submerged
portion of the distribution piping and the associated orifice port sizing in reference to the applied duckbill style diffuser.

PART 2 PRODUCTS

2.1 SYSTEM PERFORMANCE

A. This section includes all performance requirements for the system. These requirements are not specific to any manufacturer or their equipment configuration, they define the operational requirements as defined by the laws of physics for air lift mixing systems.

B. The mixing system shall be capable of ON /OFF blower operation without clogging of the mixing system piping or diffusers.

C. The mixing system shall be capable of operation after an inadvertent blower shutdown without process fluid entering the diffusers or distribution piping.

D. The mixing system shall be capable of preventing backflow of the process liquid into the diffuser and distribution piping through the diffuser air emittance opening when the discharge airflow is shut-off, there will be no exceptions to this requirement for any submitted alternate style diffusers.

E. The mixing system shall be capable of operation in process fluids ranging from 0.5% solids to a minimum of 5% solids concentration without clogging of the mixing system with solids in the diffusers and/or piping, there will be no exceptions to this requirement for any submitted alternate mixing systems.

F. The mixing system shall be capable of mixing the entire fluid body from the tank floor surface to the fluid surface. To achieve this complete vertical section mixing, the diffuser discharge point shall be within a distance approved off the finished floor (highest elevation point for sloped floors). Mixing systems with discharge points higher than 4” off the floor shall provide CFD modeling, specific to the project application, to confirm that sufficient mixing will occur across the complete vertical section. Diffusers that are designed for mounting on the top side of the distribution piping shall not be accepted nor shall they be installed upside down to comply with this requirement.

G. Air surge protection; the mixing system and individual diffusers shall be capable of handling a mass flow surge from the blower or air supply system without detrimental effects to the diffusers. The design surge rate shall be three times the design flow. During start-up and commissioning of the system, the supply air shall be spiked for air surge testing to confirm the supplied diffusers can handle the surge without deformation, disconnection or any damage to the diffuser and system piping.

H. Multiport mixing systems require air distribution control to provide even air flow across the entire system. If orifices are utilized within the mixing system, then the mixing system
manufacturer shall provide a descriptive method of how these orifice are protected from contact by the process fluid and associated solids in the event the airflow is discontinued to the system.

I. Uninhibited flow paths; the mixing system piping shall have a minimum of clearance from the bottom of the distribution pipes to the tank floor surface to adequately allow solids to flow unrestricted and prevent solids build-up against the piping.

J. Automatic condensate removal; the mixing system must be capable of automatic purging of accumulated condensate produced within the piping system. Mixing systems requiring manual condensate removal methods will not be accepted due to the maintenance requirements.

K. All pipe joints that are to be field connected shall be grooved coupling type. All joints shall be rated for 150 psi to ensure integrity of the mixing system piping which is subjected to dynamic hydrostatic loading and thermal expansion and contraction.

L. At the time of equipment submittal, the Contractor shall include the full section of this specification with each section signed by an authorized representative from the submitted equipment stating their equipment is in compliance with the “Performance Requirements” and all other requirements listed in the specifications. Submittal packages not containing this authorized document will be deemed incomplete and will not be considered. Document: Certification of Compliance with Specifications.

2.2 PROCESS DESIGN

A. The system shall be capable of providing sufficient dissolved oxygen to satisfy the process loading. The aeration system manufacturer shall provide a mathematical model showing calculations for the following;

1. Food to Biomass Ratio calculations and projection.
2. AOR distribution percentage across all tanks.
3. BOD and NH3 reduction and AOR requirements.
4. AOR to SOTR Ratio applied.
5. Mixing energy produced based on Velocity Gradient.
6. Blower requirements based on ACFM adjustment.
7. Blower annual operating cost projection.

B. Process Loading Design

1. Daily Average Flow = 110,000 gpd
2. BOD Influent = 275.0 mg/l
3. BOD Effluent = 5.0 mg/l
4. NH3 Influent = 50.0 mg/l
5. NH3 Effluent = 0.0 mg/l
6. MLSS = 2800 mg/l
7. Residual DO = 2.0 mg/l
8. Alpha Transfer = 0.65
9. Beta Transfer = 0.950
10. Theta Transfer = 1.024
11. Minimum Velocity Gradient Required = 112 sec⁻¹

2.3 DIFFUSER CONSTRUCTION AND PERFORMANCE

A. The diffusers shall be connected to the distribution piping with a threaded connection for installation and maintenance access. The diffuser connection material shall be minimum schedule 40 stainless steel. Thermoplastic connections and thermoplastic threaded nipples will not be acceptable due to the hydraulic load forces occurring in the process.

B. Any elastomer components of the diffuser must be clamped to a bushing or pipe nipple using a heavy duty clamp to ensure the diffuser will not separate from the connection during operation. Unrestrained elastomer components using compression fit, snap-on, and friction fit connections will not be accepted due to performance requirements for surge load protection.

C. All elastomer components shall be constructed of EPDM synthetic elastomer with a leachable oils content of 10% or less. Fine pore membrane diffusers shall not be acceptable as an alternate due to their potential of clogging with high solids concentrations.

2.4 GUIDELINES FOR SIZING

A. Diffuser Spacing – the maximum center to center diffuser spacing shall be 18” unless shown to be less on the contract drawings. The exact quantity of diffusers shown on the drawings shall be provided, reducing the quantity of diffusers by utilizing oversized units will not be approved, adhering to the spacing requirements to maintain the required mix pattern is required for approval.

B. The diffuser unit airflow rate shall not exceed 15 cfm per diffuser for any of the design conditions within this system.

2.5 STAINLESS STEEL PIPING MATERIALS
A. Piping

1. Referenced Standards
   ASTM A240 – Chromium-Nickel Stainless Steel Plate
   ASTM A312 – Seamless, Welded, and Cold Worked Austenitic SS Pipe
   ASTM A351 – Castings, Austenitic, for Pressure-Containing Parts
   ASTM A380 – Corrosion Protection, Acid Pickling
   ASTM A403 – Wrought Austenitic Stainless Steel Piping Fittings
   ASTM A480 – Stainless Steel Finish
   ASTM A530 – Specialized Carbon and Alloy Steel Pipe
   ASTM A554 – Welded Stainless Steel Mechanical Tubing
   ASTM A744 – Castings, Iron-Chromium-Nickel for Severe Service
   ASTM A774 – Stainless Steel Welded Fittings
   ASTM A778 – Stainless Steel Welded, Unannealed Austenitic Pipe
   ASTM D1171 – Elastomer Deterioration
   AISI 304 – 304 Stainless Steel Plate
   AISI 304L – 304L Stainless Steel Plate
   AISI 316 – 316 Stainless Steel Plate
   AISI 316L – 316L Stainless Steel Plate
   AWWA C606 – Grooved and Shouldered Joints

2. Material Grade - The material grade to be provided for all the equipment piping, supports and hardware is to be Schedule 10 – 304L SS.

3. Sourcing (Domestic / International):
   a. The stainless steel material sourcing shall be at the discretion of the equipment supplier; sourcing can be either local domestic or foreign import.

4. Assembly configuration; the assembly shall consist of an isolation stainless steel ball valve, a primary drop pipe, a connection tee and two lateral pipe sections with each being connected with a rigid style coupling for maintenance accessibility.
5. Pipe Joints - All pipe joints that are to be field connected shall be grooved coupling type. All joints shall be rated for 150 psi to ensure integrity of the mixing system piping which is subjected to dynamic hydrostatic loading and thermal expansion and contraction.

6. Cleanouts - Full pipe diameter clean-outs shall be provided at the end of each lateral distribution pipe. The cleanout shall be a coupled end cap.

7. Pipe Grooving - The Aeration Equipment Manufacturer shall be responsible for providing all grooved fittings, couplings and valves that are associated with the scope of the complete aeration system defined within these specifications. The Manufacturer shall provide warranty coverage of these components within the warranty coverage of the complete aeration system. Pipe shall be grooved using Victaulic grooving tools equipped with ‘RX’ roll sets specifically designed for stainless steel pipe. IPS Grooved Pipe Fittings - All grooved components shall be of one manufacturer, and conform to local code approval and/or as listed by ANSI-B-31.1, B-31.3, B-31.9, ASME, UL/ULC, FM, IAPMO or ICC. Grooved end product manufacturer to be ISO-9001 certified. Grooved couplings shall meet the requirements of ASTM F-1476.

8. Mechanical Couplings - Shall be Victaulic Style 489 Rigid Stainless Steel conforming to ASTM A-351, A-743, and A-744 Grade CF-8M. (Rigid coupling key shall clamp the bottom of the groove). Mechanical Coupling Bolts and Nuts - Shall be Type 316 Stainless Steel, oval neck track bolts and heavy hex nuts with chemical and physical properties of ASTM A-193, Grade B8M, Class 2 or ASTM F-593, Group 2, Condition CW. Gaskets for Grooved Couplings - Grade “E” EPDM compound (green color coded) conforming to ANSI/NSF 61 for cold and hot water service operating temperatures up to +180 degrees F (+82 degrees C).

9. Pipe Supports – The material grade shall be the same as defined in the previous section for piping material grade.

B. Valves

1. Stainless steel ball valves:
   Ball valves to be two piece and threaded or flanged, as required, and shown on the plans. Working pressure to be a minimum of 1,000 psi and be suitable for high heat air application. Ball valves to be 316 (L) stainless steel. Valve to be full port and investment cast meeting AD2000 – WO Specification. Handle to be 316 (L) stainless steel and anti-blow out design. Must meet 600°F minimum.

C. Fabrication of Stainless Steel Components

1. Cutting, Bending & Fabrication of Stainless Steel
   a. All port or branch connections to manifold piping shall be processed utilizing a laser cutting process to maintain the tolerance of +/- 0.015 inches at any point.
location. Angled end cuts shall be within the tolerance of +/- 0.5 degrees. Outlet ports of the same diameter as the main manifold shall be produced using a T-pull method.

2. Welding of Stainless Steel

   a. Welding Reference Standards

      ASME B31.1 – Code on Piping Systems

      ASME B31.3 – Code on Process Piping

      GTAW – Gas Tungsten Arc Welding

      GMAW – Gas Metal Arc Welding

   b. All welding of pipe and structural support members shall be conducted at the factory using TIG, MIG, inert gas or plasma-arc welding methods. Field welding will not be permitted without the approval of the System Manufacturer. All welded components shall be passivated in accordance with the specifications defined in this section. Weld cross-sections shall have a thickness equal to or greater than the welded material. All butt welds shall be fully penetrated with gas shielding to the interior and exterior of the joint. All face rings and flanges shall be continuously welded on both sides unless lap joint flanges are specified.

   c. Post Weld Alignment - Manifolds with significant weld points may be subject to warpage or bending of the material. The fabricator shall ensure that the finished components are in compliance with alignment requirements. Manifolds can be pre-bent prior to welding to adjust for the expected material change during welding.

3. Cleaning and Passivation

   a. All “fabricated” stainless steel pipe manifolds and “welded” stainless steel structural members shall be treated for corrosion resistance upon completion of the fabrication process. This treatment process shall consist of four stages; Precleaning, Cleaning, Passivation, and Inspection. Certified documents are required to be submitted prior to equipment shipment to the site to confirm all four stages have been applied to the material.

   b. Precleaning (surface treatment) - All parts shall be precleaned as according to definition ASTM A380 3.b. All parts shall be sprayed interior and exterior with an alkaline “degreasing” solution and thoroughly rinsed.

   c. Cleaning (full submersion) - Welded or heat modified parts shall be cleaned using a nitric/ammonium bifluoride acid solution or equivalent. The solution
shall contain approximately 15% nitric acid and 3% hydrofluoric acid at a temperature of 120°F. Parts shall be submerged long enough to remove marks, carbon, scale, etc. in preparation for passivation. All parts shall be rinsed with a pressure washer thoroughly rinsing inside and out to remove all weld discoloration and remove excess acid with iron free water at a minimum temperature of 130°F.

d. Passivation (full submersion) - Parts shall be totally immersed in a solution containing 25% to 40% by volume of nitric acid for a minimum of 30 minutes at ambient temperature. Immediately after removal from the passivation solution, parts shall be pressure washed with clean R.O. hot water thoroughly to remove all passivation solution. All rinse water shall be allowed to drain from the part and shall not be allowed to let stand or puddle anywhere on the part.

e. Inspection - All parts shall have a clean surface after rinsing, no etching, frosting or pitting shall be exhibited. All fluids shall be removed from the part before leaving the passivation area. All handlers of the materials shall wear clean gloves to prevent transfer of oils and dirt to the finished parts. Passivated parts shall not come in contact with any ferrous material. Parts shall be protected from scraping, scratching or other damage which could compromise the passivated surface. Parts shall be immediately moved to clean storage or to packaging.

f. Part Identification – All finished stainless steel manifolds and pipe spools shall have the part number, a project reference number, and the fabrication location ink printed on the exterior of each pipe.

4. Factory Testing of Fabricated Components

a. Pressure Testing of Pipe Spools and Manifolds

i. The test method shall be hydraulic pressure type. The pipe section shall be capped, flanged or plugged at all outlet ports. The pipe section shall be filled with water to a pressure point of 250 psi. The supply valve shall be closed to isolate the pipe section interior pressure. The pressure shall be monitored for 15 minutes without any loss in pressure from the initial 250 psi for the component to pass the pressure test.

ii. A certification document shall be provided summarizing the pressure testing and list of components (by part number) tested. Pass/Fail indication shall be designated on the document for each component. Document: Pressure Testing Certification

b. Material Grade Verification of Stainless Steel Components
2.6 VERTICAL PIPING SUPPORT BRACKETS

A. All components of the bracket assembly shall be the same grade of stainless steel defined in the Stainless Steel Materials section.

B. The assembly support bracing shall be anchored to the concrete wall using Hilti brand seismic rated epoxy adhesive anchoring. Expansion type anchors shall be not accepted due to their potential to allow fluids into the anchoring cavity and eventual deterioration of the concrete reducing the strength of the anchor. The pull-out rating of the combined anchors shall be a minimum of 10 times greater than the static weight of the vertical pipe section. The manufacturer shall provide the adhesive and an applicator tool for installation.

C. All welded structural components of the assembly shall be passivated in accordance with the section Stainless Steel Pipe Materials.

2.7 LATERAL PIPING SUPPORT BRACKETS

A. All components of the bracket assembly shall be the same grade of stainless steel defined in the Stainless Steel Materials section.

B. Assembly components shall consist of one cradle bracket designed to be wall anchored, extend off the wall as specified on the dimensional drawings, have a cradle portion equal to ½ the perimeter distance of the manifold.

C. The assembly shall be anchored to the wall using stainless steel wall anchors at the same load capacity as the vertical wall bracket assembly.

2.8 VERTICAL (DROP PIPE SECTION) PIPING

A. Vertical air supply piping shall be the same grade of stainless steel defined in the Stainless Steel Materials section.

B. The top end of the drop pipe shall be equipped with a Victaulic Grooved end for connection using a Victaulic Coupling Style 489 stainless steel construction and connection to the isolation valve.

C. Each drop pipe shall be equipped with a stainless steel lifting lug capable of sustaining twice the static weight of the entire manifold assembly.

i. Non-destructive Elemental Analysis; 10% of all finished stainless steel components shall be tested using an XRF (X-Ray Fluorescence) Analyzer. A minimum of (3) components shall be tested for any system. A summary report of the test with a list of part numbers tested shall accompany the material to the project site. A duplicate copy shall be held by the mixing system manufacturer. Document: Material Grade Certification
2.9 DELIVERY, STORAGE, AND MATERIAL HANDLING

A. Individual diffuser units shall be packaged separately and wrapped in protective plastic or packaging paper separate from the piping equipment.

B. Pipe sections are to be fully supported to prevent pipe deflection or damage to fittings or connections.

C. Grooved ends shall be protected by plastic caps to prevent damage to the area from fitting or valve end to the back of the groove.

D. All equipment shall be shipped on pallets capable of fully supporting the pipe sections across their entire length. Pallets should be accessible for fork lift transport or strap and hoist means without causing any load to the pipe equipment.

E. All stainless steel components shall be stored separately away from any carbon steel components or other materials which could stain or deface the stainless steel finish from run-off of oxidized ferrous materials.

F. All pipe equipment should be covered and stored in areas free from contact with construction site sediment erosion to prevent accumulation of materials within pipe threaded connections.

2.10 SUBMITTALS

A. System Design

1. The mixing system equipment manufacturer shall be responsible for providing a mathematical model of the fluid body and the mixing energy applied to the fluid body. The evaluation method shall be velocity gradient type. The fluid characteristics shall be applied in the evaluation (solids concentration, viscosity, and temperature). Oxygen transfer rates for the system shall also be included if oxygen supply is a requirement for the system. The model shall show the total power requirements in horsepower and the operating pressure at the system inlet. Document: System Design Model.

B. System Installation Drawings

1. The mixing system equipment manufacturer shall be responsible for providing engineering installation drawings of the complete mixing system supplied by the manufacturer. These drawings shall include plan view piping arrangement, sections and elevations as required, support bracket installation details, diffuser orientation details, and all dimensions required for locating the system within the specified dimensions of the tank.

2. Drawings shall be a minimum of 11 x 17 inches and provided in digital PDF format.

3. One (1) hard copy of final fabrication and installation drawings shall be included with the shipment of aeration equipment. Document: Equipment Installation Drawings.
4. Authorized and approved set of signed technical specifications of this complete product section per the requirements defined in the section for performance. Document: *Certification of Compliance with Specifications*

C. Installation, Operation and Maintenance Manuals

1. (1) Digital copy of the Installation, Operation and Maintenance (IOM) Manual for the applicable mixing system shall be provided with the submittal package. The mixing system manufacturer shall provide one (1) hard copy of the complete Installation, Operation and Maintenance (IOM) Manual at the completion of the project. Document: Installation, Operation and Maintenance Manual

2. The manuals shall be in the following format and include the listed required information as a minimum:
   - Enclosed in separate binders with project title and system designation shown on the front cover.
   - Table of contents.
   - Copy of Process calculations for the mixing system (as developed by the manufacturer).
   - Copy of complete set of installation plans (reduced size).
   - Parts and equipment list with specification numbers for ordering of replacement parts.
   - Product specification sheets for diffusers, expansion joints, expansion anchors, flow metering equipment and any other specialized items supplied with the system.
   - Installation guidelines for the mixing system and individual diffuser units.
   - Operational procedures for the mixing system.
   - Guidelines for repair of system components.
   - Schedule for suggested periodic maintenance of the aeration system.

2.11 INSTALLATION

A. Installation of the aeration system shall be in accordance with the guidelines provided by the aeration manufacturer as specified in the installation section of the IOM manual. Refer to section on Submittals for quantities and delivery schedules of the documents.

2.12 START-UP AND TESTING PROCEDURES

A. Start-up and testing procedures of the aeration system shall be in accordance with the guidelines provided by the aeration manufacturer as specified in the installation section of the IOM manual. Refer to section on Submittals for quantities and delivery schedules of the documents.

B. The aeration manufacturer shall provide inspections services by a factory representative. The inspections shall consist of two parts, the first inspection shall consist of a visual inspection of the installed system, prior to filling the tank with liquid, to confirm that it has been installed in accordance with the manufacturer’s installation plans. The second inspection shall consist of a
visual inspection of the system filled with water at 12” above the manifold piping and confirm even distribution of airflow through the diffuser units and across the entire system. The inspection representative shall provide signed inspection documents confirming the date of the inspection and approval of the installation and operational performance. The aeration manufacturer shall be detail instructions of the testing requirements within the Operations, Installation & Maintenance Manual for the aeration system. Document: Installation & Field Test Start-up Certifications

C. The equipment manufacturer shall provide the services of the inspector at a minimum allotment of [2] full days per each process tank where an associated aeration system is installed.

2.13 SPARE PARTS

A. The aeration manufacturer shall supply 10% of the total diffusers as spare diffuser assemblies, equipped with elastomer nozzle, reducer bushing, and ¾” stainless steel NPT nipple pre-assembled and ready for installation.

2.14 WARRANTY

A. All piping, support brackets, saddle assemblies, joint connections, expansion joints, and anchors shall be warranted by the aeration manufacturer against failure under design conditions for a period on one (1) year from the date of final installation and field testing certification.

B. Elastomer Diffuser nozzles shall be warranted by the aeration manufacturer against failure under design operating conditions for a period of one (1) year from the date of final installation approval by the Engineer. Elastomer components damaged as a result of maintenance activities, foreign debris in the process solution, or excessive exposure to direct ultraviolet and thermal radiation shall be excluded warranted coverage. Document: Mixing System Warranty Statement.

2.15 SUMMARY OF REQUIRED SUBMITTAL, PERFORMANCE AND TESTING DOCUMENTS

A. Certification of Compliance with Specifications

B. System Design Model

C. Equipment Installation Drawings

D. Installation, Operation and Maintenance Manual

E. Pressure Testing Certification (hold for reference)

F. Material Grade Certification (hold for reference)

G. Installation & Field Test Start-up Certifications
H. **Mixing System Warranty Statement**

END OF SECTION
STRUCTURAL SPECIFICATIONS
SECTION 03 01 30

CONCRETE RESTORATION AND COATINGS FOR REPURPOSED OLD PACKAGE (PKG) PLANT

PART 1 GENERAL

1.1 DESCRIPTION

A. This specification covers the work necessary to furnish and install a complete lining or rehabilitation system for existing corroded concrete structures, as shown on the drawings and as specified herein. Work includes, but is not limited to, the following:

1. Stopping Leaks by repair and sealing of the concrete to include removal of unsound materials, preparation, chemical grouting, structural lining, patching, plugging and sealing compounds

2. Surface preparation, and installation of Structural Cementitious Mortar and epoxy resurfacing (as required) and High Strength Corrosion Protection Lining. To include protection of surfaces not to be treated, touch-up, clean-up, and appurtenant work all in accordance with the requirements of the Contract Documents and this Specification.

1.1 REFERENCED SPECIFICATIONS CODES AND STANDARDS

A. Without limiting the generality of other requirements of these specifications, all work hereunder shall conform to the applicable requirements of the referenced portions of the following documents, to the extent that the requirements therein are not in conflict with the provisions of this Section. All references and standards listed shall be the latest revisions. Joint and individual documents are referenced.

1. SSPC – The Society for Protective Coatings
   800 Trumbull Road
   Pittsburgh, PA 15222-4643
   (412) 281-2331

2. NACE – National Association of Corrosion Engineers
   P.O. Box 218340
   Houston, TX 77218-8340
   (281) 492-0535

   a. SSPC-SP 13/NACE No. 6 Surface Preparation of Concrete
   c. SSPC-SP 5/NACE No. 1, White Metal Blast Cleaning
   d. SSPC-SP10/NACE No. 2, Near White Metal Blast Cleaning
   e. SSPC-SP 6/NACE No. 3, Commercial Blast Cleaning
   f. NACE RP0892 “Linings over Concrete for Immersion Service”
3. ICRI – International Concrete Repair Institute
3166 S. River Rd., Suite 132
Des Plaines, IL 60018
(847) 827-0830


4. ASTM – American Society for Testing and Materials
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
(610) 832-9585

a. ASTM E-337: Test Method for Measuring Humidity with a Psychrometer
b. ASTM D 4258 “Practice for Surface Cleaning Concrete for Coating”
c. ASTM D 4261 “Practice for Surface Cleaning Unit Masonry for Coating”
d. ASTM D 4262 “Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces”
e. ASTM D 4414 “Standard Practice for Measurement of Wet Film Thickness by Notch Gages”
f. ASTM D 4787 “Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates”
g. ASTM D7234-12 Standard Test Method for Pull Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers

5. ACI – American Concrete Institute
Box 19150, Redford Station
Detroit, Michigan 48219
(248) 848-3700

a. ACI 350-01 “Code Requirements for Environmental Engineering Concrete Structures”
b. ACI 350.1 “Testing of Reinforced Concrete Structures for Water Tightness”
c. ACI 350.2 “Concrete Structures for Containment of Hazardous Material”
d. ACI 503 “Use of Epoxy Compounds with Concrete”

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Unitec WWTP – Phase I Expansion – FY 2020
Laredo, Texas
Concrete Restoration and Coating for Repurposed Plant 03 01 30
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1.2 SUBMITTALS

A. Submit product data for each component specified including data substantiating that the proposed materials comply with specified requirements and recommendations by the manufacturer covering all materials.

B. The Contractor shall submit to the Engineer, for review, the following information concerning the materials the Contractor proposes to use in work covered by this section:

1. A list of all components (coatings or other materials) to be used in each coating system required herein.
2. A complete descriptive specification, including manufacturer's data sheet, of each component.
3. Prior to completing the purchase and delivery of the coating material selected by the Contractor, the Contractor shall obtain a letter from the material supplier stating that the selected material is suitable and compatible for application and use as directed under these Specifications, and that if properly applied will provide corrosion protection for ten years or longer.
4. Installer Qualifications: Engage applicators approved by the manufacturer, which have successfully completed applications using similar specified materials on projects of similar size and scope.
   • Provide (3) three references with name, address, and telephone number.
   • Provide written approval from the material manufacturer.
   • All the contractor’s jobsite personnel must be trained in the hazards associated with confined space entry. All personnel entering a confine space shall be certified for confined space entry.

1.3 QUALITY ASSURANCE

A. Acceptable Manufactures and Products for Stopping Leaks

1. Avanti Grouts AV-275
2. DeNeef® Flex LV/SLV PURe by GCP Applied Technologies Inc.

B. Acceptable Manufactures and Products for Resurfacing and Coating

1. All products described in this section shall be manufactured by or approved for use by a single manufacturer as specified herein.
<table>
<thead>
<tr>
<th>Resurfacing (Existing Concrete Only)</th>
<th>Application</th>
<th>Tnemic</th>
<th>Sherwin Williams</th>
<th>Raven Linings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type A - Heavy Concrete Resurfacing</strong> (Corrosion from ¼” – 2”) (if required only)</td>
<td>Tnemec Series 218 MortarClad</td>
<td>A.W. Cook Cement, CEMTEC Silatec Rapid Cure Vertical Grade</td>
<td>Raven 755</td>
<td></td>
</tr>
<tr>
<td><strong>Type A - Exposed Rebar Only</strong> (if required only)</td>
<td>Tnemec Series 66HS Hi-Build Epoxoline</td>
<td>Duraplate 235 Multi-Purpose Epoxy</td>
<td>Aerocoat</td>
<td></td>
</tr>
<tr>
<td><strong>Type B - Minor Concrete Resurfacing</strong> (Corrosion upto ¼”)</td>
<td>Tnemec Series 217 MortarClad</td>
<td></td>
<td>Raven 760</td>
<td></td>
</tr>
<tr>
<td>Coatings (40 mils min. and as recommended by the Manufacturer)</td>
<td>Primer (Optional)</td>
<td>Tnemec Series 217 MortarClad</td>
<td>Corobond 100 or Resuprime MVT</td>
<td>Raven 155</td>
</tr>
<tr>
<td>Corrosion Protection Coating</td>
<td>Tnemec Series 436 Perma-Shield FR</td>
<td>Dura-Plate 6000 Epoxy</td>
<td>Raven 405 Epoxy Series</td>
<td></td>
</tr>
</tbody>
</table>

1.4 QUALITY CONTROL

A. Installer Qualifications: Engage applicators approved by the manufacturer, which have successfully completed applications using similar specified materials on projects of similar size and scope.

1. Provide (3) three references with name, address, and telephone number.
2. Provide written approval from the material manufacturer.
3. All the contractor’s jobsite personnel must be trained in the hazards associated with confined space entry. All personnel entering a confine space shall be certified for confined space entry.
B. Quality Control

1. The contractor shall submit a Quality Plan (QP) including an Inspection Test Plan ITP indicating all quality control testing that will be performed during the application including acceptance criteria. The Contractor shall submit a sample of their Quality Control Reporting documents for approval by the owner or Owners representative prior to project start-up.

2. Quality Control Reporting- The Contractor shall record all Quality Control operations on a daily QC report that will be delivered to the Owner or Owners representative at interims agreed upon during the pre-Job Meeting.

3. The contractor shall have a designated trained Quality Control Inspector who will carry out or supervise all Quality Control Inspections.

4. Minimum Quality Control Testing Shall Include but not be limited to the following testing:
   a. Environmental Measurements- Document Air Temperature, Substrate Temperature, Dew Point and Relative Humidity a minimum of 4 times per day using a Digital Dew Point Meter or a combination of Sling Psychrometer along with the Psychrometric Charts, Infrared Surface temperature meter. Surface temperatures shall be at least 5 degrees F above dew point and in a rising mode for the application of Lining Materials.
   b. Substrate Condition- Prior to Surface Preparation the substrate shall be accessed for soundness, cracking, spalling and overall condition using methods described in NACE 0309-2009.
   c. Surface Cleanliness- Prior to Surface Preparation test to ensure surface cleanliness. The surface shall be free of oil, grease, and other contaminants that may impede adhesion of the mortar or lining as per ASTM D4258.
   d. Surface Preparation and Surface Profile- (Aged or Deteriorated Concrete for Mortar Repair Application) - Water Jetting (Minimum 4000-5000PSI) - Visual Inspection of surface preparation as per SSPC-SP13/NACE 6. Minimum Surface Profile of CSP#5. Surface Profile shall be verified using ICRI- Surface Finish Comparators
   e. Surface Preparation and Surface Profile- (Undamaged Concrete or New Pre-Cast Concrete for Lining) - Water Jetting (Minimum 4000-5000PSI), Abrasive Blasting or Diamond Grinding - Visual Inspection of surface preparation as per SSPC-SP13/NACE 6. Minimum Surface Profile of CSP#3. Surface Profile shall be verified using ICRI- Surface Finish Comparators
   f. Inflow & Infiltration- Visual Inspection to ensure all Inflow & Infiltration has been stopped.
   g. Wet Film Thickness (Primer (When Applicable) and Lining)- Wet Film thickness testing of the primer using notched wet film thickness gages as per ASTM D4414.
   h. Dry Film Thickness Testing-(Primer (When Applicable) and Lining) - Separate Dry Film thickness testing for all coats (primer if applicable) as per SSPC-PA9.
   i. Holiday testing- Verification of a pinhole free surface as per ASTM D4787 or NACE SP0188 (holiday test).

5. The Owner or Owners Representative retains the right to engage a Third-Party Quality Assurance Inspector to verify all quality control procedures.
C. Equipment Requirements
   1. Application equipment must be approved in writing by the Manufacturer specified herein.

D. Pre-Installation Conference
   1. The contractor, the installation sub-contractor, and the sanitary sewer infrastructure lining and rehabilitation system manufacturer’s representative shall meet on site with the owner’s representative. Particular emphasis shall be placed on these specifications, safety, weather conditions, surface preparation, material application, and inspection.

   2. The contractor shall submit to the owner’s representative any revisions or changes agreed upon, reasons thereof, and parties agreeing or disagreeing with them.

E. Substrate Conditions:
   1. Do not proceed with work until substrate preparation and tolerances have been approved by the owner’s representative, sanitary sewer infrastructure lining and rehabilitation system manufacturer’s representative, the approved installation sub-contractor, and the contractor.

1.5 DELIVERY, STORAGE, AND HANDLING
   A. Deliver products to the job site in manufacturer’s original, unopened containers bearing manufacturer’s name and label and the following information
      1. Product name
      2. Product description (generic product classification)
      3. Manufacturer’s lot number
      4. Color

   B. Store materials in sealed original manufacturer’s containers. Store materials in a protected area out of direct sunlight. Keep containers clean and undamaged. Adhere to manufacturer’s published storage temperature and shelf life recommendations. Protect all materials from freezing.

PART 2 PRODUCTS

2.1 GENERAL
   A. Comply with manufacturers written installation procedures and individual product data sheet application bulletins.

   B. Appropriate actions shall be taken by Contractor to comply with local, state and federal regulatory and other applicable agencies concerning the environment, health, and safety during work.
C. New Portland cement concrete structures shall have endured a minimum of 28 days since manufacture before commencing coating installation.

D. Any active flows shall be plugged or diverted as required to ensure all liquids are maintained below or away from the surfaces to be coated.

E. The temperature of the surface to be coated should be maintained between 40°F and 120° F. Refer to specific product data sheets for minimum surface temperature requirements.

F. Specified surfaces should be shielded to avoid exposure to direct sunlight or other intense heat sources. Where different surface temperatures do exist, coating installation should be scheduled when the temperature is falling versus rising.

G. Before commencing surface preparation, Contractor shall inspect all surfaces specified to receive the coating and notify Owner, in writing, of any noticeable disparity in the site, structure or surfaces which may interfere with the work, use of materials or procedures as specified herein.

2.1 SURFACE PREPARATION

A. Oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants which may affect the performance and adhesion of the coating to the substrate shall be removed.

B. Concrete and mortar damaged by corrosion, chemical attack or other means of degradation shall be removed so that only sound substrate remains.

C. Surface preparation method, or combination of techniques, that may be used include high-pressure water cleaning, high-pressure water jetting, abrasive blasting, shot blasting, grinding, scarifying, detergent water cleaning, hot water blasting, and others as described in NACE No. 6/SSPC SP-13. Whichever method(s) are used, they shall be performed in a manner that provides a uniform, sound clean neutralized surface suitable for the specified coating product(s).

D. Infiltration shall be stopped by using a material which is compatible with the repair products and is suitable for top-coating with the coating product(s). Active leakage of all concrete and brick structures shall be grouted as per manufacturers recommendations with polyurethane products specified in Section 1.05 B.

E. Debris resulting from surface preparation and cleaning shall not be allowed to enter any water streams and shall be removed from the structure.

2.2 APPLICATION OF REPAIR AND RESURFACING PRODUCTS

A. Areas, where rebar has been revealed and is corroded, shall be first prepared in accordance with ICRI Technical Guideline No. 310.1R. When the exposed reinforcing steel has loose rust, corrosion products, or is not well bonded to the surrounding concrete, removal should include undercutting the corroded reinforcing steel by approximately 3/4 inch (19 mm) in accordance with ICRI Guideline No. 310.1R and a minimum surface preparation of SSPC-SP2/3.
B. The exposed rebar shall be abrasively blasted and coated with a corrosion inhibiting coatings as specified in 1.05 B.

C. Repair products shall be used to fill voids, bugholes, and other surface defects (upto ¼” as specified in Section 1.05 B) which may affect the performance or adhesion of the coating product(s).

D. Resurfacing products shall be used to repair, smooth or rebuild surfaces with rough profiles to provide a concrete or masonry substrate suitable for the coating product(s) to be applied. These products shall be installed to minimum thickness as recommended by manufacturers published guidelines. Should structural rebuild be necessary, these products shall be installed to a thickness as specified by the Project Engineer.

E. Repair and resurfacing products shall be handled, mixed, installed and cured following manufacturer guidelines.

F. All repaired or resurfaced surfaces (Type A and Type B) shall be inspected for cleanliness and suitability to receive the coating product(s). Additional surface preparation may be required before coating application. For example, the mortar shall be finished with a sweeping of the wet mortar using a masonry brush to create a slight profile in the mortar equal to ICRI Guide 310.2R CSP#3.

2.3 APPLICATION OF CORROSION PROTECTION COATINGS

A. Application procedures shall conform to the recommendations of the coating product(s) manufacturer, including environmental controls, product handling, mixing, application equipment, and methods.

B. Spray equipment shall be specifically designed to accurately ratio and apply the coating product(s) and shall be in proper working order.

C. Contractors (Certified Applicator) qualified as per these specifications following Section 1.4 of these specifications shall perform all aspects of coating product(s) installation.

D. Prepared surfaces shall be coated by spray application of the coating product(s) described 1.05 B. to a manufacturer recommended minimum dry mill thickness (typical 40 dft.)

E. Subsequent top-coating or additional coats of the coating product(s) shall occur within the product’s recoat window. Other surface preparation procedures will be required if this recoat window is exceeded.

F. Coating product(s) shall interface with adjoining construction materials throughout the structure to efficiently seal and protect concrete or masonry substrates from infiltration and attack by corrosive elements. Procedures and materials necessary to affect this interface shall be as recommended by the coating product(s) manufacturer.

G. Sewage flow shall be stopped, bypassed or diverted for application of the coating product(s) to the invert and interface with pipe materials.
PART 3 EXECUTION

3.1 INSPECTION AND TESTING

A. The owner or owner’s authorized representative is recommended to retain the services of an independent third-party inspection firm to provide NACE or SSPC Level 3 minimum certified inspection during the surface preparation, application and final inspection of the installed system.

B. If test results indicate noncompliance with the specification, the following corrective action may be required of the contractor

1. Remove non-compliant systems or components.
2. Replace system or components in (1)
3. Assume the testing expenses.

C. Minimum requirements of the chemical resistant coating/lining system are that it be free of the following

1. Uncured material
2. Inadequate thickness
3. Pinholes
4. Blisters
5. Delamination
6. Foreign matter
7. Unspecified materials

D. All surfaces shall be tested by high voltage holiday testing as per ASTM D4787 or NACE SP0188 (holiday test).

3.2 PROTECTION

A. The corrosion protection coatings and/or lining system shall be protected from damage or detrimental elements during cure and until the time of final acceptance.

END OF SECTION
SECTION 03 10 00

CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Formwork for cast-in place concrete.
   2. Shoring, bracing, and anchorage.
   3. Form accessories.
   4. Form stripping.

B. Related Sections:
   1. Section 03 20 00 - Concrete Reinforcing.
   2. Section 03 30 00 - Cast-In-Place Concrete.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Formwork (Vertical Structures):
   3. Basis of Measurement: By the square foot.

B. Formwork (Horizontal Supported Structures):
   1. Basis of Measurement: By the square foot.
   2. Basis of Payment: Includes form materials, placement, placing accessories, stripping.

1.3 REFERENCES

A. American Concrete Institute:
   2. ACI 301 - Specifications for Structural Concrete.
   3. ACI 318 - Building Code Requirements for Structural Concrete.
   4. ACI 347 - Guide to Formwork for Concrete.

B. American Forest and Paper Association:
   1. AF&PA - National Design Specifications for Wood Construction.

C. The Engineered Wood Association:

D. American Society of Mechanical Engineers:

E. ASTM International:

F. West Coast Lumber Inspection Bureau:
1. WCLIB - Standard Grading Rules for West Coast Lumber.

1.4 DESIGN REQUIREMENTS
A. Design, engineer and construct formwork, shoring and bracing in accordance with ACI 318 to conform to design and applicable code requirements to achieve concrete shape, line and dimension as indicated on Contract Drawings.

B. Forms shall be designed with consideration of rate, method of placing concrete, and construction loads to be encountered, including vertical, horizontal, and impact loads.

1.5 SUBMITTALS
A. Information on the Contractor’s proposed forming system: Submit in such detail as the Engineer may require to assure himself that the intent of the specifications can be complied with by use of the proposed system.

B. Approval by the Engineer shall in no way relieve the Contractor of his responsibility to provide forms adequate and satisfactory for the purpose required.

1.6 QUALITY ASSURANCE
A. Perform Work in accordance with ACI 347, ACI 301, and ACI 318.

B. For wood products furnished for work of this Section, comply with AF&PA.

C. Install work in accordance with local, state, and federal regulations.

D. Maintain one copy of each document on site.
1.7 QUALIFICATIONS

A. Design formwork under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Texas.

B. Qualifications of Formwork Manufacturers: Use only forming systems manufactured by manufacturers having minimum 5 years’ experience, except as otherwise specified, or accepted in writing by the Engineer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver void forms and installation instructions in manufacturer's packaging.

B. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

1.9 COORDINATION

A. Coordinate this Section with other sections of work requiring attachment of components to formwork.

PART 2 PRODUCTS

2.1 WOOD FORM MATERIALS

A. Lumber Forms:

1. Application: Use for edge forms and unexposed finish concrete.

2. Boards: 6 inches or 8 inches in width, shiplapped or tongue and groove, “Standard” Grade Southern Yellow Pine, conforming to WCLIB Standard Grading Rules for West Coast Lumber. Surface boards on four sides.

B. Plywood Forms:


2. Forms: Conform to PS 1; 5-ply plywood sheets made with 100 percent waterproof adhesive and having finish surface that is coated or overlaid with surface which is impervious to water and alkaline calcium and sodium hydroxide of cement; full size 4 x 8 feet panels; each panel labeled with grade trademark of APA/EWA.


2.2 PREFABRICATED FORMS

A. Preformed Steel Forms: Rigidly constructed matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

C. Steel Forms: Sheet steel, suitably reinforced, and designed for particular use indicated on Contract Drawings.

D. Form Liners: Smooth, durable, grainless and non-staining hardboard, unless otherwise indicated on Contract Drawings.

E. Framing, Studding and Bracing: Southern Yellow Pine No. 2 with grade stamp clearly visible.

2.3 FORMWORK ACCESSORIES

A. Form Ties:

   1. General:
      a. Provide form ties for forming system selected that are manufactured by a recognized manufacturer of concrete forming equipment.
      b. Provide ties of type that accurately tie, lock and spread forms.
      c. Do not allow holes in forms for ties to allow leakage during placement of concrete.

B. Cone-Snap or Flat Bar Form Ties:

   1. Cone-snap ties shall form a cone shaped depression in the concrete with a minimum diameter of 1 inch at the surface of the concrete and 1-1/2 inches deep.
   2. Provide neoprene waterseal washer that is located near the center of the concrete.

C. Taper Ties:

   1. Neoprene Plugs for Taper Tie Holes: Size so that after they are driven, plugs are located in center third of wall thickness.
   2. Dry-Pack Mortar for Filling Taper Tie Holes:
      a. Consist of mix of 1 part of Portland cement to 1 part of plaster sand.
      b. Amount of water to be added to cement-sand mix is to be such that mortar can be driven into holes and be properly compacted.
      c. Admixtures or Additives: Are not to be used in dry-pack mortar.

D. Spreaders: Standard, non-corrosive metal form clamp assembly, of type acting as spreaders and leaving no metal within 1-1/2 inches of concrete face. Wire ties, wood spreaders or through bolts are not permitted.

E. Form Anchors and Hangers:
1. Do not use anchors and hangers exposed concrete leaving exposed metal at concrete surface.
2. Symmetrically arrange hangers supporting forms from structural steel members to minimize twisting or rotation of member.
3. Penetration of structural steel members is not permitted.

F. Form Release Agent: Colorless mineral oil that will not stain concrete, or absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.

G. Corners: Chamfer, rigid plastic or wood strip type; 3/4 inch bevel unless indicated otherwise on Contract Drawings; maximum possible lengths. Provide 1/4 inch bevel at expansion and construction joints.

H. Keyways: Steel, plastic, or lumber treated with form coating, applied according to label directions.

I. Dovetail Anchor System: System consisting of dovetail slots cast into the concrete, dovetail anchors that tie the masonry veneer to dovetail slots, and continuous wires that are embedded in the masonry and connect to the dovetail anchors:
   1. Dovetail Slot: 18 gage, Type 304 stainless steel in accordance with ASTM A 167, foam filled and in 10 foot lengths.
      a. Manufacturers:
         1) Hohmann and Barnard, Inc.; Hauppauge, NY; Model No. 305.
         2) Heckmann Building Products, Inc.; Chicago, IL; Model No. 100.
         3) Substitutions: Submit substitutions for approval.
   2. Dovetail Anchors: 23 gage, 1 inch wide, Type 304 stainless steel in accordance with ASTM A 167, and with seismic notch for attachment to wire embedded in masonry.
      a. Manufacturers:
         1) Hohmann and Barnard, Inc.; Hauppauge, NY; Model No. 303SV.
         2) Heckmann Building Products, Inc.; Chicago, IL; Model No. 361.
         3) Substitutions: Submit substitutions for approval.
   3. Wire Reinforcement: 9 gage, Type 304 stainless steel wire in accordance with ASTM A 580.
      a. Manufacturers:
         1) Hohmann and Barnard, Inc.; Hauppauge, NY.
         2) Heckmann Building Products, Inc.; Chicago, IL.

J. Flashing Reglets: Galvanized steel or rigid PVC, 22 gage thick, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.


L. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength and character to maintain formwork in place while placing concrete.
PART 3 EXECUTION

3.1 EXAMINATION

A. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Contract Drawings.

B. When formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement before proceeding, request instructions from Engineer.

C. Do not place any concrete until all forms have been thoroughly checked for alignment, level, strength, and to assure accurate location of all mechanical and electrical inserts or other embedded items.

3.2 INSTALLATION

A. Earth Forms:

1. Trench earth forms neatly, accurately, and at least 2 inches wider than footing widths indicated on Contract Drawings.
2. Trim sides and bottom of earth forms.
3. Construct wood edge strips at top of each side of trench to secure reinforcing and prevent trench from sloughing.
4. Form sides of footings where earth sloughs.
5. Tamp earth forms firm and clean forms of debris and loose material before depositing concrete.

B. Formwork - General:

1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
3. Camber forms where necessary to produce level finished soffits unless otherwise shown on Contract Drawings.
4. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
5. Complete wedging and bracing before placing concrete.

C. Forms for Smooth Finish Concrete:

1. Use steel, plywood or lined board forms.
2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
3. Install form lining with close-fitting square joints between separate sheets without springing into place.
4. Use full size sheets of form lines and plywood wherever possible.
5. Tape joints to prevent protrusions in concrete.
6. Use care in forming and stripping wood forms to protect corners and edges.
7. Level and continue horizontal joints.
8. Keep wood forms wet until stripped.

D. Forms for Surfaces to Receive Membrane Waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.

E. Framing, Studding and Bracing:

1. Space studs at 16 inches on center maximum for boards and 12 inches on center maximum for plywood.
2. Size framing, bracing, centering, and supporting members with sufficient strength to maintain shape and position under imposed loads from construction operations.
3. Construct beam soffits of material minimum of 2 inches thick.
4. Distribute bracing loads over base area on which bracing is erected.
5. When placed on ground, protect against undermining, settlement or accidental impact.

F. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301 and ACI 318.

G. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

H. Obtain Engineer’s approval before framing openings in structural members not indicated on Contract Drawings.

I. Install chamfer strips on external corners of beams, joists, columns and slabs exposed to view.

J. Do not reuse wood formwork more than 3 times for concrete surfaces to be exposed to view. Do not patch formwork.

3.3 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer’s specifications. Do not coat forms for concrete indicated to receive “scored finish”. Apply form coatings before placing reinforcing steel.
3.4 INSTALLATION - INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Install formed openings for items to be embedded in or passing through concrete work.

B. Locate and set in place items required to be cast directly into concrete.

C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

D. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.

E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

G. Form Ties:

1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
2. Place ties at least 1 inch away from finished surface of concrete.
3. Leave inner rods in concrete when forms are stripped.
4. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Contract Drawings.
5. Cone-Snap Rod and Bar Ties: Tie forms together at not more than 2-foot centers vertically and horizontally. After forms are removed from wall, fill tie holes as follows:
   a. Remove form ties from surfaces.
   b. Roughen cone shaped tie holes by heavy sandblasting before repair.
   c. Dry pack cone shaped tie holes with dry-pack mortar.
6. Taper Ties:
   a. After forms and taper ties are removed from wall, plug tie holes with neoprene plug as follows:
      1) Heavy sandblast and then clean tie holes.
      2) After cleaning, drive neoprene plug into each of taper tie holes with steel rod. Final location of neoprene plug shall be in center third of wall thickness. Bond neoprene plug to concrete with epoxy.
      3) Locate steel rod in cylindrical recess, made in plug, during driving:
         a) At no time are plugs to be driven on flat area outside cylindrical recess.
   b. Dry-Pack of Taper Tie Holes: After installing plugs in tie holes:
      1) Coat tie hole surface with epoxy bonding agent and fill with dry-pack mortar:
      2) Dry-Pack Mortar: Place in holes in layers with thickness not exceeding tie hole diameter and heavily compact each layer.
3) Dry-pack the outside of the hole no sooner than 7 days after the inside of the hole has been dry packed.

4) Wall surfaces in area of dry-packed tie holes: On the water side of water containing structures and the outside of below grade walls:
   a) Cover with minimum of 10 mils of epoxy gel.
   b) Provide epoxy gel coating on wall surfaces that extend minimum of 2 inches past dry-pack mortar filled tie holes.
   c) Provide finish surfaces that are free from sand streaks or other voids.

H. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

I. Construction Joints:
   1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
   2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
   3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
   4. Arrange joints in continuous line straight, true and sharp.

J. Embedded Items:
   1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
   2. Do not embed wood or uncoated aluminum in concrete.
   3. Obtain installation and setting information for embedded items furnished under other Specification sections.
   4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
   5. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 for size and location limitations.

K. Openings for Items Passing Through Concrete:
   1. Frame openings in concrete where indicated on Contract Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
   2. Coordinate work to avoid cutting and patching of concrete after placement.
   3. Perform cutting and repairing of concrete required as result of failure to provide required openings.

L. Screeds:
1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
2. Slope slabs to drain where required or as shown on Contract Drawings.
3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.

M. Screed Supports:

1. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad or base type screed supports which will not puncture membrane.
2. Staking through membrane is not permitted.

N. Cleanouts and Access Panels:

1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

END OF SECTION
SECTION 03 20 00

CONCRETE REINFORCING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Reinforcing bars.
   3. Reinforcement accessories.

B. Related Sections:
   1. Section 03 10 00 - Concrete Forming and Accessories.
   2. Section 03 30 00 - Cast-In-Place Concrete.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Bar Reinforcement:
   1. Basis of Measurement: By the ton.
   2. Basis of Payment: Includes reinforcement, placement, and accessories.

B. Welded Wire Fabric Reinforcement:
   1. Basis of Measurement: By the square foot.
   2. Basis of Payment: Includes welded wire reinforcement, placement, and accessories.

1.3 REFERENCES

A. American Concrete Institute:
   1. ACI 301 – Specifications for Structural Concrete.
   2. ACI 318 - Building Code Requirements for Structural Concrete.
   4. ACI 530.1 – Specifications for Masonry Structures.

B. ASTM International:
   1. ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
4. ASTM A496/A496M - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
6. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
7. ASTM A704/A704M - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
8. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
9. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.

C. American Welding Society:
1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

D. Concrete Reinforcing Steel Institute:
2. CRSI - Placing Reinforcing Bars.

1.4 SUBMITTALS

A. Shop Drawings: Indicate bar size, spacing, location, and quantity of reinforcing steel or welded wire fabric, bending and cutting schedules, and supporting and spacing.

B. Certificates: Submit AWS qualification certificate for welders employed on the Work.

C. Manufacturer's Certificate:
1. Submit certified copies of mill test report of reinforcement materials analysis.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with CRSI – Manual of Standard Practice, ACI 301, and/or ACI 318.

B. Prepare shop drawings in accordance with ACI SP-66.

C. Perform work in accordance with TxDot Standard Specification Item 440 “Reinforcing Steel”, as modified herein.
D. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Welders: AWS qualified within previous 12 months.

1.7 COORDINATION

A. Coordinate with placement of formwork, formed openings and other work.

PART 2 PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel: ASTM A615/A615M, 60ksi yield grade, deformed billet bars, uncoated finish.

B. Welded Plain Wire Fabric: ASTM A185/A185M; in flat sheets; unfinished.

2.2 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gage annealed type, unfinished.

B. Chairs, Bolsters, Bar Supports, and Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor retarder puncture.

C. Special Chairs, Bolsters, Bar Supports, Spacers: Adjacent to Weather Exposed Concrete Surfaces: Plastic coated steel hot dip galvanized metal spacers with plastic tips, Stainless steel or plastic spacers type; size and shape to meet Project conditions.

2.3 FABRICATION

A. Fabricate concrete reinforcement in accordance with CRSI Manual of Practice and ACI 318.

B. Form standard hooks for 180 degree bends, 90 degree bend, stirrup and tie hooks, and seismic hooks as indicated on Drawings.

C. Reinforcing shall be bent cold, true to the shapes indicated on the drawings. Bending shall preferably be done in the shop.

D. Irregularities in bending shall be cause for rejection.

E. Form reinforcement bends with minimum diameters in accordance with ACI 318.

F. Fabricate column reinforcement with offset bends at reinforcement splices.
G. Form spiral column reinforcement from minimum 3/8 inch diameter continuous deformed bar or wire.

H. Form ties ad stirrups from the following:
   1. For bars No. 10 and Smaller: No. 3 deformed bars.
   2. For bars No. 11 and Larger: No. 4 deformed bars.

I. Locate reinforcement splices not indicated on Drawings, at point of minimum stress. Submit location of splices to Engineer for review and approval.
   1. Refer to TxDOT Standard Specification Item 440, Article 440.2.E for nomenclature.

PART 3 EXECUTION

3.1 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position beyond specified tolerance.
   1. Do not weld crossing reinforcement bars for assembly.
   2. Unless otherwise shown on the drawings, dimensions shown for reinforcing bars are out to out of steel.
   3. All reinforcing steel shall be tied at all intersections. Where spacing is less than one foot in each direction, tie every other intersection.
   4. Reinforcing steel shall be supported and tied in such a manner as to provide a sufficiently rigid cage of steel.
   5. If the cage is not adequately supported to resist settlement or floating upward of the steel, over-turning of truss bars or movement in any direction during concrete placement, permission to continue concrete placement will be withheld until corrective measures are taken.
   6. Sufficient measurements shall be made during concrete placement to insure that the reinforcement remains in the proper position.

B. Do not displace or damage vapor retarder.

C. Accommodate placement of formed openings. Check drawing requirements (plans, sections and details) for additional reinforcing steel at all openings.

D. Space reinforcement bars with minimum clear spacing in accordance with ACI 318 of one bar diameter, but not less than 1 inch.
   1. Where bars are indicated in multiple layers, place upper bars directly above lower bars.

E. For cast-in-place concrete, maintain concrete cover around reinforcement in accordance with ACI 318 as follows:
### Reinforcement Location

<table>
<thead>
<tr>
<th>Reinforcement Location</th>
<th>Minimum Concrete Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete cast against and permanently exposed to earth</td>
<td>3 inches</td>
</tr>
<tr>
<td>Concrete exposed to earth or weather</td>
<td></td>
</tr>
<tr>
<td>No. 6 bars and larger</td>
<td>2 inches</td>
</tr>
<tr>
<td>No. 5 bars and smaller</td>
<td>1-1/2 inches</td>
</tr>
<tr>
<td>Concrete not exposed to weather or in contact with ground; slabs, walls &amp; joists</td>
<td></td>
</tr>
<tr>
<td>No. 14 bars and larger</td>
<td>1-1/2 inches</td>
</tr>
<tr>
<td>No. 11 bars and smaller</td>
<td>3/4 inches</td>
</tr>
<tr>
<td>Beams and Columns</td>
<td>1-1/2 inches</td>
</tr>
<tr>
<td>Shell and Folded Plate Members</td>
<td></td>
</tr>
<tr>
<td>No. 6 bars and larger</td>
<td>3/4 inch</td>
</tr>
<tr>
<td>No. 5 bars and smaller</td>
<td>1/2 inch</td>
</tr>
</tbody>
</table>

F. Minimum concrete cover over reinforcement shall be as specified in the table above unless specifically noted otherwise on the “Issued for Construction” drawings. Splice reinforcing where indicated on Drawings and in accordance with splicing device manufacturer’s instructions.

G. Development and splices of reinforcing steel shall be in accordance with ACI 318

H. When placed in the work, reinforcement shall be free from dirt, grease, oil, concrete laitance or other foreign matter prior to concrete placement.

I. Reinforcing shall be free from injurious defects such as cracks and laminations.

J. Install additional top and bottom corner bars, same size and quantity as the beam, footing or wall reinforcing, shown on the drawings and at all beam corners and interior/exterior beam, footing or wall intersections.

K. Unless noted otherwise, corner or intersection bar lap lengths shall be a minimum of 40 bar diameters in both directions.

### 3.2 STORING

A. Steel reinforcing shall be stored above the surface of the ground upon platforms, skids or other supports and shall be protected as far as practicable from mechanical injury and surface deterioration caused by exposure to conditions producing rust.

### 3.3 ERECTION TOLERANCES

A. Install reinforcement within the following tolerances for flexural members, walls, and compression members:
### Reinforcement Depth Tolerance Chart

<table>
<thead>
<tr>
<th>Reinforcement Depth</th>
<th>Depth Tolerance</th>
<th>Concrete Cover Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than 8 inches</td>
<td>plus or minus 3/8 inch</td>
<td>minus 3/8 inch</td>
</tr>
<tr>
<td>Less than 8 inches</td>
<td>plus or minus 1/2 inch</td>
<td>minus 1/2 inch</td>
</tr>
</tbody>
</table>

**B.** Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.

### 3.4 FIELD QUALITY CONTROL

**A.** The contractor shall implement a quality control plan to ensure that the reinforcing size, type, finish, spacing, cover, splicing, material and placement are in accordance with the “Issued for Construction” drawings.

**B.** If the project requires reinforcing inspections, no concrete shall be deposited until the engineer has inspected the reinforcing steel and has given permission to proceed with concrete placement. Notify the engineer a minimum of 48 hours prior to the planned concrete pour.

**C.** The contractor shall provide free access to Work and cooperate with the engineer or engineer’s appointed inspector.

**END OF SECTION**
SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete for the following:

1. Building frame members.
2. Shear walls, elevator shafts, and foundation walls.
3. Supported slabs and slabs on grade.
4. Control and expansion joints.
5. Equipment pads.
7. Thrust blocks.
8. Manholes and junction boxes.
11. Retaining walls.
14. Curbs and curb and gutter.
15. Concrete riprap.

B. Related Sections:

1. Section 03 10 00 - Concrete Forming and Accessories.
2. Section 03 20 00 - Concrete Reinforcing.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Cast-in-place concrete shall not be measured and paid for separately; it shall be subsidiary to other items of work.

1.3 REFERENCES

A. American Concrete Institute:

1. ACI CT - Concrete Terminology.
2. ACI 301 - Specifications for Structural Concrete.
3. ACI 305 - Hot Weather Concreting.
5. ACI 308.1 - Standard Specification for Curing Concrete.
6. ACI 309R - Guide for Consolidation of Concrete.
7. ACI 318 - Building Code Requirements for Structural Concrete.
8. ACI 347 - Guide to Formwork for Concrete.

B. ASTM International:

2. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
5. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
6. ASTM C78 – Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).
11. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
12. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
13. ASTM C192 - Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
14. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
20. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
30. ASTM C1218 - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
32. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
38. ASTM E154 – Standard Test Methods for Water Vapor Retarders Used in Contact with Earth under Concrete Slabs, on Walls, or as Ground Cover.
39. ASTM E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
40. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

C. Concrete Reinforcing Steel Institute:
   1. CRSI Design Handbook.

D. South Coast Air Quality Management District:
   1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.

1.4 PERFORMANCE REQUIREMENTS

A. Vapor Barrier Permeance: Maximum 0.01 Perms (grains/ft² * hr * in.Hg) when tested in accordance with ASTM E96/E96M, desiccant method or water method.

1. Maintain permeance of less than 0.01 Perms (grains/ft² * hr * in.Hg) after mandatory conditioning tests per ASTM E154 Sections 8, 11, 12, and 13.

1.5 SUBMITTALS

A. Product Data: Submit data on manufactured products, admixtures and vapor barrier.

B. Design Data:
1. Submit concrete mix design for each concrete strength/class indicated on Drawings a minimum of fifteen days prior to concrete placement. Submit separate mix designs when admixtures are required for the following:
   a. Hot and cold weather concrete work.
   b. Air entrained concrete work.
2. Identify mix ingredients, including type, brand, source and proportions of cement, fly ash, and admixtures, as well as aggregate gradation and chemical composition. Also include applicable reference specifications and copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for job conditions.
3. Admixtures shall not contain chloride ions.

C. Certificate of Compliance: Submit to the Engineer for approval for each strength/class of concrete indicated on Drawings:
   1. Aggregates
   2. Admixtures
   3. Cement
   4. Fly Ash
   5. Epoxy Grout

D. Obtain approval by Engineer before concrete placement.

E. Manufacturer’s Installation Instructions: Submit installation procedures and interface required with adjacent Work.

1.6 CLOSEOUT SUBMITTALS
   A. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

1.7 QUALITY ASSURANCE
   A. Perform Work in accordance with ACI 301 and 318.
   B. Conform to ACI 305 when concreting during hot weather.
   C. Conform to ACI 306.1 when concreting during cold weather.
   D. Acquire cement and aggregate from one source for Work.
   E. Maintain one copy minimum of each document on site.

1.8 DELIVERY
   A. Do not deliver concrete until forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement and Engineer’s inspection has been completed satisfactorily.
B. Packing and Shipping:

1. Deliver and store packaged materials in original containers until ready for use.

1.9 ENVIRONMENTAL CONDITIONS

A. Maintain concrete temperature after installation at minimum 50 degrees F for minimum 7 days.

B. Maintain high early strength concrete temperature after installation at minimum 50 degrees F for minimum 3 days.

C. Concrete temperature at time of delivery shall not exceed 85 degrees F. Any temperature above this will not be accepted. Measures shall be taken to ensure proper temperature at time of placement.

1.10 COORDINATION

A. Coordinate placement of joint devices, sleeves, penetrations, openings, conduits, piping, etc. with erection of concrete formwork and placement of form accessories.

PART 2 PRODUCTS

2.1 CONCRETE

A. Consistency of concrete mixtures shall be such that:

1. The mortar will cling to the coarse aggregate.
2. The aggregates will not segregate in the concrete when it is transported to the place of deposit.
3. The concrete, when dropped directly from the discharge chute of the mixer, will flatten out at the center of the pile, but the edge of the pile will stand and not flow.
4. The concrete and mortar will show no free water when removed from the mixer.
5. The concrete will slide and not flow into place when transported in metal chutes at an angle of thirty (30) degrees with the horizontal.
6. The surface of the finished concrete will be free of a surface film of “laitance”.

2.2 CONCRETE MATERIALS

A. Cement: ASTM C150, Type II – Moderate or Type V – Sulfate Resistant Portland type.

B. Site Mixed Cement

1. Cement used to make concrete shall be as indicated above.
2. Cement shall be of a standard brand manufactured by a reputable firm.
3. Only one brand of cement will be permitted unless otherwise authorized by the Engineer.
4. Each bag of cement shall be plainly marked with the name of the manufacturer and shall weigh no less than 94 pounds net.
5. Cement must be in good condition at the time it is delivered and it shall be properly protected against dampness after delivery.
6. No cement will be accepted which has become caked.

C. Normal Weight Aggregates: ASTM C33.
   1. The source of supply of fine and coarse aggregates shall be approved by the Engineer before any material is delivered. If required, samples of the fine or coarse aggregates shall be submitted to the Engineer for approval.
   2. Each sample shall be accompanied by complete information as to the source, name of producer, capacity and type of plant.

   1. Coarse Aggregate Maximum Size: In accordance with ACI 318.

E. Water: ACI 318; potable, without deleterious amounts of chloride ions, oils, acids, alkali, salts, organic material or other substances that may be deleterious to concrete or steel.

2.3 ADMIXTURES

A. Manufacturers:
   1. BASF Construction Chemicals - Building Systems.
   2. Euclid Chemical Company (The); an RPM company.
   4. Sika Corporation.
   5. Substitutions: Permitted. Contractor to submit substitutions to Engineer for review and approval.

B. Air Entrainment: ASTM C260.

C. Chemical: ASTM C494.
   1. Type A - Water Reducing.
   2. Type D - Water Reducing and Retarding.
   3. Type F - Water Reducing, High Range.
   4. Type G - Water Reducing, High Range and Retarding.

D. Fly Ash: ASTM C618; Class F; 25% of cementitious materials by weight, maximum.

E. Silica Fume: ASTM C1240.

F. Plasticizing: ASTM C1017
   1. Drilled piers; walls and columns where reinforcing steel is congested and additional fluidity is required in concrete mix without adding water: Type I, plasticizing
   2. Drilled piers utilizing temporary casing: Type II, plasticizing and retarding.
G. Prohibited admixtures include calcium chloride, thiocyanates, and all admixtures that contribute free chloride ion in excess of 0.1% by weight of cement.

2.4 ACCESSORIES

A. Bonding Agent: Polymer resin emulsion, Polyvinyl Acetate, Latex emulsion, or two-component modified epoxy resin.

1. Manufacturers:
   a. Euclid Chemical Company (The); an RPM company.
   b. Meadows, W.R., Inc.
   c. QUIKRETE.
   d. Sika Corporation.
   e. Substitutions: Permitted. Contractor to submit substitutions to Engineer for review and approval.

B. Vapor Barrier: ASTM E1745 Class A: 15 mil thick extruded polyolefin membrane; type recommended for below grade application. Furnish joint tape recommended by manufacturer.

1. Manufacturers:
   a. Stego Wrap by Stego Industries, LLC.
   b. Vapor Guard by Griffolyn.
   c. Zero-Perm by Alumiseal.
   d. Substitutions: Not Permitted.

C. Non-Shrink Grout: ASTM C1107; premixed compound consisting of non-metallic aggregate, cement, 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.

1. Manufacturers:
   a. Euclid Chemical Company (The); an RPM company.
   b. QUIKRETE.
   c. Sika Corporation.
   d. Substitutions: Permitted. Contractor to submit substitutions to Engineer for review and approval.

D. Curing Compound:

1. A curing compound, which may be sprayed on the surface of the concrete to prevent evaporation of moisture, may be used with the Engineer’s prior approval. This curing compound must be compatible with the sealer.

2.5 JOINT DEVICES AND FILLER MATERIALS

A. Construction Joint Devices: Not Applicable.
B. Expansion Joint Filler Material:

1. Joint Filler Type A: ASTM D994; Asphalt impregnated fiberboard or felt; thickness as specified on Drawings; tongue and groove profile.

C. Sealant: ASTM C920, elastomeric, self-leveling polyurethane sealant or as indicated on Drawings.

2.6 CONCRETE MIX

A. Select proportions for concrete in accordance with ACI 318 trial mixtures or field experience.

B. Provide structural concrete to the following criteria, unless indicated otherwise on Structural Series Drawings:

<table>
<thead>
<tr>
<th>Minimum Compressive Strength (f’c) 28-day (psi)</th>
<th>Max. Aggregate Size (in)</th>
<th>Slump (in)</th>
<th>Cement Type</th>
<th>Maximum Water-Cement Ratio</th>
<th>Types of Structures</th>
</tr>
</thead>
<tbody>
<tr>
<td>3000</td>
<td>1 1/2</td>
<td>6 +/- 1</td>
<td>Type I Normal</td>
<td>0.5</td>
<td>drilled piers, under ream piers</td>
</tr>
<tr>
<td>4000</td>
<td>1</td>
<td>4 +/- 1</td>
<td>Type I Normal</td>
<td>0.45</td>
<td>spread footings and pedestals, mat foundations, and columns not exposed to wastewater</td>
</tr>
<tr>
<td>4000</td>
<td>3/4</td>
<td>4 +/- 1</td>
<td>Type I Normal</td>
<td>0.45</td>
<td>slab on grade foundations, suspended slabs, beams, roof slabs, walls, retaining walls not exposed to wastewater</td>
</tr>
<tr>
<td>4500</td>
<td>1</td>
<td>4 +/- 1</td>
<td>Type II Moderate or Type V Sulfate Resistant</td>
<td>0.40</td>
<td>Clarifier foundation, Clarifier slabs, Aeration Basin and Digester foundation, Aeration Basin and Digester elevated walkways</td>
</tr>
<tr>
<td>4500</td>
<td>1</td>
<td>5 +/- 1</td>
<td>Type II Moderate or Type V</td>
<td>0.40</td>
<td>Clarifier walls, Aeration Basin and Digester walls</td>
</tr>
</tbody>
</table>
C. Provide concrete to the following criteria, unless indicated otherwise on Civil Series Drawings:

<table>
<thead>
<tr>
<th>Class of Concrete</th>
<th>Minimum Cement Content (sacks/CY)</th>
<th>Minimum Compressive Strength (f´c) 28-day (psi)</th>
<th>Minimum Flexural Strength (f_r) 7-day (psi)</th>
<th>Maximum Water-Cement Ratio (gal./sack) (wt. ratio)</th>
<th>Types of Structures</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5.0</td>
<td>3000</td>
<td>N/A</td>
<td>6.5</td>
<td>driveways, sidewalks, curb &amp; gutter, header curbs, curb ramps, curb inlets, valley gutters, storm water manholes, collars for manholes and valves, manhole footings, sign post and fence post footings, channel lining, riprap, safety end treatment, thrust blocks and bollards</td>
</tr>
<tr>
<td>B</td>
<td>4.5</td>
<td>2500</td>
<td>N/A</td>
<td>8.0</td>
<td>concrete cradle for Class A pipe bedding, concrete pipe collar for RCP</td>
</tr>
<tr>
<td>C</td>
<td>6.0</td>
<td>3600</td>
<td>N/A</td>
<td>6.0</td>
<td>cast-in-place reinforced concrete box (RCB) culverts (except top slab for direct traffic culverts), headwalls, wingwalls, aprons for box culverts, grate inlets, post inlets, junction</td>
</tr>
</tbody>
</table>
D. Slump requirements for concrete detailed on Civil Series Drawings shall be in accordance with Table 8 of TxDOT Item 421, unless indicated otherwise on Drawings.

E. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water/cement ratio is not exceeded. The Contractor shall be held responsible for the concrete being within the permissible ranges of slump.

F. Admixtures: Include admixture types and quantities indicated in concrete mix designs only when approved by Engineer.

1. Use accelerating admixtures in cold weather. Use of admixtures will not relax cold weather placement requirements.
2. Do not use calcium chloride or admixtures containing calcium chloride.
3. Use set retarding admixtures during hot weather.
4. Add air entrainment admixture to concrete mix for work exposed to freezing and thawing or deicing chemicals.
5. For concrete exposed to deicing chemicals, limit fly ash, pozzolans, silica fume, and slag content as required by applicable code.

G. Average Compressive Strength Reduction: Not permitted.

H. Ready Mixed Concrete: Mix and deliver concrete in accordance with ASTM C94/C94M.

1. When a truck mixer is used for delivery of concrete, no water from the truck water system or elsewhere shall be added after the initial introduction of the mixing water, except when on arrival at the job site the slump of the concrete is less than that specified, and water was withheld at the plant.
2. Certification: The manufacturer of the concrete shall furnish to the Contractor with each batch of concrete before unloading at the site, a delivery ticket on which is printed, stamped, or written the following information:

   a. Name of ready mix batch plant.
   b. Serial number of ticket.
   c. Date and truck number.
   d. Name of Contractor.
e. Designation of job.

f. Class or designation of concrete.

g. Amount of concrete (cubic yards).

h. Time loaded.

i. Water added by receiver of concrete and his initials.

j. Type, name and amount of admixture.

k. Amount of water withheld.

I. Site Mixed Concrete: Mix concrete in accordance with ACI 318.

J. Mortar Mixes for Concrete Finishes:

1. Mortar Mix for F4 Finish: Consist of 1 part cement and 1-1/2 parts fine sand passing Number 100 screen, mixed with enough water and emulsified bonding agent to have consistency of thick cream.

2. Mortar Mix for F5 Finish: Consist of 1 part cement to 1-1/2 parts of sand which passes Number 16 screen.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify requirements for concrete cover over reinforcement.

B. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere or move from position with placing concrete.

3.2 PREPARATION

A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Remove laitance, coatings, and unsound materials.

B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and epoxy as indicated on Drawings.

C. Remove debris and ice from formwork, reinforcement, and concrete substrates.

D. Remove water from areas receiving concrete before concrete is placed.

E. Before beginning work, the contractor shall inform the Engineer fully on the methods of construction, which he proposes to follow, including the amount and character of the equipment which he plans to use on the work.

F. Contractor is responsible for the safety and correctness of his method of construction, and for the adequacy of his equipment to carry out and complete the work in accordance with the contract documents. Concurrence on the part of the Engineer in any proposed method of construction, approval of equipment or the approval of concrete form plans shall not be
considered as relieving the Contractor of his responsibility to provide for the safety of workers and the public.

3.3 PLACING CONCRETE

A. Place concrete in accordance with ACI 318.

B. Notify testing laboratory and Engineer minimum 48 hours prior to commencement of operations. Engineer shall be permitted to inspect the forms, reinforcing steel placement and the preparations for placing the concrete with ample time for Contractor to correct any and all noted deficiencies before concrete arrives on site.

C. The Contractor shall be responsible for the protection of all concrete placed under any and all weather conditions.

D. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, and other cast-in items are not disturbed during concrete placement.

E. When it is necessary to continue mixing, placing and finishing concrete after daylight hours, the work area shall be brilliantly lighted so that all operations are plainly visible.

F. In general, concrete placing shall be so regulated that all finishing will be completed during daylight hours.

G. Install vapor barrier under interior slabs on grade in accordance with ASTM E1643. Lap joints and seal watertight in accordance with manufacturer’s installation instructions.

H. Repair vapor barrier damaged during placement of reinforcing steel. Repair with vapor barrier material; lap over damaged areas and seal watertight in accordance with manufacturer’s installation instructions.

I. Apply sealants in joints in accordance with Section 07 90 00.

J. Deposit concrete as nearly as practical in its final position. Prevent segregation of mix.

K. Concrete placed with a tremie pipe shall not be allowed to free fall more than 6 feet, with the exception of concrete piers.

L. Place concrete in continuous operation for each panel or section determined by predetermined joints.

M. Consolidate concrete immediately after placing by use of internal concrete vibrators supplemented by hand spading, rodding and tamping.
   1. Air entrained concrete shall not be vibrated for more than 12 seconds.
   2. Vibrators shall not be used to transport concrete inside forms.
   3. The vibrating equipment shall at all times be adequate in number of units and power to properly consolidate all concrete.
4. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing objectionable segregation.
5. Vibrators shall be applied at uniformly spaced points not farther apart than the visible effectiveness of the machine.
6. Where conditions make consolidation difficult or where reinforcement is congested, batches of mortar containing the same proportions of cement, sand, and water used in the concrete shall first be deposited in the forms to a depth of at least one inch.

N. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

O. Place concrete continuously between predetermined expansion, control, and construction joints.

P. Do not interrupt successive placement between planned/approved joint locations; do not permit cold joints to occur.

1. A cold joint, as defined by ACI CT, is a joint or discontinuity resulting from a delay in placement of sufficient duration to preclude intermingling and bonding of the material.

Q. Place floor slabs in saw-cut pattern as indicated on Drawings.

R. Contractor shall submit construction joint placement plans for Engineer approval prior to placing concrete.

S. Saw cut joints within 8 hours after placing. Use 3/16 inch thick blade, cut into 1/4 depth of slab thickness or 3/4 inch minimum, whichever is greater, or as specified on Drawings.

T. Screed floors and slabs on grade level, maintaining surface flatness of maximum 1/8 inch in 10 ft.

3.4 TRANSPORTING REQUIREMENTS

A. Concrete mixed in stationary mixers or paving mixers and transported by non-agitating equipment shall be placed in the forms within 45 minutes from the time ingredients are charged into the mixing drum.

B. Concrete that is truck mixed or transported in truck mixers or truck agitators shall be delivered to the site of the work and discharge completed in the forms within the time specified in ASTM C94.

C. Transit-mixed concrete that is completely mixed at the site of concrete placement or batched cement and aggregates transported to mixers shall be placed in forms within 90 minutes after cement has been added.

D. Concrete shall be placed in forms within 15 minutes after discharge from the mixer at the job site.
3.5 CONCRETE FINISHING – DESCRIPTION

A. Cement for Finishes:

1. Addition of white cement may be required to produce finish which matches color of concrete to be finished.

B. Vertical Concrete Surfaces: Use following finishes for vertical concrete surfaces as indicated in section “Concrete Finishing – Application”:

1. F1 Finish: No special treatment other than repair defective work and fill depressions 1 inch or deeper and tie holes with mortar after removal of curing membrane.
2. F2 Finish: No special treatment other than repair defective work, remove fins, fill depressions 1/2 inch or deeper and tie holes with mortar after removal of curing membrane.
3. F3 Finish: Repair defective work, remove fins, offsets, and curing membrane, and grind projections smooth. Fill depressions 1/4 inch or larger in depth or width and tie holes with mortar after removal of curing membrane.
4. F4 Finish:
   a. Same as specified for F3 finish, and in addition fill depressions and holes 1/16 inch or larger in width with mortar.
   b. “Brush-Off” sandblast surfaces prior to filling holes to expose all holes near surface of the concrete.
   c. Thoroughly wet surfaces and commence filling of pits, holes, and depressions while surfaces are still damp.
   d. Perform filling by rubbing mortar over entire area with clean burlap, sponge rubber floats, or trowels.
   e. Do not let any material remain on surfaces, except that within pits and depressions.
   f. Wipe surfaces clean and moist cure.
5. F5 Finish: Receive same finish specified for F3 Finish, and in addition, receive special stoned finish in accordance with the following requirements:
   a. Remove forms and perform required repairs, patching, and pointing as specified in this Section.
   b. Wet surfaces thoroughly with brush and rub with hard wood float dipped in water containing 2 pounds of Portland cement per gallon.
   c. Rub surfaces until form marks and projections have been removed.
   d. Spread grindings from rubbing operations uniformly over surface with brush in such manner as to fill pits and small voids.
   e. Moist cure brushed surfaces and allow to harden for 3 days:
      1) After curing, obtain final finish by rubbing with carborundum stone of approximately Number 50 grit until entire surfaces have smooth texture and uniform color.
      2) Continue curing for remainder of specified time.
   f. If any concrete surface is allowed to become too hard to finish in above specified manner, sandblast and wash related surfaces exposed to view, whether finished or not.
1) While still damp, rub over surface, plastic mortar, as specified for brushed surfaces and hand stoned with Number 60 grit carborundum stone, using additional mortar for brushed surfaces until surface is evenly filled without excess of mortar.

2) Continue stoning until surface is hard.

3) After moist curing for 3 days, make surface smooth in texture and uniform in color by use of Number 50 or Number 60 carborundum stone.

4) After stoning, continue curing until 7 day curing period is completed.

C. Horizontal Concrete: After proper and adequate vibration and tamping, use following finishes for horizontal concrete surfaces as indicates in section “Concrete Finishing–Application”:

1. S1 Finish: Screed to grade and leave without special finish.
2. S2 Finish: Smooth steel trowel finish.
3. S3 Finish: Steel trowel finish free from trowel marks. Provide smooth finish free of all irregularities.
4. S4 Finish: Steel trowel finish, without local depressions or high points, followed by a light hair broom finish. Do not use stiff bristle brooms or brushes. Perform brooming parallel to slab drainage. Provide resulting finish that is rough enough to provide nonskid finish. Finish shall be subject to review and acceptance by the Owner and/or Engineer.
5. S5 Finish: Nonslip abrasive: After concrete has been screeded level and hardened enough to support a man standing on a board, sprinkle abrasive from shake screen into surface at a uniform rate of 25 pounds for each 100 square feet of surface area, wood float into finish, then trowel abrasive into surface with steel trowel properly exposing abrasive in surface as required to provide non-slip surface.

3.6 CONCRETE FINISHING - APPLICATION

A. Finish concrete surfaces as indicated on the Drawings. Where not specified or indicated on the Drawings, finish surfaces as follows:

1. F4 Finish for Following Vertical Surfaces:
   a. Concrete surfaces specified or indicated to be painted.
   b. Concrete surfaces, interior or exterior, exposed to view.

2. Surfaces in Open Channels, Basins, and Similar Structures:
   a. F3 Finish for vertical surfaces which are normally below water surface.
   b. F4 Finish for vertical surfaces located above normal water surface and exposed to view.
   c. Remove fins and fill tie holes from concrete surfaces located in closed boxes or channels where there is normally no access or passageway.

3. S4 Finish for Following Surfaces:
   a. Exterior walkways.
   b. Tops of exterior walls or beams which are to serve as walkways.
   c. Tops of exterior walls or beams which are to support gratings.

4. S3 Finish for Following surfaces:
   a. Building and machine room floors which are not covered with surfacing material:
      Provide floors that are free from trowel marks.

5. S2 Finish for Following Surfaces:
   a. Tops of corbels.
b. Tops of walls and beams not covered above in S4 Finish.
c. Tops of slabs not covered in S1 Finish below.
d. All other surfaces not specified to be finished otherwise.

6. S1 Finish for Following Surfaces:
a. Basin bottoms to which layer of grout is to be applied.
b. Projecting footings which are to be covered with dirt.
c. Slab surfaces which are to be covered with concrete fill.

B. Concrete Floor Surfaces to which Surfacing Material is Applied

1. Finish smooth with tolerance within 1/8 inch in 10 feet in any direction from lines indicated on the Drawings.
   a. Wood float surfaces receiving quarry tile, ceramic tile or terrazzo with full bed setting system.
   b. Steel trowel surfaces receiving carpeting, resilient flooring, seamless flooring, thin set quarry tile, or thin set ceramic tile.

C. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains as indicated on drawings.

D. Defects: Concrete with excessive honeycomb (including exposed steel reinforcing, cold joints, entrapped debris, separated aggregate, or other defects) which affect the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete shall not vary more than the allowable tolerances of ACI 347. Exposed surfaces shall be uniform in appearance and finished as specified above.

3.7 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

1. Protect concrete footings from freezing for minimum 5 days.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete. Cure concrete in accordance with ACI 301, ACI 308.1 and ACI 318.

C. Curing shall be continuous for a minimum of 7 days or until 70% of the specified compressive strength has been obtained.

D. Contractor shall submit the curing method selected from those published in ACI 308.1 to the Engineer of Record for approval.

3.8 FIELD QUALITY CONTROL

A. Field testing will be performed by an independent commercial testing laboratory. Owner will employ lab for field testing, in accordance with ACI 318. Contractor shall be responsible for the cost of all failed tests.
1. Two copies of all test reports shall be furnished directly to the Owner.

B. Provide free access to Work and cooperate with appointed testing firm.

C. Submit proposed mix design of each class of concrete to Engineer for review prior to commencement of Work.

D. Concrete Inspections:
   1. Continuous Placement Inspection: Inspect for proper installation procedures.
   2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.

E. Strength Test Samples:
   3. Sample concrete and make one set of four 6-inch diameter by 12-inch long test cylinders or five 4-inch diameter by 8-inch long test cylinders for every 50 cu yds or less of each class of concrete placed each day, or any fraction thereof.
   4. When volume of concrete for any class of concrete would provide less than 5 sets of cylinders, take samples from five randomly selected batches, or from every batch when less than 5 batches are used.
   5. Make one additional cylinder during cold weather concreting and field cure.

F. Field Testing:
   4. Measure slump and temperature at commencement of concrete placement, for each compressive strength concrete sample, and for each batch (minimum) or every 10 cubic yards (maximum) of concrete.
   5. Measure air content in air entrained concrete at commencement of concrete placement, for each compressive strength concrete sample, and for each batch (minimum) or every 50 cubic yards (maximum) of concrete.

G. Cylinder Compressive Strength Testing:
   2. Test Acceptance: In accordance with ACI 318.
   3. Test one cylinder at 7 days.
   4. Test two 6-inch diameter by 12-inch long cylinders or three 4-inch diameter by 8-inch long cylinders at 28 days.
   5. Retain one cylinder for testing when requested by Engineer.
   6. Dispose of remaining cylinders when testing is not required.

H. Core Compressive Strength Testing:
2. Test Acceptance: In accordance with ACI 318.
3. Drill three cores for each failed strength test from concrete represented by failed strength test.

I. Water Soluble Chloride Ion Concentration Test Method: ASTM C1218; tested at 28 days.
   1. Maximum Concentration: As permitted by applicable code.

J. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.

3.9 DEFECTS

A. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.

B. Concrete with honeycomb (including exposed steel reinforcing, cold joints, entrapped debris, separated aggregate, or other defects) which affects the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair.
   1. As described in ACI 309R, honeycomb occurs when the mortar does not fill the space between the coarse aggregate particles and when it shows on a surface, it is necessary to chip out the area and make a repair.

C. The surface of the concrete shall not vary in alignment more than the allowable tolerances of ACI 347.

D. Exposed surfaces shall be uniform in appearance and finished as specified in the “Concrete Finishing” paragraphs above.

E. Patch imperfections as directed by Engineer.

3.10 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, design strength, tolerances or specified requirements.

B. Repair or replacement of defective concrete will be determined by Engineer.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

D. Failure to Meet Strength Requirements:
   1. The Engineer shall have the right to require changes in proportions, or to require additional curing on those portions of the structure represented by the test specimens, which failed.
2. If additional curing does not give the strength required, the Engineer shall have the right to require strengthening or removal and replacement of those portions which fail to develop required strength.

3. Specimens will be considered to have failed when average strength for any period of placing is less than values indicated in the following table:

<table>
<thead>
<tr>
<th>No. Days Consecutive Placing of Any One Class of Concrete</th>
<th>Percent of Strength Specified</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>85</td>
</tr>
<tr>
<td>2</td>
<td>95</td>
</tr>
<tr>
<td>3</td>
<td>95</td>
</tr>
<tr>
<td>5 or more</td>
<td>100</td>
</tr>
</tbody>
</table>

4. When additional curing of portions of the structure is ordered by the Engineer, it shall be done at Contractor’s expense and no claim for extra compensation for such additional curing shall be allowed.

5. In no case shall the Contractor be required to provide such additional curing beyond a total of 21 days, except where average strength of specimens, representing concrete placed on any three consecutive days, fall below 80% of the value specified in the “Concrete Mix” section of this specification. In this case, curing shall be continued until cores drilled from portions of the structure involved show an average strength equal to that specified in the “Concrete Mix” section of this specification. Cores shall have a diameter of approximately three times the maximum size aggregate and shall be tested in accordance with ASTM C42.

END OF SECTION
SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural shapes.
2. Channels and angles.
3. Hollow structural sections.
4. Structural pipe.
5. Structural plates and bars.
6. Floor plates.
7. Bolts, connectors, and anchors.
8. Grout.

B. Work Included: Work consists of furnishing all labor, material, and equipment necessary for completion of the following work:

1. Structural steel framing and support members, tension rods or cables, pipe columns, struts and braces complete with required braces, connection plates, welds, washers, bolts, nuts, shims, anchor bolts and templates.
2. Base plates, cap plates, and shear stud connectors.
3. Erecting, connecting, field welding and adjusting for plumb and level.
4. All other work normally related to the above, as shown on Contract Drawings, or specified under this section.

C. Work Furnished but not Installed:

1. Anchor bolts, anchor bolt templates, loose bearing plates and embedded items installed under Division 3 and/or Division 4 sections.

D. Definitions:


E. Related Requirements:

1. Section 03 60 00 - Grouting: Grout for setting base and bearing plates.
2. Section 05 50 00 - Metal Fabrications: Steel fabrications affecting structural steel work.
1.2 REFERENCE STANDARDS

A. American Institute of Steel Construction:


B. American Society of Civil Engineers:

1. ASCE 19 - Standard Applications of Steel Cables for Buildings.

C. ASTM International:

11. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
17. ASTM A588/A588M - Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4-in. (100-mm) Thick.
18. ASTM A618/A618M - Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing.
21. ASTM A852/A852M - Standard Specification for Quenched and Tempered Low-Alloy Structural Steel Plate with 70 ksi (485 MPa) Minimum Yield Strength to 4 in. (100 mm) Thick.
26. ASTM E164 - Standard Practice for Ultrasonic Contact Examination of Weldments.

D. American Welding Society:

1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
2. AWS D1.1 - Structural Welding Code - Steel.

E. Green Seal:


F. Research Council on Structural Connections:

1. RCSC - Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts.

G. SSPC: The Society for Protective Coatings:

1. SSPC - Steel Structures Painting Manual.
2. SSPC Paint 15 - Steel Joist Shop Paint.
3. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).
4. SSPC SP 3 - Power Tool Cleaning.
5. SSPC SP 6 - Commercial Blast Cleaning.
6. SSPC SP 10 - Near-White Blast Cleaning.

1.3 COORDINATION

A. Pre-Installation Conference: Schedule and attend a meeting prior to beginning steel erection at the site.

1.4 SUBMITTALS

A. Shop Drawings:

1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and size and type of bolts.
3. Cambers, loads, and clearances.
4. Indicate welded connections with AWS A2.4 welding symbols. State AWS pre-qualified weld designations for all types of groove welds used. Clearly indicate net weld lengths, sizes and welding sequences.

B. Erection Drawings:

1. Submit erection drawings defining location of each assembly or piece within the structure.
   a. Provide sufficient details to describe all field welding.
   b. Clearly identify all high strength bolts not required to be tensioned (a snug tight as defined by AISC).
   c. If drawings are submitted in multiple packages, each submittal shall be complete with all erection drawings, details, and piece drawings.
   d. Subsequent submittals of erection drawings which modify or add to earlier versions will be clearly marked.
2. Submit setting drawings for bolts and plates installed by others.
   a. Submit this information to the concrete contractor also so it may be utilized for installation of such items.

C. Reproduction of the Contract Documents is not permitted.

D. Manufacturer’s Mill Certificate: Certify products meet or exceed specified requirements.

E. Mill Test Reports: Submit indicating structural strength, and destructive and non-destructive test analysis.

F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.
G. Welding Procedure: Submit one copy welding procedure to Engineer of record and one copy to the testing agency for review. Welding procedures shall minimize distortions due to welding and through thickness stresses due to restraint of welding shrinkage.

1. Submit welding procedure specifications per AWS D1.1 for all groove welds.

H. Contractor Requested Changes:

1. All contractor requests for substitutions of member sizes or material grades or modification of the strength or configuration of the structural framing for the Contractor’s convenience, erection sequence, or construction equipment, shall be subject to the Owner’s written approval. Additional costs for such changes shall be borne by the Contractor.

2. Contractor shall compensate the structural engineer of record to make these changes or review the design calculations of others and modify the construction documents.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with the following:


B. Unidentified Members: Structural steel members shown on plans but not identified as to size, section and/or material grade will be included in the bid price for the work by assuming sizes, sections and/or material grades, shown for similarly loaded members having approximately the same overall length.

1. All such members and their associated cost will be identified in the bid for the work.

1.6 QUALIFICATIONS

A. Fabricator: Company specializing in performing Work of this section with minimum 5 years documented experience.

B. Erector: Company specializing in performing Work of this section with minimum 5 years documented experience for projects of similar size.

C. Shop Painter: Company specializing in performing Work of this section with minimum 5 years documented experience.

D. Welders and Welding Procedures: AWS D1.1 qualified within previous 12 months.
PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

A. Structural W-Shapes: ASTM A992/A992M, unless otherwise indicated on Contract Drawings.

B. Structural M-Shapes: ASTM A36/A36M, unless otherwise indicated on Contract Drawings.


D. Structural T-Shapes: Cut from structural W-shapes.

E. Channels and Angles: ASTM A36/A36M, unless otherwise indicated on Contract Drawings.

F. Round Hollow Structural Sections: ASTM A500/A500M, Grade B.

G. Rectangular Hollow Structural Sections: ASTM A500/A500M, Grade B.

H. Structural Pipe: ASTM A53/A53M, Grade B.

I. Structural Plates and Bars: ASTM A36/A36M. Unless otherwise indicated on Contract Drawings.

J. Floor Plates: ASTM A786/A786M; pattern as indicated on Contract Drawings.

K. Sliding Bearing Plates: Teflon coated.

L. Suspension Cable: wire rope as indicated on Contract Drawings.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. Bolts: Heavy hex, structural type.

1. ASTM A325; Type 1, plain unless otherwise indicated on Contract Drawings.

2. ASTM A490; Type 1 plain.

B. Nuts: ASTM A563; heavy hex type.

1. Finish: Plain, unless otherwise indicated on Contract Drawings.

C. Washers: ASTM F436; Type 1, circular.

1. Finish: Plain, unless otherwise indicated on Contract Drawings.

D. Compressible-Washer-Type Direct Tension Indicators: ASTM F959; Type 325 unless otherwise indicated on Contract Drawings.

1. Finish: Mechanically galvanized, unless otherwise indicated on Contract Drawings.
E. Tension Control Assemblies: ASTM F1852; Type 1, heavy hex head, twist off type; complete with washers and heavy hex nuts.

1. Finish: Unfinished, unless otherwise indicated on Contract Drawings.

F. Shear Connectors: ASTM A108; 60 ksi ultimate stress; headed, unfinished and in accordance with AWS D1.1; Type B.

G. Anchor Rods: ASTM F1554; Grade 36, weldable, unless otherwise indicated on Contract Drawings.

1. Shape: Hooked, unless otherwise indicated on Contract Drawings.
2. Plate Washers: ASTM A36/A36M.


1. Finish: Unfinished, unless otherwise indicated on Contract Drawings.


1. Interior Use: Conditioned environments free from potential moisture; provide carbon steel anchors
   a. Finish: Zinc plating in accordance with ASTM B633, type III Fe/Zn 5 (SC1).
2. Exterior or Exposed Use: Exposed or potentially wet environments and attachment of exterior cladding materials; provide galvanized carbon steel conforming to ASTM A153 or stainless steel anchors. Stainless steel nuts shall conform to ASTM F594.
   a. Type: Galvanized, unless otherwise indicated on Contract Drawings.
   b. Nuts and washers shall match alloy group of anchor and shall have minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener.
   c. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
3. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Owner, provide one of the following:
   a. Kwik Bolt 3, ICC ESR-1385 and ESR-2302 – Hilti Fastening Systems
   b. Trubolt, ICC ESR 2251 – ITW Red Head
   c. Wedge-All, ICC ESR-1396 – Simpson Strong-Tie

1. Interior Use: Conditioned environments free from potential moisture; provide carbon steel anchors
   a. Finish: Zinc plating in accordance with ASTM B633, type III Fe/Zn 5 (SC1).

2. Exterior or Exposed Use: Exposed or potentially wet environments and attachment of exterior cladding materials; provide galvanized carbon steel conforming to ASTM A153 or stainless steel anchors. Stainless steel nuts shall conform to ASTM F594.
   a. Type: Galvanized, unless otherwise indicated on Contract Drawings.
   b. Nuts and washers shall match alloy group of anchor and shall have minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener.
   c. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.

3. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Owner, provide one of the following:
   a. HIT-RE 500 SD, ICC ESR-2322 – Hilti Fastening Systems
   b. SET22, ICC ESR-1772 – Simpson Strong-Tie

K. Drilled-In Inserts: Size and type as noted on the Contract Drawings.

L. Forged Structural Steel Hardware:

2. Eye Nuts and Eye Bolts: ASTM A108; Grade 1030.

2.3 WELDING MATERIALS

A. Welding Materials: AWS D1.1; type required for materials being welded.

1. Rebar used for welding shall meet the requirements of ASTM A706. Rebar bends shall meet the minimum bend diameters listed in ACI 318.

2.4 FABRICATION

A. General:

1. Fabricate and assemble structural assemblies in shop to greatest extent practicable, in accordance with reference standards cited herein and final shop drawings.
2. Use detailing and fabrication procedures that account for distortion and shrinkage due to welding processes, both in the shop and in the field.
3. Take measurements on site as required for correct fabrication and installation. Fabricator shall be responsible for errors in fabrication and for correct fit of structural steel.

B. Connections:
1. Provide connections as shown or noted on the Contract Drawings. The design of connections not shown or noted shall be provided by the Owner upon request. Standard framing connections not shown shall be bid on the basis of connection tables on pages 4-9 thru 4-31 of the AISC A Manual of Steel Construction, ASD.

2. Alternate connections designed by the Contractors Engineer may be submitted with one set of stamped calculations for record.

3. Alternate connection concepts shall be pre-approved during bidding.

4. All connections shall be designed for 110% of the value noted on plans.

5. Welds not specified shall be 3/16” fillet continuous but not less than the AISC minimum based on the thickness of the parts joined.

C. Space shear stud connectors at as indicated on Contract Drawings.

1. Automatically end weld according to AWS D1.1, unless indicated otherwise on Contract Drawings.
2. Shop weld where possible.
3. Thoroughly clean surface where stud is to be attached. Remove mill scale by grinding or sandblasting where it is sufficiently thick to interfere with proper welding.

D. Continuously seal joined members by continuous welds.

E. Fabricate connections for bolt, nut, and washer connectors.

F. Develop required camber for members.

G. Mark all members in protected, plainly visible locations in accordance with reference numbers on setting diagrams.

1. The member work point at each end of columns shall be determined and marked in the shop with a center punch or other acceptable means.
2. Marking shall be placed on the flanges and web at each end of columns.
3. Work point shall be as defined in AISC Code of Standard Practice, Section 7.11.2(a).

H. Perform all necessary cutting, fitting and drilling for the accommodation of other trades.

1. Secure correct information for required openings both before and after steel is delivered.
2. No cutting or drilling will be permitted on the job without the acceptance of the Owner.

I. Splicing of members to obtain the required lengths will not be permitted without prior acceptance of the Owner, unless shown on the Contract Drawings.

J. Camber beams and girders where indicated on the Contract Drawings.
K. Where exact sizes and weights called for are not readily available, secure the Owner's acceptance of suitable sizes in time to prevent delay due to such substitutions.

2.5 FINISHES

A. Prepare structural component surfaces to be covered in the completed structure in accordance with SSPC SP 3.

B. Prepare structural component surfaces exposed to weather in the completed structure in accordance with SSPC SP 6.

C. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted friction type (slip critical) connections.

D. Galvanizing: ASTM A123/A123M; hot dip galvanize after fabrication where shown on Contract Drawings.

E. Galvanizing for Bolts, Connectors, and Anchors: Where shown on Contract Drawings
   1. Hot-Dip Galvanizing:
      b. Connectors and Anchors: ASTM A153/A153M.
   2. Mechanical Galvanizing: ASTM B695; Class 50 minimum.

2.6 ACCESSORIES

A. Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing minimum compressive strength of 7,000 psi at 28 days.

B. Shop Primer: SSPC Paint 15, Type 1, red oxide, minimum 2 coats at 2 oz per square foot.

C. Touch-Up Primer: Match shop primer.

D. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 Type I Inorganic or Type II Organic.

2.7 SOURCE QUALITY CONTROL

A. Testing Agency:
   1. Testing and inspection will be made by an approved testing laboratory selected and paid by the Owner.
      a. Retention by the Owner of an independent testing agency shall in no way relieve the Contractor of responsibility for performing all work in accordance with the contract documents.

B. Shop test bolted and welded connections as specified for field quality control tests.
C. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

1. Specified shop tests are not required for Work performed by approved fabricator.

D. Furnish the testing agency with the following:

1. Access on site to a complete set of field use shop and erection drawings with Engineer’s stamp.
2. Mill test reports.
3. Information as to time and place of all rollings and shipment of material to shops.
4. Full and ample means and assistance for testing all material.
5. Proper facilities, including scaffolding, temporary work platforms, etc., for inspection of the work in the mills, shop and field.
6. Representative sample pieces requested for testing.
7. Welding procedure specification.

E. Assign an identifying symbol or mark to each person installing connections. Identify all shop and field connections with this mark so that the inspector can refer back to the person making the connection.

F. Shop welds, including stud and rebar welds to embed plates and assemblies shall be tested before arriving at the job site.

G. Contractor shall notify testing agency at least 10 working days in advance of any qualification testing for welding required herein.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify bearing surfaces are at correct elevation. Report all deviations to the General Contractor.

B. Verify anchor rods are set in correct locations and arrangements with correct exposure for steel attachment. Report all deviations to the General Contractor.

C. Do not proceed with erection until all unacceptable conditions are corrected.

3.2 PREPARATION

A. Furnish setting drawings, templates and directions for installation of anchor rods and embedments in concrete and masonry work.

1. Templates shall be permanently marked with column center lines and north arrow.
B. Deliver anchor bolts and other anchorage devices which are embedded in cast-in-place concrete and masonry work to the project site in time to be installed before the start of cast-in-place concrete and masonry work operations.

C. Storage of Structural Steel:

1. Support structural steel members which are stored at the project site above ground on platforms, skids, or other supports, upright to prevent twisting.
2. Protect steel from corrosion.
3. Store other materials in weather-tight and dry place, until ready for use.
4. Store packaged materials in their original, unbroken package or container.
5. Where materials are to be stored on structure, store in a manner that will not cause distortion or damage the supporting structure.
6. Repair or replace damaged materials or structures as directed.

3.3 ERECTION

A. Erect structural steel in accordance with AISC Specifications, including supplements, with additional requirements of this section.

B. Allow for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in alignment until completion of erection and installation of permanent bracing.

1. Consider all structural steel as non-self-supporting steel frames until permanently secured.
2. Permanently secured is when the structure has its complete gravity and lateral load resisting systems in place including floor and roof diaphragms, vertical bracing and/or shear walls and foundations.
3. Contractor shall coordinate installation of all non-structural steel items which will load the non-self-supporting structural steel frame. The structural steel frame temporary supports shall resist all loads from these non-structural steel items.

C. Protect any adjacent materials or areas below from damage due to weld splatter or sparks during field welding.

D. Set base and bearing plates level and at correct elevations on roughened surfaces cleaned of all bond reducing materials. Temporarily support on steel wedges or shims until supported members are plumbed and grouting is completed.

E. Field weld components and shear connectors indicated on Contract Drawings and shop drawings.

1. Clean existing surfaces before welding to existing steel.

F. Field connect members with threaded fasteners; torque all high strength bolts used in column splices, connections of beams and girders to columns, and where noted on the Contract Drawings to the minimum tension shown in Table J3.7 of AISC “Specification for Structural Steel Buildings, ASD”, June 1, 1989; tighten to snug tight for bearing type connections.
1. All A325 and A490 bolts specified as slip critical or fully pre-tensioned shall be tightened and inspected using Direct Tension Indicating washers.

2. No drifting or cutting to enlarge unfair holes will be allowed. Make minor corrections by reaming.

3. Serious defects may not be corrected in the field but shall be called to the attention of the Owner for a decision as to the method and/or procedure for correction.

G. Do not field cut or alter structural members without approval of Engineer.

H. Splice only where indicated on Contract Drawings.

I. Fasten splices in compression after bearing surfaces have been brought into contact. Clean bearing surfaces before assembly. Close all gaps 1/32” wide or greater by driving non-tapered mild steel shims full depth of the bearing surface along the full length of the gap.

J. After erection, touch up welds and abrasions to match shop finishes.

K. Drilled-In Inserts: Install in accordance with manufacturer’s recommendations in accurately drilled holes of required diameter and depth. Where adhesive inserts are used, clean hole in accordance with manufacturer’s recommendations.

1. Do not drill holes in concrete until material has achieved full design strength.

3.4 GROUT INSTALLATION

A. Grout under base plates as indicated on Contract Drawings, in accordance with Section 03 60 00.

B. Shim bearing plates and equipment supports to proper elevation, snug tighten anchor bolts.

C. Fill void under bearing surface with grout. Install and pack grout to remove air pockets.

D. Moist cure grout.

E. Remove forms after grout is set. Trim grout edges to from smooth surface, splayed 45 degrees.

F. Tighten anchor bolts after grout has cured for a minimum of 3 days, or as recommended by manufacturer.

3.5 TOLERANCES

A. Comply with Requirements of AISC Code of Standard Practice for Steel Buildings and Bridges, except as follows:

1. Columns:
   a. Maximum deviation of column from established column line shall not exceed 1”, accumulative from all sources.
b. Bases of all columns shall be located on established centerlines (plan dimension) within +/- 1/8”. Bases shall be at specified elevation +/- 1/16”.

c. Maximum variation between top elevation of all columns shall not exceed 1/4”. Maximum variation between top elevations of any two adjacent columns shall not exceed 1/8”.

2. Members connecting to Columns:
   a. Horizontal deviation of member working point from position with respect to supporting column working line shall not exceed +/- 1/16” from the location shown on Contract Drawings.
   b. Elevation deviation of member working point with respect to upper splice line of supporting column shall not exceed +1/8” or –1/4” from the elevation shown on Contract Drawings.

3. Cambered Steel Beams: Fabrication camber shall be adjusted to compensate for conditions of shipping, handling and erection. Maximum deviation of vertical camber at mid span of beam after erection, prior to placing deck, +3/8” or -0” maximum.

4. Other Members: Deviation of member working point horizontal location and elevation with respect to the supporting member shall not exceed +/- 1/16” from the location and elevation shown on the Contract Drawings.

5. Leveling and Plumbing: Base leveling and plumbing on a mean temperature of 70 degrees F. Compensate for difference in temperature at time of erection.

3.6 FIELD QUALITY CONTROL

A. Verification of Erection Tolerances:
   1. Surveys, made by a surveyor with experience on similar projects, employed by the General Contractor and acceptable to the Owner shall be made as follows:
      a. Determine actual plan location and elevation at the top and bottom of each column immediately upon completion of erection.
   2. Survey reports shall be submitted to the Owner within 24 hours after recording the data. Such reports shall, in addition, identify all deviations of member location and/or elevation in excess of allowable tolerances specified.

B. Shop inspection by the Testing Agency for all columns and 20% of beams and girders shall include examination of steel for straightness and alignment, conformance to length and camber tolerances, fissures, mill scale and other defects and deformities, as described in ASTM A6 and examination of aforementioned fabricated pieces for conformity with approved shop drawings.

C. Bolted Connections: Inspect in accordance with AISC 303 and “Specification for Structural Joints Using ASTM A325 or A490 Bolts”.
   1. Visually inspect all bolted connections. Verify the specified surface preparation of the faying surface has been correctly prepared. If twist off (self-indicating) bolts are used, verify that all torque-off splines have been sheared off.
   2. Inspect the bolt tightness of 10% of the bolts (minimum of 2), selected at random, in each high strength bolted connection.
a. If rejectable bolts are found in any connection, all remaining bolts in that connection shall be inspected for tightness.

3. For Direct Tension Indicators, comply with requirements of ASTM F959. Verify that gaps are less than gaps specified in Table 2.

4. When splines of twist off bolts are not sheared, or indicator washers are not properly deformed, the Testing Agency shall determine that proper bolt tension has been achieved by the application of a properly calibrated testing torque or the Contractor may, at his option, remove and replace all bolts with unsheared splines and all bolts without properly deformed indicator washers. All cost of additional inspection required by this paragraph shall be borne by the Contractor.

D. Drilled-In Inserts

1. Self-Expanding Inserts: The testing Agency shall inspect self-expanding, drilled-in inserts shown on the structural Contract Drawings as follows:
   a. Prior to installation, the Testing Agency shall determine that the installing contractor has the proper materials and equipment for drilling holes in the receiving surface of required diameter and length.
   b. All inserts shall be visually inspected after installation to ensure that they have been installed perpendicular to the receiving surface and to the proper depth.

2. Adhesive-Bonded Inserts: The Testing Agency shall inspect adhesive-bonded, drilled in inserts as follows:
   a. The Testing Agency shall be present at the site to observe the installation of the first 10 inserts placed. Such observation shall be to ensure that drilled holes are of required diameter and depth, holes are properly cleaned prior to installation of the insert, and that holes are completely filled with properly mixed adhesive after installation.
   b. All inserts shall be visually inspected after installation to ensure that the insert has been installed perpendicular to the receiving surface and to proper depth.

E. Welding: Inspect welds in accordance with AWS D1.1.

1. 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.

2. Inspection of welding by the Testing Agency will be such as to assure that the work conforms to specified requirements, and will include:
   a. Ascertainment that electrodes used for manual shielded metal-arc welding and the electrodes and flux used for submerged arc welding conform to the requirements herein.
   b. Ascertaint that the welding is performed only by welding operators and welders who are properly certified.
   c. Ascertainment that the fit-up, joint preparation, size, contour, extent of reinforcement, and length and location of welds conform to specified requirements and the Contract Drawings, and that no specified welds are omitted or unspecified welds added without approval of the Owner.

3. Visually inspect all welds.
4. Ultrasonic Inspection: ASTM E164; perform on all full and/or partial penetration groove welds.
5. Liquid Penetrant Inspection: ASTM E165.
6. Magnetic Particle Inspection: ASTM E709; performed on 10% of all other welds.
7. Radiographic Inspection: ASTM E94; performed on may be substituted for ultrasonic inspection with prior approval.
8. All embedded plates and assemblies manufactured by the steel fabricator and supporting structural elements shall be tested.
9. Test components of those embedded plates and assemblies as follows:
   a. Welded reinforcing bars and deformed anchors: 100% visual and 10% magnetic particle, 100% ultrasonic for all complete penetration groove welds to reinforcing bars.
   b. Stud connectors shall have all studs visually and acoustically tested in accordance with AWS D1.1.
   c. Plates: Embedded plates thicker than 3/8” shall be ultrasonically tested along the center line of the plate width. Such tests shall be made after stud/rebar shop welding.
      1) Any discontinuity shall be cause for rejection.
10. If defective welds are discovered, the remaining uninspected welds shall receive such ultrasonic or magnetic particle inspection as may be required by the Owner. All cost of additional inspection required by this paragraph shall be borne by the Contractor.
11. The welding inspector will have the authority to reject weldments. Such rejection may be based on visual inspection where in his opinion the weldment would not pass a more detailed investigation.
12. Reports by the Testing Agency’s inspector will contain, as a minimum, an adequate description of each weld tested, the identifying mark of the welder responsible for the weld, critique of any defects noted by visual inspection or testing, and a statement regarding the acceptability of the weld tested, as judged by current AWS standards. Reports shall be distributed as early as possible, but not later than one work week after the tests have been performed. The Owner shall be notified by phone if, in the judgment of the inspector, test results require immediate comment.

F. Correct defective bolted connections and welds.

1. The cost of re-inspection of previously defective bolted and/or welded connections shall be borne by the Contractor.

END OF SECTION
SECTION 05 50 00
METAL FABRICATIONS

PART 1 PART 1 GENERAL

1.1 SUMMARY

A. Provide all labor, materials and equipment to accomplish all loose miscellaneous metal work; including, but not limited to lintels, support angles and frames, their anchorage and other items of ferrous metals indicated or required for completion of the project unless otherwise shown – all metal to HDG

B. Related Sections:

1. Section 05 12 00 - Structural Steel Framing

1.2 REFERENCE STANDARDS

A. Aluminum Association:

1. AA DAF-45 - Designation System for Aluminum Finishes.

B. American Architectural Manufacturers Association:

1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.

C. American National Standards Institute:

1. ANSI A14.3 - American National Standard (ASC) for Ladders - Fixed - Safety Requirements.

D. American Welding Society:

1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
2. AWS D1.1/D1.1M - Structural Welding Code - Steel.
3. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel.
E. ASTM International:

5. ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
13. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
18. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
19. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
27. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire.

F. Builders Hardware Manufacturers Association (BHMA):


G. California Department of Health Services:


H. SSPC: The Society for Protective Coatings:

1. SSPC - Steel Structures Painting Manual.
2. SSPC Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
3. SSPC Paint 20 - Zinc-Rich Coating (Type I - Inorganic and Type II - Organic).
4. SSPC SP 1 - Solvent Cleaning.
5. SSPC SP 10 - Near-White Blast Cleaning.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

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. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

C. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.4 INSERTS AND ANCHORAGES

A. Furnish inserts and anchoring devices to be built into other work for installation of miscellaneous metal items; coordinate delivery to job site to avoid delay.
PART 2 PART 2 PRODUCTS

2.1 BASIC MATERIALS SHALL MEET OR EXCEED THE FOLLOWING:

A. Steel Plates, Shapes, Bars:  ASTM A 36.

B. Cold-Formed Steel Tubing:  ASTM A 500, Grade B.

C. Steel Pipe:  ASTM A 53, Grade B.

D. Cold-Rolled Steel Sheets:  ASTM A 366.

E. Anchors: ASTM F 1554; Grade 55, hooked, weldable unless noted otherwise on Drawings. Furnish with nut and washer.

F. Galvanized Steel Sheets:  ASTM A 526, with ASTM A 525, Grade G90 zinc coating. (minimum 2 oz. per square foot of surface area.)

G. Concrete Inserts:  Malleable iron (ASTM A 47) or cast steel (ASTM A 27) inserts, with steel bolts, washers and shims; hot dip galvanized.

H. Shop Paint:  FS TT-P-86, Type II, or, SSPC-Paint 14. Apply to cleaned and degreased steel surfaces at rate to provide a 2.0-mil dry film thickness, minimum 2 coats.

I. Galvanizing:  ASTM A 386 for assembled products;  A 153 for iron and steel hardware.

PART 3 PART 3 EXECUTION

3.1 FABRICATION, GENERAL

A. Fit and shop-assemble items in largest practical sections for delivery to Site.

B. Fabricate items with joints tightly fitted and secured.

C. Use materials of size and thickness shown or, if not shown, of required size and thickness to produce strength and durability in finished product.  Shop paint all items not specified to be galvanized after fabrication.

D. Weld corners and seams continuously; grind exposed welds smooth and flush.

E. Form exposed connections with hairline, flush joints; use concealed fasteners where possible.

3.2 ROUGH HARDWARE

A. Furnish Custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes for framing and supporting and anchoring woodwork.  Galvanize, unless otherwise indicated.
3.3 LOOSE BEARING PLATES

A. Provide for steel items bearing on masonry or concrete, as shown. Drill plates to receive anchor bolts. Galvanize after fabrication.

3.4 MISCELLANEOUS FRAMING AND SUPPORTS

A. Provide as required to complete work and not included with structural steel framework. Fabricate lengths of welded construction in as large units as possible; drill and tap as required to receive hardware and similar items. Include required anchors for building into other work; spaced not more than 24” o.c.

3.5 MISCELLANEOUS STEEL TRIM

A. Fabricate to shapes and sizes as required for profiles shown; continuous welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings, and anchorages; coordinate assembly and installation with other work.

3.6 INSTALLATION

A. Perform cutting, drilling and fitting required for installation; set work accurately in location, alignment and elevation, measured from established lines and levels. Provide anchorage devices and fasteners where necessary for installation to other work.

B. Set loose items on cleaned bearing surfaces, using wedges or other adjustments as required. Solidly pack open spaces with bedding mortar, consisting of one part Portland cement to three parts sand and only enough water for packing and hydration, or use commercial non-shrink grout material.

C. Touch up shop paint after installation. Clean field welds, bolted connections and abraded areas, and apply same type paint as used in shop. Use galvanizing repair paint on damaged galvanized surfaces.

END OF SECTION
SECTION 05 72 10
ORNAMENTAL ALUMINUM RAILINGS

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. Section Includes: Ornamental Aluminum Railing.

1.3 DEFINITIONS

A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas, pedestrian guidance and support, visual separation, or wall protection.

1.4 PERFORMANCE REQUIREMENTS

A. Comply with requirements of building authorities having jurisdiction in Project location and the following:

1. Handrail Standard: ANSI A1264.1

B. Structural Performance:
Engineer, fabricate, and install handrails, guardrails and railing systems to withstand, when tested per ASTM E935, loadings and stresses within limits required by applicable building and safety codes but not less than the following:

1. Handrails and Top Rails of Guards:
   a. Uniform load of 50 lbf/ft. applied in any direction.
   b. Concentrated load of 200 lbf applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 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.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Manufacturer's product lines of railings assembled from standard components.
   2. Grout, anchoring cement, and paint products.
   3. Preparation instruction and recommendations.
   4. Storage and handling requirements and recommendations.
   5. Installation methods and requirements.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Shop drawings shall be signed and sealed by a Texas Registered Professional Engineer.
   1. For illuminated railings, include wiring diagrams and roughing-in details.

C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.

D. Welding certificates.

E. Product Test Reports: Submit test results from a qualified testing agency, according to ASTM E 894 and ASTM E 935, on the manufacturer’s supplied system indicating compliance with required structural loading.

F. Manufacturer’s Certificates: Certify products meet or exceed specified requirements.

G. Closeout submittals: Provide manufacturer’s maintenance instructions that include recommendations for periodic cleaning and maintenance of all components.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 3 years documented experience producing systems specified in this section.

B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

C. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including structural analysis, preconstruction testing, field testing, and in-service performance.
   1. Do not modify intended aesthetic effects, as judged solely by OWNER, except with OWNER's approval. If modifications are proposed, submit comprehensive explanatory data to OWNER for review.
D. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.7 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.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer’s unopened, properly labeled, original packaging until ready for installation.

B. Store components to avoid damage from moisture, abrasion, and other construction activities.

1.9 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 suit structural performance requirements.

PART 2 PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.2 FASTENERS

A. Welding Fastener Materials: Unless otherwise indicated, provide the following:
   1. Uncoated Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed; Type 304 stainless-steel fasteners where exposed.
   2. Dissimilar Metals: Type 304 or Type 316 stainless-steel fasteners.
B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.
   1. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

E. Post-Installed Anchors: Torque-controlled expansion anchors.

2.3 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.


2.4 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. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.
E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Form changes in direction as follows:
   1. As detailed.

H. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

I. Close exposed ends of hollow railing members with prefabricated end fittings.

J. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.6 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
   1. Color and Gloss: As selected by Architect from manufacturer's full range.
PART 3 EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
   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 (2 mm in 1 m).
   3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. 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.

3.4 ANCHORING POSTS

A. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material attached to post with set screws.

C. Leave anchorage joint exposed with 1/8-inch (3-mm) buildup, sloped away from post.
3.5 ATTACHING RAILINGS

A. Anchor railing ends to concrete and masonry with sleeves concealed within railing ends and anchored to wall construction with anchors and bolts.

3.6 CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

PART 4 MEASUREMENT AND PAYMENT

A. Measurement and Payment for this item will be as indicated within the PROPOSAL FORM. If this item is not indicated within the PROPOSAL FORM then it is to be considered subsidiary to the applicable sections(s).

B. Payment shall fully compensate the Contractor for all required supervision, insurance, labor, materials, parts and all equipment, electrical wiring and conduits, piping/valves/fittings, lubrication/grease, field welding/erection, performance testing and start up, grating platforms, stairs, handrails, anchoring, concrete foundation, drains, startup on-site factory representative including training, submittals for all tanks, equipment, grating, platforms, and concrete foundations to be approved, certified and sealed by a Licensed Professional Engineer, all work installed meeting all local, state, and federal regulations, codes, laws, statutes and guidelines, and all incidental expenses which are required to complete the work in place, complete, ready-to-use and in accordance with the Drawings and Specifications.

END OF SECTION
SECTION 07 90 00

JOINT PROTECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preparing substrate surfaces.
B. Sealant and joint backing.

1.2 REFERENCES

A. ASTM C919 Use of Sealants in Acoustical Applications.
B. ASTM C920 Elastomeric Joint Sealants.

1.3 SUBMITTALS

A. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, color availability.
B. Manufacturer's Installation Instructions: Indicate special procedures, surface preparation, perimeter conditions requiring special attention.

1.4 QUALITY ASSURANCE

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
B. Perform acoustical sealant application work in accordance with ASTM C919.
C. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 5 years documented experience.
B. Applicator: Company specializing in performing the work of this section with minimum 3 years documented experience approved by manufacturer.
1.6 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.7 COORDINATION

A. Coordinate work with all disciplines.

B. Coordinate the work with all sections referencing this section.

1.8 WARRANTY

A. Provide five year warranty.

B. Warranty: Include coverage for installed sealants and accessories which fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.1 SEALANTS

A. Silicone Sealant: Single component, low modulus, moisture curing, non-sagging, non-staining, non-bleeding; color as selected; Spectrum I manufactured by Tremco.
   1. Elongation Capability: 100 percent
   2. Service Temperature Range: 65 to 300 degrees
   3. TT-S-00230C (COMB-NBS) Type III, Class A.
   4. TT-S-001543A (COM-NBS) Class A.  ASTM 920-86,
   5. Type S, Grade NS, Class 25.

B. Acoustical Sealant: Tremco Acoustical Sealant

C. Exterior flatwork joint cap sealant: (where green streak G610 and G628 are not used): Pourable type sealant (conforming to requirements of AASTO M173 or ASTM D1190) FS TT-S-00227e, Type I at flatwork; Type II non-sag at CMU wall.

2.2 ACCESSORIES

A. Primer: Non staining type, 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 D1565; round, cell polyethylene foam rod; oversized 30 to 50 percent larger than joint width.

D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.
PART 3 EXECUTION

3.1 EXAMINATION
   A. Verify that substrate surfaces and joint openings are ready to receive work.
   B. Verify that joint backing and release tapes are compatible with sealant.

3.2 PREPARATION
   A. Remove loose materials and foreign matter which might impair adhesion of sealant.
   B. Clean and prime joints in accordance with manufacturer's instruction.
   C. Perform preparation in accordance with manufacturer's instructions.
   D. Protect elements surrounding the work of this section from damage or disfiguration.

3.3 INSTALLATION
   A. Install sealant in accordance with manufacturer's instructions.
   B. Measure joint dimensions and size materials to achieve required 2:1 width/depth ratios.
   C. Install joint backing to achieve a neck dimension no greater than 1/3 of the joint width.
   D. Install bond breaker where joint backing is not used.
   E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
   F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
   G. Tool joints concave.

3.4 CLEANING
   A. Clean work as required during the course of construction.
   B. Clean adjacent soiled surfaces.

3.5 PROTECTION OF FINISHED WORK
   A. Protect finished installation.
   B. Protect sealants until cured.

END OF SECTION
SECTION 31 23 16

EXCAVATION

PART 1 GENERAL

1.1 DESCRIPTION

A. Section Includes:
   1. Excavating for roads and parking areas.
   2. Excavating for drainage ditches.
   3. Excavating for site structures.
   4. Excavating for landscaping.

B. Related Sections:
   1. Section 31 10 00 - Site Clearing.
   2. Section 31 23 23 - Fill.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

A. Excavating Soil Materials:
   2. Basis of Payment: Includes general excavating to required elevations, loading and placing materials in stockpile or removing from site, as indicated. Over Excavating: Payment will not be made for over excavated work or for replacement materials.

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with TxDOT Standard Specification Item 110 "Excavation".

1.4 SUBMITTALS

A. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

1.5 QUALIFICATIONS

A. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State of Texas.
PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 PREPARATION

A. Call Local Utility Line Information service not less than five working days before performing Work.
   1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Notify appropriate utility company to remove and/or relocate utilities.

C. Locate, identify, and protect existing utilities from damage.

D. Protect trees, plant growth, and other features designated to remain as portion of final landscaping.

E. Protect benchmarks, survey control points, existing structures and other improvements from damage or displacement.

3.2 BACKFILLING

A. Underpin adjacent structures which may be damaged by excavation work.

B. Excavate subsoil to proposed subgrade elevation for roads, parking areas, slabs-on-grade and site structures.
   1. Maintain moisture until compaction efforts are complete and subsequent course has been constructed.

C. Excavate subsoil to proposed elevations and slopes for drainage ditches.
   1. Bottom and side slopes shall be undercut sufficiently to accommodate topsoil for seeding or sodding, as specified on Drawings.
   2. Tops of excavated slopes shall be rounded.
   3. Keep drainage ditch drained insofar as possible during construction.

D. Excavate to working elevation for piling work.

E. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with Section 31 23 23.

F. Slope banks with machine to angle of repose or less until shored.
G. Do not interfere with 45 degree bearing splay of foundations.

H. Grade top perimeter of excavation to prevent surface water from draining into excavation.

I. Trim excavation. Remove loose matter.

J. Remove lumped subsoil, boulders, and rock up to 12 inches in any dimension.

K. Cut out soft areas of subgrade not capable of compaction in place. Backfill with subsoil material as specified in Section 31 05 13 and re-compact subgrade to density requirements for subsequent backfill materials or as otherwise indicated.

L. Notify Engineer of unexpected subsurface conditions.

M. Correct areas over excavated as directed and approved by Engineer.

N. Compact excavation as indicated on Drawings.

O. Remove excess material and unsuitable material from site.

P. Stockpile suitable excavated material in area designated on site in accordance with Section 31 05 13.

Q. Repair or replace items indicated to remain that are damaged by excavation operations.

3.3 WORKER SAFETY

A. Provide for worker safety in accordance with:


B. It is the sole responsibility of the Contractor, and not the Owner or Engineer, to determine and monitor the specific applicability of a safety system to the field conditions on the Project.

C. Contractor shall indemnify and hold harmless the Owner and Engineer from all damages and costs that may result from failure of methods or equipment used by Contractor to provide for worker safety.

3.4 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Support excavations more than 4 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
C. Design sheeting and shoring to be removed at completion of excavation work.

D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

3.5 FIELD QUALITY CONTROL

A. Perform laboratory material tests in accordance with ASTM D698 (Standard Proctor) for subsoil fill and select fill materials.

B. ASTM D1556 is a sand cone method. ASTM D2167 is a balloon method. ASTM D2922 and ASTM D3017 are nuclear methods. Coordinate required test methods with geotechnical report.

C. Perform laboratory material tests in accordance with ASTM D1557 (Modified Proctor) for crushed limestone structural fill.

D. Perform in place compaction tests and moisture content tests.

1. Under areas to receive pavement, compact subsoil and select fill materials to not less than 98% Standard Proctor density (ASTM D698) while maintaining moisture content at or slightly above optimum moisture (+/- 3.0%).

2. In non-paved areas, compact subsoil and select fill materials to not less than 95% Standard Proctor density (ASTM D698) while maintaining moisture content at or slightly above optimum moisture.

3. Compact crushed limestone structural fill to not less than 98% Modified Proctor density (ASTM D1557) while maintaining moisture content within 1.5% of optimum moisture.

E. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

F. Proof roll fill areas if directed by the Engineer to test uniformity of compaction. Immediately correct all irregularities, depressions, weak spots and soft spots.

3.6 PROTECTION

A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

C. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.
PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT AND PAYMENT

A. Measurement and payment for this item will be as indicated within the PROPOSAL FORM. If this item is not indicated within the PROPOSAL FORM then it is to be considered subsidiary to the applicable sections(s).

B. Payment shall fully compensate the Contractor for all required labor, materials, equipment, supervision, insurance, maintenance, codes, laws, statues, or regulations, and all incidental expenses which are required to complete the work in place, ready-to-use and in accordance with the Drawings, Specifications, and all OSHA and TCEQ regulations and requirements.

END OF SECTION
SECTION 31 23 23

FILL

PART 1 GENERAL

1.1 DESCRIPTION

A. Section Includes:
   1. Fill under paving (roadway embankment)
   2. Backfilling around site structures.
   3. Fill for over-excavation in roadway or drainage ditch.
   4. Fill for site grading and contouring.

B. Related Sections:
   1. Section 03 30 00 - Cast-In-Place Concrete: Concrete materials.
   2. Section 31 05 13 - Soils for Earthwork
   3. Section 31 23 16 - Excavation.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:
   1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 5.5-lb (2.5-kg) Rammer and a 12 in. (305 mm) Drop.

B. ASTM International:
   1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
   2. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
   3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
   4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
   5. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

C. Geotechnical Report:
   1. Bore hole locations and findings of subsurface materials (boring logs).

1.3 QUALITY ASSURANCE
   A. Perform Work in accordance with TxDOT Standard Specification Item 132 "Embankment", as modified herein.

1.4 SUBMITTALS
   B. Materials Source: Submit name of imported fill materials suppliers.
   C. Supplier's Certificate:
      1. Certify materials meet or exceed specified requirements.
      2. Include laboratory test reports to verify compliance.

PART 2 PRODUCTS

2.1 FILL MATERIALS
   A. Subsoil Fill for Roadway Embankment: Subsoil materials as specified in Section 31 05 13.
   B. Subsoil Fill for Over-Excavation in Roadway or Drainage Ditch: Subsoil materials as specified in Section 31 05 13.
   C. Subsoil Fill for Low Areas to Raise Site to Required Elevations: Subsoil materials as specified in Section 31 05 13.
   D. Select Fill for Areas Designated on Drawings: Select materials as specified in Section 31 05 13.
   E. Structural Fill for Backfill Around Site Structures: Crushed Limestone, Type A, Grade 1, in accordance with TxDOT Standard Specification Item 247 "Flexible Base", or as otherwise specified on Drawings.
   F. Flowable Fill/Flowable Grout, for Areas Designated on Drawings:
      1. 100 lb/CY Portland cement.
      2. 300 lb/CY fly ash.
3. 250 lb/CY water.
4. 2100 lb/CY sand.
5. 6 oz/CY "DaraFill" admixture.

2.2 ACCESSORIES

A. "DaraFill" Admixture: Manufactured by Grace Construction Products.

PART 3 EXECUTION

3.1 PREPARATION

A. Proof roll to identify soft spots.
B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with subsoil material as specified in Section 31 05 13.
C. Loosen surface to a depth of not less than 6 inches or as otherwise specified on Drawings by scarifying or disk ing.
D. Re-compact subgrade to density requirements for subsequent backfill materials or as otherwise indicated.

3.2 BACKFILLING

A. Backfill areas to contours and elevations with suitable materials.
B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
C. If specified on the Drawings, place geotextile fabric over fill prior to placing next lift of fill.
D. Place fill material in continuous layers not to exceed 8 inches uncompacted depth to total compacted thickness indicated on Drawings.
E. In sloped areas, place fill from low side.
F. Employ placement method that does not disturb or damage other work.
G. Maintain optimum moisture content of backfill materials to attain required compaction density.
H. Backfill simultaneously on each side of structures.
I. Slope grade away from structure minimum 2 percent slope for minimum distance of 10 feet, unless noted otherwise.
J. Make gradual grade changes. Blend slope into level areas.
K. Remove surplus backfill materials from site.

3.3 FIELD QUALITY CONTROL

A. Perform laboratory material tests in accordance with ASTM D698 (Standard Proctor) for subsoil fill and select fill materials.

B. ASTM D1556 is a sand cone method. ASTM D2167 is a balloon method. ASTM D2922 and ASTM D3017 are nuclear methods. Coordinate required test methods with geotechnical report.

C. Perform laboratory material tests in accordance with ASTM D1557 (Modified Proctor) for crushed limestone structural fill.

D. Perform in place compaction tests and moisture content tests.
   1. Under areas to receive pavement, compact subsoil and select fill materials to not less than 98% Standard Proctor density (ASTM D698) while maintaining moisture content at or slightly above optimum moisture (+/- 3.0%).
   2. In non-paved areas, compact subsoil and select fill materials to not less than 95% Standard Proctor density (ASTM D698) while maintaining moisture content at or slightly above optimum moisture.
   3. Compact crushed limestone structural fill to not less than 98% Modified Proctor density (ASTM D1557) while maintaining moisture content within 1.5% of optimum moisture.

E. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

F. Proof roll fill areas if directed by the Engineer to test uniformity of compaction. Immediately correct all irregularities, depressions, weak spots and soft spots.

3.4 PROTECTION OF FINISHED WORK

A. Reshape and re-compact fills subjected to vehicular traffic.

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT AND PAYMENT

A. Measurement and payment for this item will be as indicated within the PROPOSAL FORM. If this item is not indicated within the PROPOSAL FORM then it is to be considered subsidiary to the applicable sections(s).
B. Payment shall fully compensate the Contractor for all required labor, materials, equipment, supervision, insurance, maintenance, codes, laws, statues, or regulations, and all incidental expenses which are required to complete the work in place, ready-to-use and in accordance with the Drawings, Specifications, and all OSHA and TCEQ regulations and requirements.

END OF SECTION
ELECTRICAL SPECIFICATIONS
ELECTRICAL

PART 1: GENERAL

SCOPE OF WORK:
Furnish and install complete Electrical system for the Unitech Expansion Phase 2 Improvements Project. Scope of work shall include Furnishing and Installation of a complete Electrical equipment and materials for a fully operational and functional system including all conduit and wiring; conduit fittings; conduit support system; Improvements to Control Panels along with supporting rack systems; Switchgear and Low Voltage equipment and additions to same type existing equipment where applicable.

1.01 GENERAL
The General Conditions and Requirements, Special Provisions, if applicable are hereby made a part of this section.

A. The Electrical Drawings and Specifications under this section shall be made a part of the contract documents. The Drawings and specifications of this contract, as well as supplements issued thereto, information to bidders and pertinent documents issued by the Owner's representative are a part of these drawings and specifications and shall be complied with in every respect. All of the above documents will be on file at the Owner's office and shall be examined by all bidders. Failure to examine all documents shall not relieve this responsibility or be used as a basis for additional compensation due to omission of details of other sections from the electrical documents.

B. Furnish all work, labor, tools, superintendence, material, equipment, and operations necessary to provide for a complete and workable electrical system as defined by the contract documents.

C. The Contractor is responsible for visiting the site and checking the existing conditions. Ascertain the conditions to be met for installing the work and adjust bid accordingly. Failure to examine all site conditions shall not relieve this responsibility or be used as a basis for additional compensation due to omission of details of other sections from the electrical documents.

D. It is intent of the contract document that upon completion of the electrical work, the entire system shall be in a finished, workable condition.

E. All work that may be called for in the specifications but not shown on the drawings; or, all work that may be shown on the drawings but not called for in the specifications, shall be performed by the Contractor as if described in both. Should work be required which is not set forth in either document, but which work is
nevertheless required for fulfilling of the intent thereof; then, the contractor shall perform all work as fully as if it were specifically set forth in the current documents.

G. The definition of terms used throughout the contract documents shall be as specified by the following agencies:
   1. Underwriters Laboratories
   2. National Electrical Manufacturers Association
   3. American National Standard Institute
   4. Insulated Power Cable Engineers Association
   5. National Electrical code

H. The use of the word “furnish” or “Install” or “provide”, shall be taken to mean that the item or facility is to be both furnished and installed under this section unless specifically stated to the contrary that the item or facility is to be furnished under another section and installed under this section; furnished under this section and installed under another section; or furnished and installed under another section.

I. The use of the term “as or where Indicated”; “as or where shown”; “as or where specified”; or “as or where scheduled” shall be taken to mean that the reference is made to the contract documents either under the drawings and/or the specifications.

1.02 PERMITS, CODES AND UTILITIES

A. Secure all permits, licenses, and inspections as required by all authorities having jurisdiction. It is the responsibility of the contractor to investigate and identify all required permits, licenses and inspections required and investigate and identify any AHJ. Give all notices and comply with all laws, ordinances, rules, regulations and contract requirements bearing on the work.

B. The minimum requirements of the electrical system installation shall conform to the latest edition of the National Electrical Code as well as state and local codes.

C. Codes and ordinances having jurisdiction and specified codes shall serve as minimum requirements; but, if the Contract Documents indicate requirements which are in excess of those minimum requirements then the requirements of the Contract Documents shall be followed. Should there be any conflicts between the Contract Documents and codes, or any ordinances, report these with bid.

D. Determine the exact requirements for ALL utility service connections and metering facilities as set forth by the utilities that will serve the project, and pay for and perform ALL work as required by those utilities.
1.03 STANDARDS

A. All materials and equipment shall conform to the requirements of the Contract Documents. All materials and equipment shall be of the highest quality in order to provide the most reliable end product possible. They shall be new, free from defects, and they shall conform to the following standards where these organizations have set standards:

1. Underwriters Laboratories, Inc. (UL)
2. National Electrical Manufacturer's Association (NEMA)
3. American National Standards Association (ANSI)
4. Insulated Cable Engineers Association (ICEA)

B. The definition of terms used throughout the contract documents shall be as specified by the following agencies:

1. Underwriters Laboratories
2. National Electrical Manufacturer's Association
3. American National Standards Institute
4. Insulated Power Cable Engineers Association
5. National Electrical Code

C. All material and equipment, of the same class, shall be supplied by the same manufacturer unless specified to the contrary.

E. All products shall bear UL labels where standards have been set for listing.

1.04 SHOP DRAWINGS AND SUBMITTALS

A. Shop drawings shall be taken to mean detailed drawings with dimensions, schedules, weights, capacities, installation details and pertinent information that will be needed to describe material or equipment in detail.

B. Submittals shall be taken to mean catalog cuts, general descriptive information, catalog numbers and manufacturer's name.

C. Submit for review in sextuplet within fifteen (15) days after notice to proceed, all shop drawings and submittals as hereinafter called for. If shop drawings and submittals are not received in fifty (15) days, the Owner's representative reserves the right to go directly to the manufacturer for the information and any expense incurred shall be borne by the contractor.
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D. Review of submittals or shop drawings shall not remove the responsibility for furnishing materials or equipment of proper dimensions, quantity and quality; nor will such review remove the responsibility for error in the shop drawings or submittals.

E. Failure to process submittals or shop drawings on any item and/or items specified shall make the Contractor responsible for the suitability of the item and/or items, even though the item and/or items installed appear to comply with the Contract Documents.

F. Assume all costs and liabilities which may result from the ordering of any material or equipment prior to the review of the shop drawings or submittals, and no work shall be done until the shop drawings or submittals have been reviewed. In case of correction or rejection, resubmit until such time as they are accepted by the Owner's representative and such procedures will not be cause for delay. After final review, supply up to six (3) copies, if requested.

G. Submittals and shop drawings shall be compiled from the manufacturer's latest product data. Should there be any conflicts between this data and the Contract Documents, report this information for each Submittal and/or shop drawing.

H. Shop drawings and submittals will be returned and unchecked if the specific items proposed are not clearly marked, or if the general contractor's approval stamp is omitted.

I. When requested, furnish samples of materials for acceptance review. If a sample has been reviewed and accepted, then that item of material or equipment installed on the job shall be equal in quality to the sample; if it is found that the installed item is not equal then replace all such items with the accepted sample equivalent.

J. Materials to be submitted as required are as follows:

1. Variable Frequency Drives
2. Meters
3. Wire & Wiring Devices
4. Conduit and Fittings
5. J-Boxes
6. Control Panel Enclosures
7. Electrical Equipment and Materials
8. Software and Programming materials
9. 
10. 

K. Each submittal shall be accompanied with a written statement certifying that the submitted equipment and/or material meet the plans and specifications.
1.05 ACCEPTANCE AND SUBSTITUTIONS

A. All manufacturers named are a basis as a standard of quality and substitutions of any equal product will be considered for acceptance. The judgment of equality of product substitution shall be made by the Engineer.

B. Substitutions after award of contract shall be made only within sixty (15) days after the notice to proceed. Furnish all required supporting data. The submittal of substitutions for review shall not be cause for time extensions.

C. Where substitutions are offered, the substituted product shall meet the product performance as set forth in the specified manufacturer's current catalog literature, as well as meeting the details of the Contract Documents.

D. The details on the drawings and the requirements of the specifications are based on the first listed item of material or equipment; if any other than the first listed materials or equipment is furnished, the contractor shall assume responsibility for the correct function, operation, and accommodation of the substituted item. In the event of misfits or changes in work required, either in this Section or other Sections of the Contract, or in both; bear all costs in connection with all changes arising out of the use of other than the first listed item specified.

E. Energy Efficiency of each item of power consuming equipment shall be considered one of the standards for evaluation.

1.06 EXCAVATION AND BACKFILLING (as required)

A. Do all excavating and backfilling necessary for the installation of the work. This shall include shoring and pumping in ditches to keep them dry until the work in question has been installed. All shoring required to protect the excavation and safeguard employees shall be properly performed.

B. All excavations shall be made to the proper depth, with allowances made for floors, forms, beams, piping, finished grades, etc. Ground under conduits shall be well compacted before conduits are installed.

C. All backfilling shall be made with Concrete Backfill.

D. All excavated material not suitable and not used in the backfill shall be removed offsite at the Contractors expense.

E. Field check and verify the locations of all underground utilities prior to any
excavating. Avoid disturbing these as far as possible. In the event existing utilities are broken into or damaged, they shall be repaired so as to make their operation equal to that before the trenching was started.

F. Where the excavation requires the opening of existing walks, drives, or other existing pavement, these facilities shall be cut as required to install new lines and to make connections to existing lines. The sizes of the cut shall be held to a minimum consistent with the work to be installed. After installation of new work is completed and the excavation has been backfilled in accordance with above, repair existing walks, drives or other existing pavement to match existing installation.

G. Any construction involving the opening of trenches and or Sidewalks and Concrete Drives is to be done in an efficient manner so as to reduce the impact of to surrounding areas. Trenches are shall not be left open during periods of rain so as to reduce the impact of the weather to surrounding areas/structures.

1.07 CUTTING AND PATCHING

A. Cutting and patching required under this section shall be done in a neat workmanlike manner. Cutting lines shall be uniform and smooth.

B. Use concrete saws for large cuts in concrete and core drills for small round cuts in concrete.

C. Where openings are cut through masonry walls, provide lintel or other structural supports to protect the remaining masonry. Adequate support shall be provided during the cutting operation to prevent damage to masonry.

D. Where large openings are cut through metal surfaces, attach metal angles around the opening.

E. Patch concrete openings that are to be filled with non-shrinking cementing compound. Finish concrete patching shall be troweled smooth and shall be uniform with surrounding surfaces.

G. No cutting of structural elements shall be done without permission of the Engineer.

1.08 WATERPROOFING

A. Interiors of raceways that are likely to have water ingress such as runs to and from J-Boxes, Control Boxes shall have water-stops/sealing hubs etc. installed to prevent water from entering into installations.
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1.09 CONSTRUCTION REQUIREMENTS

A. Except where specifically detailed or shown, the locations and elevations of equipment are approximate and are subject to small revisions as may prove necessary, or desirable, at the time the work is installed. Final locations shall be confirmed with the engineer in advance of construction. Confirmed locations shall be made for the following:

1. Poles
2. Receptacles
3. Rough-ins and connections for equipment furnished under other sections
4. Lighting Fixtures
5. Outlets
6. J-Boxes, Control Panels, and, Switchgear, Electrical Panels, Control Panels etc.

B. All work shall be done in the best and most workmanlike manner by qualified careful electricians who are skilled in their trade. The standards of work required throughout shall be of the first class only and electricians whose work is unsatisfactory to the Engineer shall be instantly dismissed from the work upon written notice from the Engineer at no additional cost to the Owner. All work must meet the approval of the Engineer.

D. Unless shown in detail, the drawings are diagrammatic and do not give exact details as to the elevations and routing of conduits, nor do they show all offsets and fittings. Nevertheless, the installation must be made to fit and conform to the structural and mechanical conditions of the construction. Unless locations and routing of exposed conduits are shown, confirm locations and routing prior to installation with Engineer.

E. Holes for raceway penetration into sheet metal cabinets and boxes shall be accurately made with a hole-punch. Cutting openings with a torch or other device that produces a jagged edge, rough cut will not be acceptable.

F. Raceway entry into equipment shall be carefully planned. Cutting of enclosure framework to accommodate poorly planned raceway placement will not be acceptable. No hole-punch penetrations shall be made on top of any equipment, panel, or Junction box. All hole-punch penetrations shall be properly sealed so as to prevent moisture and gasses from entering the equipment, panel, or Junction Box etc.

G. Cabling inside equipment shall be carefully routed, trained, and laced. Cables so placed that they obstruct equipment devices shall not be acceptable.

H. Equipment, inclusive of supporting devices, shall be set level and plumb.
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Supporting devices installed shall be set and so braced that equipment is held in a rigid tight fitting manner.

1.10 EQUIPMENT PROTECTION

A. Provide suitable protection for all equipment, work and property against damage during construction.

B. Assume full responsibility for material and equipment stored at the site.

C. Conduit openings shall be closed with caps or plugs during installation. All outlet boxes and cabinets shall be kept free of concrete, plaster, dirt, and debris.

D. Equipment shall be and tightly sealed against entrance of dust, dirt, and moisture.
E. Interiors of Switchgear, Motor Control Centers, Control Panels, shall be kept clean and dry prior to energization. Maintain heat inside each unit with one 200 watt Lamp located the bottom of each section, or panel. Energizing integral condensation heaters shall be acceptable in place of lamps.

1.11 COOPERATION WITH WORK UNDER OTHER SECTIONS

A. Cooperate with all other trades so as to facilitate the general progress of the work. Allow other trades every reasonable opportunity for then installation of their work and the storage of their materials.

B. The work under this section shall follow the general construction closely. Set all pipe sleeves, inserts, etc., and see that openings for cases, pipes, etc., are provided before any concrete is placed or masonry is installed.

C. Work with other trades in determining exact locations of outlets, conduits, fixtures, and pieces of equipment to avoid interference with lines as required to maintain proper installation of other work.

D. Make such progress in work that will not delay the work of other trades. Schedule the work so that completion dates as established by the Engineer are met. Furnish sufficient labor or work overtime as required to accomplish these requirements if directed to do so.

1.12 CLEAN-UP

A. Remove all temporary labels, dirt, paint, grease and stains from all exposed
equipment. Upon completion of work, clean equipment and the entire installation so as to present a first class job suitable for occupancy. No loose parts or scraps or equipment shall be left on the premises.

B. Equipment paint scars shall be repaired with paint kits supplied by the equipment manufacturer, or with an approved paint.

C. Clean interiors of each item of electrical equipment. At completion of work all equipment interiors shall be free from dust, dirt, and debris.

1.13 TESTING AND ENGINEERING STUDIES

A. All cables shall have an insulation test performed using a 1000 Volt Megger tester. Testing shall include the entire length of cable from the source terminal to the load terminal. Testing shall be performed prior to final landing of power cables to equipment. Reports are to be made during the time of the testing and submitted to the Engineer for review. Reports must include time and date, weather conditions, printed names and signatures of tester and at least one witness. Testing must be performed in the presence of the Engineer/Owner Representative. Insulation values of each cable shall be equivalent to or greater than 500,000 ohms. In the event a cable’s test value is not equivalent or greater than 500,000 ohms, that cable shall be removed and replaced. Upon reinstallation, ALL cables are to be retested. Retesting must result in the same resistance value equal to or greater than 500,000 ohms. Retested and/or replaced cables are required to achieve the proper resistance rating.

B. Cables installed with an unacceptable insulation reading shall be removed and new cable installed and retested at no additional cost to the owner.

1.14 RECORD DRAWINGS

A. At the start and during the progress of the job, keep one separate set of blue-line prints for making construction notes and mark-ups.

B. Show conduit routing and wiring runs as constructed and identify each.

C. Record all deviations from the Contract Documents.

D. Submit set of marked-up drawings for review.

1.16 OPERATIONS AND MAINTENANCE MANUALS
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A. Prior to the completion of the project, compile an operations and maintenance manual on each item of equipment. These manuals shall include detailed instructions and maintenance, as well spare parts lists.

B. Submit six (3) copies for review.

PART 2 PRODUCTS

2.01 RACEWAYS

A. Above ground rigid metallic conduit shall be schedule 40 Aluminum conduit, Rigid Conduit, or PVC coated plastibond conduit with like fittings as indicated on plans sheets. Conduit couplings shall be threaded Aluminum, Rigid, or PVC coated plastibond as indicated on plansheets. Such conduit shall be Republic, Triangle, Wheatland, or equivalent. Please provide full submittal for review and acceptance by Engineer. Conduits in wet areas shall be PVC Coated Conduits with PVC Coated couplings and condulets.

B. Rigid non-metallic conduit shall be Schedule 40 PVC plastic type DB. Couplings shall be PVC solvent weld type. Such conduit shall be Carlon, or equivalent.

C. 90 degree transitions from underground to above shall be PVC Coated Rigid Conduit. Couplings shall be PVC Coated Plastibond Couplings with PVC solvent weld type Adapter in ductbank. Above Ground use PVC Coated Couplings for transition to Aluminum Conduit above ground. The transition shall be 12” minimum above ground with PVC Coated conduit transition and nipples. The Contractor shall use long sweep 90 degree bends as required. All above ground nipples shall be cut uniformly including threading to provide a uniform near and workman like appearance.

2.02 CONDUIT FITTINGS

A. Rigid metallic conduit locknuts shall be galvanized steel, Aluminum, or PVC coated plastibond as indicated on the plan sheets, in sizes under 2” and galvanized malleable iron on sizes 2 ½” and larger. Sealing locknuts shall also have an integrally fused thermoplastic gasket so that the locknut is rated NEMA-4. These lock nuts shall have a integral grounding terminal for proper grounding. These fittings and shall be MYERS "SCRU-TITE", or equal.

B. Chase nipples, reducers, enlargers, “Ericksons”, capped els, short els, long els, split couplings and fittings shall be HDG malleable iron threaded type for use with rigid metallic conduit. All such fittings shall be PVC coated where as required.

C. Rigid metallic conduit locknuts shall be galvanized steel in sizes under 2” and
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galvanized malleable iron on sizes 2 ½” and larger. Sealing locknuts shall have in addition to that specified above, an integrally fused thermoplastic gasket so that the locknut is rated NEMA-4.

D. Rigid metallic conduit insulating bushings shall be molded canvas bakelite type suitable for operation in 100°C rise over 40°C ambient. Polypropylene bushings will not be acceptable.

E. Rigid Metallic Conduit Grounding type bushings shall be Hot Dipped Galvanized steel with threaded steel body insulated throat, and ground lug. Insulated throat shall meet specifications under article D above.

F. Rigid metallic conduit expansion/deflection fittings shall be water-tight with flexible plastic sleeve that allows ¾” movements in all directions. Hubs shall be threaded, hot dipped galvanized (HDG) malleable iron. Clamping bands shall be stainless steel. There shall be on equipment ground bonding jumper, Expansion deflection fittings shall be Crouse-Hinds, OZ, or equivalent.

G. Rigid metallic conduit hubs shall be liquid-tight type with threaded HDG malleable iron female body, with sealing ring on conduit side and threaded make tapered steel body with hardened steel locknut on box side. Plastic jacketed hubs shall have 40 mils PVC coating. Such fittings shall be OCAL “Blue” or equivalent. Conduit and fittings such as Robroy Plastibond and Perma-cote “Supreme” shall be acceptable.

H. Cadmium and electro-galvanized plated devices and hardware shall not be acceptable.

2.03 CONDUIT BODIES AND BOXES

A. Conduit bodies such as "C", "LB", "T" and the like pulling fittings shall be sand-cast copper free aluminum. Covers shall be gasketed cast metal with stainless steel cover screws and clamp style attachment. Furnish Crouse-Hinds Form 7, or equal.

B. Conduit bodies such as "GUA", "GUAT", "GUAL", and the like pulling/splicing fittings shall be copper free aluminum with cast metal covers. All such conduit bodies shall be Crouse-Hinds GU/EA series, Appleton "GR" series, equal.

C. Rigid metallic conduit bodies shall be HDG malleable iron type with threaded hubs, gasketed metal covers, with stainless steel screws. Plastic jacketed type shall have 40 mils minimum coating of PVC. Such conduit shall be OCAL “Blue” or equivalent. Conduit and fittings such as Robroy Plastibond and Perma-cote “Supreme” shall be acceptable.
D. Cast metal outlet boxes, pullboxes, and junction boxes whose volume is smaller than 100 cubic inches, and cast metal device boxes, shall be sand-cast copper free aluminum. All boxes shall have threaded hubs. Furnish Crouse-Hinds "FD" style Condulets, Appleton "FD" style Unilets, or equal.

E. Covers for cast metal boxes shall be gasketed cast metal covers with stainless steel screws.

F. Rigid metallic conduit boxes shall be HDG cast iron, with threaded integrally-cast hubs, cast metal cover, and stainless steel cover screws. Such boxes shall be Crouse Hinds, Appleton, or equivalent. Plastic jacketed type shall have 40 mils minimum coating of PVC.

2.04 WIRE AND CABLE

A. Contractor shall refer to Section 16123. All conductors shall be soft-drawn, stranded annealed copper that meets ANSI 44, ASTM B3-74/38-72.

B. All 480V conductors shall be insulated with moisture and heat-resistant thermoplastic suitable for use in Dry and Wet locations. All such wire shall be type XHHW rated at 600V for use in 75ºC. Furnish okonite "Okolon", Rockbestos "Firewall", or equal.

C. All 120/240V conductors shall be insulated with moisture and heat-resistant thermoplastic suitable for use in Dry and Wet locations. All such wire shall be type XHHW rated at 600V for use in 75ºC. Furnish okonite "Okolon", General Cable, South Wire, Encore, or Engineer approved equal.

D. Factory pigmented insulation color for sizes #6 and smaller for power wiring shall be as follows:

150V to Ground, or less:

<table>
<thead>
<tr>
<th>Phase</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Black</td>
</tr>
<tr>
<td>B</td>
<td>Red</td>
</tr>
<tr>
<td>C</td>
<td>Blue</td>
</tr>
<tr>
<td>Grounding Conductor</td>
<td>Green</td>
</tr>
<tr>
<td>Grounded Conductor</td>
<td>White</td>
</tr>
</tbody>
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Greater than 150V to ground

<table>
<thead>
<tr>
<th>Phase</th>
<th>Color</th>
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A    Brown  
B    Orange  
C    Yellow  
Grounding Conductor    Green  
Grounded Conductor    Gray

E.  Bare conductors for grounding purposes shall be hard-drawn stranded copper.

2.05  CONNECTORS

A.  Mechanical connectors shall be copper alloy bolted pressure type with bronze hardware.

B.  Insulated spring-wire connectors, "wire-nuts", for small building wire taps and splices shall be plated spring steel with thermoplastic jacket. Connector shall be rated at 105° C continuous. Furnished 3M "Hyflex", T&B "PT" or equal.

C.  Insulated set-screw connectors shall consist of copper body with flame-retardant 600V plastic insulated shield. Furnished Ideal, T&B, or equal.

D.  Connectors for control conductor connections to screw terminals shall be crimp-type with vinyl insulated barrel and tin-plated copper ring-tongue style connector. Furnish T&B "Sta-kon", 3M "Scothlok", or equal.

E.  Terminal strips shall be channel-mounted type with tin-plated solderless box lugs contained with barriered nylon-insulated separable barriers. Such devices shall be Square D, Cutler Hammer, Allen Bradley, or equivalent.

F.  Terminal connectors for flat head terminal screws shall be locking spade type with vinyl insulated compression indent shaft, T&B, Ideal, Amp, or equivalent.

2.06  INSULATING PRODUCTS

A.  Tape products shall be furnished as hereinafter specified and shall be Plymouth, Okonite, F.E., 3M, or equal.

B.  General purpose electrical tape shall be 7 mil thick stretchable vinyl plastic, pressure adhesive type, "slipknot Grey", 3M Scotch 33+, or equal.

C.  Insulating void-filling tape and high voltage bedding tape shall be stretchable ethylene propylene rubber with high-tack and fast fusing surfaces. Tape shall be rated for 90 degrees Celsius continuous, 130 degrees Celsius overload, and shall be moisture-proof void filling tape shall be "plysafe", 3M Scotch 23, or equal.
D. High temperature protective tape shall be rated 180 degrees Celsius continuous indoor/outdoor, stretchable, self-bonding silicone rubber. High temperature tape shall be "Plysil #3445", 3M Scotch 70, or equal.

E. Insulation putty filler-tape shall be Plymouth #2074, 3M, or equal. Putty to be used as necessary to keep moisture and gasses from entering raceways.

2.07 LABELS

A. Colored banding tape shall be 5 mil stretchable vinyl with permanent solid color. Color shall be as hereinafter specified. Tape shall be Plymouth "Slipknot 45", 3M Scotch #35, or equal.

B. Numbered marking labels shall be colored vinyl markers, T&B, Brady, or equal.

C. Cable identification labels shall be water resistant polyester with blank write-on space, T&B, Brady, or equal.

D. Buried conduit marking tape for marking path of buried conduits shall be a four (4") inch nominal width strip of polyethylene with highly visible, repetitive marking "BURIED CONDUIT", or similar language, along its length.

E. Nameplates shall be micarta lamicoid material, 1/6" thick, black background with white engraving. Attachment means shall be self-tapping stainless steel screws.

2.08 GROUNDING DEVICES

A. Exothermally welded joints shall be made with Enrico "cadweld", Burndy "Thermweld", or equal kits.

B. Ground bus connectors shall be Square D type "LU", OZ Type "XLH", or equal.

C. Conduit grounding bushings shall be as specified under CONDUIT FITTINGS.

2.09 SUPPORTING DEVICES

A. Contractor shall refer to Section 16070 Mounting hardware, nuts, bolts, lock washers, and washers, shall be grade 316 stainless steel.

B. Unless otherwise indicated, slotted channel framing and supporting devices shall be good quality Aluminum; 1-5/8" wide x 3-1/4" deep unistrut. Clamp nuts and mounting hardware for use with slotted channels shall be grade 316 stainless steel.
C. Conduit straps for use with slotted channels shall be stainless steel with stainless steel hardware. HDG unistrut and straps shall be acceptable for this project. Please provide full submittal for Engineer review and acceptance.

D. Concrete and Masonry Anchors shall be stainless steel type. Furnish Hilti, or equal.

E. Poles for supporting outdoor control panels shall be Hot Dipped Galvanized, with footings encased in concrete. Tops of poles shall be covered with a Hot Dipped Galvanized conduit cap.

H. "U" bolts shall be stainless steel with Stainless Steel hex-head bolts.

I. Plastic saddles for supporting buried conduits shall be interlocking type that provides separation between conduits vertically and laterally and between bottom of conduits and trench floor.

2.10 MISCELLANEOUS MATERIAL

A. Double bushing for insulating wiring through sheet metal panels shall consist of mating male and female threaded phenolic bushings. Phenolic insulation shall be high-impact "ABB", Gedney type "ABB", or equal.

B. Cable grips shall be grip-type wire mesh with machined metal support. Furnish Kellems, Appleton, or equal products.

C. Conduit pull-cords for use in empty raceways shall be glass-fiber reinforced tape with foot-marked along its length. Furnish Thomas, Greenlee, or equal products.

D. Conduit thread coating compound shall be conductive, non-galling, and corrosion-inhibiting. Furnish Crouse-Hinds type "STL", Appleton type "ST", or equal.

E. Wire pulling compound shall be non-injurious to insulation and to conduit and shall be lubricating, non-crumbling, and non-combustible. Furnish Gedney "Wire-Quick", Ideal "Yellow", or equal.

F. Plastic compound for field-coating of ferrous material products shall be PVC in liquid form that sets-up semi-hard upon curing. Furnishing Rob Roy "rob Kote", Sedco "Patch Coat", or equal.

G. Zinc spray for coating electrogalvanized steel products shall be Research Laboratory type "LPS", Mobil "Zinc-spray", or equal.
H. Splicing kit shall be provided with insulating and sealing compound to provide a moisture-tight splice. Provide Scotchcast Series 82 or equal splicing kit.

PART 3: INSTALLATION

3.01 RACEWAYS

A. Install the conduit system to provide the facility with the utmost degree of reliability and maintenance free operation. The conduit system shall have the appearance of having been installed by competent workmen. Kinked conduit, conduit inadequately supported or carelessly installed, will not be accepted.

B. Raceways shall be installed for all wiring runs except as otherwise indicated.

C. Conduit sizes, where not indicated, shall be N.E.C. code-sized to accommodate the number and diameter of wires to be pulled into the conduit. Unless otherwise indicated, 3/4" trade-size shall be minimum size conduit.

D. Unless otherwise noted, conduit runs shall be installed exposed. Such runs shall be made parallel to the lines of structures. Where aluminum conduit or supporting devices come in contact with concrete, the conduit and or supporting devices shall be coated with zinc chromate or other suitable coating to prevent galvanic action.

E. Unless otherwise indicated, conduit runs installed below-grade in earth shall be schedule 40 PVC electrical conduit. Use manufacturer's approved cement for joining couplings and adapters. Runs shall be installed so that tops of conduits are at least Thirty-Six (36") inches below finished grade. Support runs on plastic spacers and backfill to three (3") inches above and all around including topmost conduits with 3000 PSI Red Concrete. Complete backfill to finished grade with selected soil that is free from clods, debris, rocks and the like. Pneumatically tamp backfill in six (6") inches to eight (8") inches below finished grade, install continuous run of "BURIED CABLE" marking taped.

F. Below-grade to above-grade upturns in non-metallic runs shall be made with Schedule PVC Coated rigid conduit as in PART 2 PRODUCTS 2.01 RACEWAYS C.

G. Rigid metallic conduit runs shall have their couplings and connections made with screwed fittings and shall be made up wrench-tight. Check all threaded conduit joints prior to wire pull.

H. All conduit runs shall be watertight over their lengths of run except where drain fittings are indicated. In which cases, install specified breather-drain fittings.
I. Empty conduits shall have pull-tape installed. Identify each terminus as to location of other end. Use blank plastic waterproof write-on label and write information on each label with waterproof ink. Cap exposed ends of empty conduit with plastic caps.

J. Conduit runs into boxes, cabinets, and enclosures shall be set in a neat manner. Vertical runs shall be set plumb. Conduits set cocked or out of plumb will not be acceptable.

K. Conduit entrances into equipment shall be carefully planned. Cutting away of enclosure structure, torching out sill or braces, and removal of enclosure structural members, will not be acceptable.

L. Use approved hole cutting tools for entrances into sheet metal enclosure. Use of cutting torch or incorrect tools will not be acceptable. Holes shall be cleanly cut and they shall be free from burrs, fagged edges, and torn metal.

M. All raceways shall be swabbed clean after installation. There shall be no debris left inside. All interior surfaces shall be smooth and free from burrs and defects that would injure wire insulation. All conduits shall be sealed after cable installation with electrical insulation putty.

N. Surface mounted conduit and all fittings shall be schedule 40 Aluminum conduit and shall conform to Section, 2.01 RACEWAYS; A. Mounting hardware shall be Aluminum Deep Channel Unistrut with stainless steel hardware including nuts, bolts, anchor bolts and pipe clamps.

3.02 CONDUIT BODIES AND BOXES

A. Contractor shall refer to Section 16134. Conduit bodies such as "LB", "T", etc., shall be installed in exposed runs of conduit wherever indicated and where required to overcome obstructions and to provide pulling access to wiring. Covers for such fittings shall be accessible and unobstructed by the adjacent construction. PVC coated fittings shall be used as required.

B. Covers for conduit bodies installed shall be gasketed cast metal type.

C. All conduit boxes installed shall be cast metal type Aluminum as required or indicated. Covers for all such boxes shall be gasketed stainless steel to match box construction.

3.03 RACEWAY SUPPORT
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A. Contractor shall refer to Section 16070. All raceway systems shall be adequately and safely supported. Loose, sloppy and inadequately supported raceways will not be acceptable. Supports shall be installed at intervals not greater than those set forth under Article 300 of N.E.C., unless shorter intervals are otherwise indicated, or unless conditions require shorter intervals of supports.

B. Below-grade conduits shall be supported with plastic saddles.

3.04 WIRING

A. Branch circuits may be spliced for receptacle, lighting and small appliances load inside appropriate junction boxes.

B. Except as otherwise specified, taps and splices with #10 AWG and smaller shall be made with insulated spring wire connectors. Such connectors in damp or wet locations shall be further insulated with an envelope of stretched piece of EPR tape around each wire to fill the interstices between the wires. Then, apply one-half lapped layer of electrical tape over all.

C. Taps, splices, and connection in #8 AWG and larger wires shall be made with copper alloy bolted pressure connectors. Each such connector shall be insulated by means of applying insulation putty over sharp edges so as to present a smooth bonding surface. Next, apply at least four (4) layers, half-lapped each layer of EPR tape. Then, make final wrapping of at least three (3) layers, half-lapped each layer of electrical tape.

D. Control wiring connections to stud type and screw type terminals shall be made with ring-tongue type crimp connectors. Label each terminal jacket with wire marking label at each connection.

E. Each wire connection shall be made up tightly so that resistance of connection is as low as equivalent length of associated conductor resistance.

F. Numbered labels shall be installed to identify circuit numbers from panel boards. Install labels on each wire in each panelboard, junction, and pullbox, and device connection.

G. Label each wiring run with write-on waterproof labels inside each motor control center and in service switchboard. Install write-on label ties around wire group at conduit entrance and write-on label the wire size, and service.

H. Install numbered marking on each control wiring termination at each terminal strip and at each device. Do this in motor control center, terminal cabinets, safety switches, remote controllers, pilot operators, and instrumentation equipment. Number
selected shall correspond to number on terminal strip.

I. All wiring inside enclosures will be neatly trained and laced with nylon tie-wraps.

J. All wiring shall be installed in raceways unless otherwise noted; however, no wire shall be drawn into a conduit until all work of a nature which may cause injury is completed. Do not exceed wire and cable manufacturer's recommended pulling tensions. A cable pulling compound shall be used as a lubricant and its composition shall not affect the conductor or its insulation.

3.05 WIRING DEVICES

A. Contractor shall refer to Section 16140. Install wiring devices where indicated. Wiring devices shall be type as indicated.

B. Each wiring device shall be set with axis plumb and installed with yoke screw so as to adequately support device yokes to the box.

C. Device boxes shall be cast metal condulets or equal.

D. Use ganged boxes for ganged devices.

E. Each device box shall be equipped with specified cast metal cover.

3.06 GROUNDING

(Refer to Section 16060)
PART 1 GENERAL

1.01 ENGINEERING STUDIES

A. The coordination report shall include all portions of the electrical distribution system from the normal power source or sources down to and including each low voltage secondary main breaker. All plant electrical facilities, both new and future, shall be included in the report as indicated on the Overall One Line Diagrams and other pertinent Electrical drawings. Normal system connections and those, which result in maximum and minimum fault conditions, shall be adequately covered in the report. Additional information if necessary may be obtained from the local Utility.

B. The coordination report shall be submitted to the Engineer prior to receiving final approval of the distribution equipment shop drawings and prior to release of equipment for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Engineer may be obtained for a preliminary submittal of sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.

C. The firm performing the work shall be currently involved in high- and low-voltage power system evaluation. The work shall be performed, stamped and signed by a professional engineer currently licensed in the State of Texas. Credentials of the individual(s) performing the work and background of the firm shall be submitted to the Design Engineer for approval prior to start of the work. A minimum of ten (10) years’ experience in power system analysis is required for the individual in charge of the project.

D. The firm performing the work shall demonstrate capability and experience to provide assistance during start up as required.

1.02 DATA COLLECTION

A. Any data which is necessary for completion of the studies shall be obtained by the Contractor

B. The Contractor shall expedite completion of the work and submission of the report as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacturing.

PART 2 Products

2.01 Short-Circuit and Coordination Report

A. The short-circuit and coordination effort shall be performed using SKM PowerTools, ETAP, or Engineer approved computer software. Contractors shall use latest
version of any software proposed. Methods shall be in accordance with the latest applicable IEEE and ANSI standards.

B. In the short-circuit report, provide calculation methods and assumptions, the base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculations, tabulations of calculation quantities and results, conclusions, and recommendations. Calculate short-circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at each switchgear bus, transformer primary and secondary terminals, and other significant overcurrent protective device locations throughout the system. Provide a ground fault current study for the same system areas, including the associated zero sequence impedance data. Include in tabulations fault impedance, X to R ratios, asymmetry factors, motor fault contribution, short circuit kVA and symmetrical and asymmetrical fault currents.

C. In the protective device coordination report, provide time-current curves (TCC) graphically indicating the coordination proposed for the system, centered on conventional, log-log forms 11 inch x 17 inch minimum size. Include with each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular curve sheet. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Use manufacturers application software for microprocessor based relays. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings for all devices in a Microsoft Excel spreadsheet.

D. Include on the TCC curve sheets power company relay and fuse characteristics, medium- voltage equipment protective relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, pertinent transformer characteristics, pertinent motor and generator characteristics of other system load protective devices. In addition, include all devices down to each low voltage secondary main breaker. Include all adjustable settings for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Show transformer full load currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical fault currents. Terminate device characteristic curves at a point reflecting the maximum symmetrical fault current to which the device is exposed.

E. Select each primary protective device required for a wye-wye connected transformer so that it’s characteristic or operating band is within the transformer characteristics; including a point equal to 58 percent of the ANSI withstand point to provide secondary line-to-ground fault protection. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by a 16 percent current margin to provide proper coordination and protection in the event of secondary line-to-line faults. Separate medium-voltage relay characteristic curves from downstream device curves by at least a 0.4-second time margin over relays and 0.2 seconds over fuses.
F. Include complete fault calculations as specified herein based on design documents and field survey data.

G. Submit qualifications of engineer(s) who will perform the work for approval prior to commencement of work. Provide reports in conjunction with equipment submittals to verify equipment ratings required. Submit a preliminary report to the Engineer for review and approval prior to delivery of final report. Make all additions or changes as required by the reviewer.

H. Notify the Engineer in writing of any circuit protective devices found to be not properly rated for fault conditions.

I. As part of this report the Contractors shall provide a Harmonic analysis of the entire electrical system is required as a part of this project. This report is intended to show the effects of the VFD’s and other Harmonic generating equipment on the electrical system and to verify system conformance with IEEE Std. 519. The point of Common Coupling shall be taken at the interconnection between the Pad Mount transformer and the Main Incoming breaker. The full load amps for the system shall include all motors running (using NEC tables for motor ampacity) with an additional 100A assumed as the MCC load. The testing company should contact the local utility for any additional information required regarding available fault current of the utility system/transformer.

1.) Short-Circuit Analysis shall consist, but not be limited to the following

a. Calculation of the maximum RMS symmetrical three-phase short-circuit current at each significant location in the electrical system shall be made using a digital computer.

b. Appropriate motor short-circuit contribution shall be included at the appropriate locations in the system so that the computer calculated values represent the highest short-circuit current the equipment will be subjected to under fault conditions.

c. A tabular computer printout shall be included which lists the calculated short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings, and notes regarding the adequacy or inadequacy of the equipment.

d. The study shall include a computer printout of input circuit data including conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.

e. Include a computer printout identifying the maximum available short-circuit current in RMS symmetrical amperes and the X/R ratio of the fault current for each bus/branch calculation.

f. The system one-line diagram shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit
analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis. A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for improvements to the system.

g. The contractor shall be responsible for supplying pertinent electrical system conductor, circuit breaker, generator, and other component and system information in a timely manner to allow the short-circuit analysis to be completed prior to final installation.

h. Any inadequacies shall be called to the attention of the engineer and recommendations made for improvements as soon as they are identified.

2.) Protective Device Time-Current Coordination Analysis

a. The time-current coordination analysis shall be performed with the aid of computer software intended for this purpose, and will include the determination of settings, ratings, or types for the overcurrent protective devices supplied.

b. Where necessary, an appropriate compromise shall be made between system protection and service continuity with system protection considered more important than service continuity.

c. A sufficient number of computer generated log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.

d. Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, the short-circuit current availability at the device location when known, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.

e. The study shall include a separate, tabular computer printout containing the suggested device settings of all adjustable overcurrent protective devices, the equipment where the device is located, and the device number corresponding to the device on the system one-line diagram.

f. A computer generated system one-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.

h. A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for addressing system protection or device coordination deficiencies.

i. Significant deficiencies in protection and/or coordination shall be called to the attention of the engineer (architect) and recommendations made for improvements as soon as they are identified.

j. The contractor shall be responsible for supplying pertinent electrical system conductor, circuit breaker, generator, and other component and system
information in a timely manner to allow the time-current analysis to be completed prior to final installation.

3.) Load Flow and Voltage Drop Analysis

a. The Load Flow and Voltage Drop Analysis shall be made using a digital computer and include calculations of power flow in all three-phase branch and feeder circuits, calculated voltages at each bus and voltage drops of each feeder.
b. The analysis shall provide the calculated maximum values of kVA, kW, kVAr, power factor, and amperes for each power circuit.
c. The calculated power losses in each branch and total system losses shall be provided.
d. A computer printout listing all cables, transformers, loads, and other circuit data shall be included.
e. Provide tabular bus-to-bus computer printouts listing the calculated values.
f. The analysis shall include a computer generated system one-line diagram clearly identifying individual equipment buses, bus numbers, cable and bus connections, power flow throughout the system, and other information related to the analysis.
g. A discussion section evaluating the loading and voltage levels for the system shall be provided and recommendations included as appropriate to improve system operation. Significant deficiencies in loading or voltage levels shall be called to attention of the engineer (architect) and recommendations made for improvements at soon as they are identified.

2.02 FINAL REPORT

A. The results of the power system study shall be summarized in a final report. Four (4) bound copies of the final report shall be submitted.

B. The report shall include the following sections:
   1. Descriptions, purpose, basis, and scope of the analysis.
   2. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short-circuit duties, and commentary regarding same.
   3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
   4. Fault current calculations including a definition of terms and guide for interpretation of computer printout.
   5. SKM electronic files including project, library and report files.
PART 3          EXECUTION

3.01      FIELD SETTINGS

A. Field setting and calibration of protective devices shall be performed in accordance with Section 16600.
B. Necessary adjustments and minor modifications to equipment to accomplish conformance with the approved short-circuit and protective device coordination report shall be carried out by the Contractor at no additional cost to the City.

END OF SECTION
SECTION 16060
GROUNDING AND BONDING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Grounding electrodes.
   2. Grounding electrode conductors.
   3. Equipment grounding conductors.
   4. Main bonding jumper.
   5. Ground connections.
   6. General requirements for grounding.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor’s responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor’s Work.
   3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Submittal Procedures.
      b. Section 16000 – General Electrical Specifications

1.02 REFERENCES

A. As specified in Section 16000.

B. ASTM International (ASTM):

C. Institute of Electrical and Electronics Engineers (IEEE):

D. Underwriters Laboratories, Inc. (UL):
   1. 467 – Ground and Bonding Equipment.

1.03 DEFINITIONS

A. As specified in Section 16000.
1.04 SYSTEM DESCRIPTION

A. Ground equipment and raceway systems so that the completed installation conforms to all applicable code requirements.

B. Provide a complete electrical grounding system as indicated on the Drawings and as specified including but not limited to:
   1. Grounding electrodes.
   2. Bonding jumpers.

C. Provide bonding jumpers and wire, grounding bushings, clamps and appurtenances required for complete grounding system to bond equipment and raceways to equipment grounding conductors.

D. The ground system resistance (electrode to ground) of the completed installation, as determined by tests specified in Section 16950, shall be:
   1. 5 ohms or less for industrial systems.
   2. 1 ohm or less for electrical buildings.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 16000 and other pertinent sections of the Plans and Specifications

B. Product data:
   1. Catalog cut sheets.

1.06 QUALITY ASSURANCE

A. As specified in Section 16000.

B. All grounding components and materials shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16000.

1.08 PROJECT/SITE CONDITIONS (NOT USED)

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 16000.

1.12 SYSTEM START-UP

A. As specified in Section 16000.

1.13 OWNER'S INSTRUCTIONS (NOT USED)
1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Compression steel connectors: One of the following or equal:
   1. FCI Burndy.
   2. Thomas & Betts.

B. Exothermic connectors: One of the following or equal:
   1. Erico.
   2. Harger.

C. Ground rods: One of the following or equal:
   1. Erico.
   2. Harger.
   3. Conex.

D. Ground cable: One of the following or equal:
   1. Nehring.
   2. Harger.

E. Precast ground well boxes: One of the following or equal:
   1. Brooks Products, 3-RT Valve Box.
   2. Christy Concrete Products, G12 Valve Box.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. Ground rod:
   1. Minimum: 3/4-inch diameter, 10 feet long.
   2. Uniform 10 mil covering of electrolytic copper metallically bonded to a rigid steel core:
      a. The copper-to-steel bond shall be corrosion resistant.
   3. In accordance with UL 467.
   4. Sectional type joined by threaded copper alloy couplings.
   5. Fit the top of the rod with a threaded coupling and steel-driving stud.
   6. Minimum of three rods spaced the length of the rod as indicated in the NEC.

B. Ground cable:
   1. Requirements:
      a. Soft drawn (annealed).
      b. Concentric lay, coarse stranded in accordance with ASTM B 8.
      c. Bare copper in accordance with ASTM B 3.
   2. Size is as indicated on the Drawings, but not less than required by the NEC.
C. Compression connectors:
   1. Manufactured of high copper alloy specifically for the particular grounding application.
   2. Suitable for direct burial in earth and concrete.
   3. Identifying compression die number inscription to be impressed on compression fitting.

D. Exothermic welds:
   1. Current carrying capacity equal to that of the conductor.
   2. Permanent molecular bond that cannot loosen or corrode over time.
   3. Will not deteriorate with age.

E. Equipment grounding conductors:
   1. Conductors shall be the same type and insulation as the load circuit conductors:
      a. Use 600-volt insulation for the equipment grounding conductors for medium voltage systems.
   2. Minimum size in accordance with the NEC.

F. Grounding electrode conductors:
   1. Minimum size in accordance with the NEC.

G. Main bonding jumpers and bonding jumpers:
   1. Minimum size in accordance with the NEC.

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

   A. Precast ground well boxes:
      1. Minimum 10 inch interior diameter.
      2. Traffic-rated cast iron cover.
      3. Permanent “GROUND” marking on cover.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3    EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)
3.03 INSTALLATION

A. As specified in Section 16050.

B. Provide a separate, green insulated, grounding conductor in each raceway independent of raceway material:
   1. Multi-conductor power and control cables shall include an integral green insulated grounding conductor.
   2. Provide a separate grounding conductor in each individual raceway for parallel feeders.

C. Provide a separate grounding conductor for each motor and connect at motor terminal box. Do not use bolts securing motor box to frame or cover for grounding connectors:
   1. When grounding motors driven by variable frequency drives (VFD) comply with the requirements of the VFD manufacturer.

D. Provide a grounding type bushing with lug for connection of grounding conductor for conduits that originate from each motor control center section, switchboard, or panelboard:
   1. Individually bond these raceways to the ground bus in the equipment.

E. Provide grounding type bushings with lugs for connection of grounding conductor at both ends of metallic conduit runs. Bond ground bushings to the grounding system.

F. Provide a green insulated wire-grounding jumper from the ground screw to a box grounding screw and, for grounding type devices, to equipment grounding conductor.

G. Interconnect the secondary switchgear, switchboard, or panelboard neutral bus to the ground bus in the secondary switchgear, switchboard, or panelboard compartment, only at service entrance point or after a transformer.

H. Duct bank ground system:
   1. Provide a bare copper grounding conductor the entire length of each duct bank, embedded in the concrete of the duct bank as specified in the Specifications.
   2. Bond duct bank ground conductors together where duct banks join, merge, intersect, or split.

I. Grounding at service (600 V or Less):
   1. Connect the neutral to ground only at one point within the enclosure of the first disconnecting means on the load side of the service transformer.

J. Ground connections:
   1. All connections to the ground grid system, the duct bank grounding system, equipment, ground rods, etc., shall be made using compression type grounding connectors or exothermic welds as required, UL listed, and labeled for the application.
   2. Make ground connections in accordance with the manufacturer's instructions.
3. Do not conceal or cover any ground connections until the Engineer or authorized representative has established and provided written confirmation that every grounding connection is as indicated on the Drawings or specified in the Specifications.

K. Grounding electrode system:
1. Ground ring:
   a. Provide all trenching and materials necessary to install the ground ring around process facility and structures or indicated on the Drawings. Ground ring shall be required for all structures.
   b. Ground ring conductor shall be in direct contact with the earth, or where embedded, concrete, of the size per NEC.
   c. Minimum burial depth 36 inches.
   d. Re-compact disturbed soils to original density in 6 inch lifts.
2. Ground rods:
   a. Locations at corners of structures, structural members or as indicated.
   b. Length of rods forming an individual ground array shall be equal in length.
   c. Drive ground rods and install grounding conductors before construction of concrete slabs and duct banks.
   d. Pre-crimp all ground rods, as recommended by the manufacturer, before crimping connector to ground rod.
3. Metal underground water pipe:
   a. Bond metal underground domestic water pipe to grounding electrode system.
4. Metal frame of building or structure:
   a. Bond metal frame of building or structure to grounding electrode system.
5. Extend grounding conductors through concrete to accessible points for grounding equipment and electrical enclosures.
6. Install grounding system at each structure where switchgear, motor control centers, switchboards, panelboards, panels, or other electrical equipment are installed.

L. Shield grounding:
1. Shielded instrumentation cable shall have its shield grounded at one end only unless shop drawings indicate otherwise:
   a. The grounding point shall be at the control panel or at the power source end of the signal carried by the cable.
2. Terminate the shield drain wire on a dedicated terminal block.
3. Use manufacturer’s terminal block jumpers to interconnect ground terminals.
4. Connection to the panel main ground bus shall be via a green No. 12 conductor to the main ground bus for the panel.

M. Telephone panel ground:
1. Install individual ground rod or ground system at telephone panels:
   a. Install a dedicated grounding electrode conductor from the telephone panel to the grounding electrode system.
   b. Do not connect any other grounds to the telephone panel grounding electrode conductor.
2. Install ground rod or ground system in accordance with telephone company requirements.

N. Where indicated on the Drawings, install ground rods in precast ground wells.
3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL
   A. As specified in Section 16000.
   B. Measure grounding electrode system resistance to ground in accordance with IEEE 81.

3.08 ADJUSTING
   A. Under the direction of the Engineer, add additional parallel connected ground rods and/or deeper driven rods until the ground resistance measurement meets the specified resistance requirements:
      1. Use of salts, water, or compounds to attain the specified ground resistance is not acceptable.

3.09 CLEANING (NOT USED)

3.10 DEMONSTRATION AND TRAINING (NOT USED)

3.11 PROTECTION
   A. As specified in Section 16000.

3.12 SCHEDULES (NOT USED)

END OF SECTION
PART 1  GENERAL

1.01  SUMMARY

A.  Section includes:
   1. Mounting and supporting electrical equipment and components.

B.  Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor’s responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor’s Work.
   3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Submittal Procedures.
      b. Section 16000 – General Electrical Specifications

1.02  REFERENCES

A. As specified in Section 16000.

B.  ASTM International (ASTM):

1.03  DEFINITIONS

A. As specified in Section 16000.

1.04  SYSTEM DESCRIPTION

A.  Design requirements:
   1. Conform to the requirements of the Building Code as required.
2. Demonstrate the following using generally accepted engineering methods:
   a. That the anchors to the structure are adequate to resist the loads generated in accordance with the Building Code and equipment requirements.
   b. That the required load capacity of the anchors can be fully developed in the structural materials to which they are attached.

3. Design loading and anchoring requirements:
   a. As indicated in the Building Code unless otherwise specified.
   b. Seismic loading requirements:
      1) Freestanding or wall-hung equipment shall be anchored in place by methods that will satisfy the requirements for the seismic design specified in Section 16000.
   c. Wind loading requirements:
      1) All exterior freestanding equipment shall be anchored in place by methods that will satisfy the requirements for wind design specified in Section 16000.
   d. Minimum safety factor against overturning: 1.5.
   e. The foundation and structures to which hangers and supports are attached shall be capable of withstanding all anchor loads.

B. Performance requirements:
   1. Hangers and supports individually and as a system shall resist all weights and code-required forces without deflections and deformations that would damage the supporting elements, the equipment supported, or the surrounding construction.

1.05 SUBMITTALS
A. Furnish submittals as specified in Section 16000 and other pertinent sections of the Plans and Specifications.
B. Product data:
   1. Supports:
      b. Geometry.
      c. Manufacturer.
   2. Hardware:
      b. Manufacturer.
C. Shop drawings:
   1. Complete dimensioned and scalable shop drawings of all supporting structures, trapezes, wall supports, etc.
   2. Complete anchoring details for equipment, lighting and raceway, supporting structures, trapezes, wall supports for all equipment in excess of 200 pounds, and all freestanding supports:
      a. Stamped by a professional engineer licensed in the state where the Project is being constructed.
      b. Said submittals, by virtue of the fact that they bear the stamp of a registered engineer, will be reviewed for general consistency with the requirements specified in the Contract Documents, but not for context, accuracy, or method of calculation.
3. Include data on attachment hardware and construction methods that will satisfy the design loading and anchoring criteria.

D. Installation instructions:
   1. Furnish anchorage instructions and requirements based on the wind conditions of the Site:
      a. Stamped by a professional engineer licensed in the state where the Project is being constructed.

1.06 QUALITY ASSURANCE
   A. As specified in Section 16000.

1.07 DELIVERY, STORAGE, AND HANDLING
   A. As specified in Section 16000.

1.08 PROJECT OR SITE CONDITIONS
   A. As specified in Section 16050.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY
   A. As specified in Section 16000.

1.12 SYSTEM STARTUP
   A. As specified in Section 16000.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. One of the following or equal:
      1. Thomas & Betts.
      2. Power-Strut.
      3. Unistrut.
      5. Robroy.
      6. Aickinstrut.
      7. Champion.
2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. Use materials appropriate for the area as specified in Section 16000.

B. Stainless steel:
   1. Supports:
      a. In accordance with ASTM A 240.
      b. ANSI Type 316 material.
   2. Hardware:
      a. ANSI Type 316 material.

C. PVC coated galvanized steel:
   1. Supports:
      a. Hot dip galvanized steel as specified in this Section.
      b. PVC coating thickness of 10 to 20 mils.
   2. Hardware:
      a. ANSI Type 316 material.

D. Fiberglass:
   1. Supports:
      a. Vinyl ester.
   2. Hardware:
      a. Polypropylene.
      b. Thermal plastic elastomer.
      c. Fiberglass reinforced plastic.

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

A. Anchor bolts:
   1. As specified in Section 16000 and other pertinent sections of the Plans and Specifications.

2.08 MIXES (NOTUSED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES

A. Paint and finish all supporting structures as specified in Section 16000 and other pertinent sections of the Plans and Specifications.

2.11 SOURCE QUALITY CONTROL (NOT USED)
PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 16000 and other pertinent sections of the Plans and Specifications.

B. Mount all raceways, cabinets, boxes, fixtures, instruments, and devices on Contractor-fabricated racks unless otherwise indicated on the Drawings.
   1. Provide the necessary sway bracing to keep trapeze type structures from swaying.

C. Brace and anchor freestanding equipment supports using methods that provide structural support based on the seismic loads and wind loads:
   1. Lateral deflection at top of supports not to exceed support height divided by 240 unless otherwise approved by the Engineer.

D. Provide fabricated steel support pedestals for wall mounted panels that weigh more than 200 pounds:
   1. Fabricate pedestals out of welded angle, tube sections, or preformed channel.
   2. If the supported equipment is a panel or cabinet, match the supported equipment in physical appearance and dimensions.
   3. Provide auxiliary floor supports for transformers hung from stud walls and weighing more than 200 pounds.
   4. Mount all equipment, cabinets, boxes, instruments, and devices in damp or wet locations on minimum of 7/8-inch preformed mounting channel.
      a. Mount channel vertically along the length of the device so that water or moisture may run freely behind the device.

E. Corrosion protection:
   1. Isolate dissimilar metals, except where required for electrical continuity,
      a. Use neoprene washers, 9-mil polyethylene tape, or gaskets for isolation.

F. Raceway:
   1. Furnish all conduit racks and trapeze structures needed to support the raceway from the structure.
      a. Group conduits and position on racks to minimize crossovers.
      b. Provide the necessary bracing to keep trapeze type structures from swaying under loads from cable installation, seismic forces, or wind forces.

G. Anchoring methods:
   1. Solid concrete: Anchor bolts, anchor rods, or post-installed anchors as specified in Section 05190.
   2. Metal surfaces: Machine screws or bolts.
   3. Hollow masonry units: Post-installed anchors as specified in Section 05190.

H. When supporting devices on metal or wood stud construction, bridge studs with preformed channel, and mount the devices to the channel.
I. Re-coat all scratches, cuts, and drilled holes in galvanized surfaces with CRC "Zinc-It" or similar product.

J. Re-coat all drilled holes and cut surfaces on PVC-coated materials.

K. Seal all drilled holes and cut surfaces on fiberglass materials.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL

A. As specified in Section 16000 and other pertinent sections of the Plans and Specifications.

3.08 ADJUSTING (NOT USED)

3.09 CLEANING (NOT USED)

3.10 DEMONSTRATION AND TRAINING (NOT USED)

3.11 PROTECTION

A. As specified in Section 16000 and other pertinent sections of the Plans and Specifications.

3.12 SCHEDULES (NOT USED)

END OF SECTION
SECTION 16075
ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Identifying electrical, instrumentation, and process equipment and components.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor’s responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor’s Work.
   3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Submittal Procedures.
      b. Section 16000 – General Electrical Specifications
      c. Section 16130 – Conduits.

1.02 REFERENCES

A. As specified in Section 16000.

B. Occupational Safety and Health Administration (OSHA).

1.03 DEFINITIONS

A. As specified in Section 16000.

1.04 SYSTEM DESCRIPTION

A. Nameplates:
   1. Provide a nameplate for each piece of mechanical equipment, process equipment, valve, pump, mixer, feeder, fan, air-handling unit, motor, switch, receptacle, controller, instrument transducer, instrument power supply, solenoid, motor control center, starter, panelboard, switchboard, individually mounted or plug-in type circuit protector or motor controller, disconnect switch, bus duct tap switch, time switch, relay and for any other control device or major item of electrical equipment, either located in the field or within panels.
   2. Provide all nameplates of identical style, color, and material throughout the facility.
3. Device nameplates information:
   a. Designations as indicated on the Drawings and identified on the Process and Instrumentation Drawings.
   b. Device tag and loop number ID (#) (e.g. EDV-#).
   c. Circuit ID (e.g. LPA-11).
   d. Area served (e.g. Lighting Chemical Building).

B. Wire numbers:
   1. Coordinate the wire numbering system with all vendors of equipment so that every field wire has a unique number associated with it for the entire system:
      a. Wire numbers shall correspond to the wire numbers on the control drawings or the panel and circuit numbers for receptacles and lighting.
      b. Wire numbers shall correspond to the terminal block number to which they are attached in the control panel.
      c. Internal panel wires on a common terminal shall have the same wire number.
      d. Multi-conductor cables shall be assigned a cable number that shall be attached to the cable at intermediate pull boxes and stub-up locations beneath freestanding equipment. All multi-conductor and instrumentation cables shall be identified at pull points as described above:
         1) Label armored multi-conductor cable using the conduit number as indicated on the Drawings, following the requirements for conduit markers in Section 16130.

1.05 SUBMITTALS
A. Furnish submittals as specified in Section 16000 and other pertinent sections of the Plans and Specifications.

B. Product data:
   1. Nameplates:
      a. Color.
      b. Size:
         1) Outside dimensions.
         2) Lettering.
      c. Material.
      d. Mounting means.
   2. Nameplate schedule:
      a. Show exact wording for each nameplate.
      b. Include nameplate and letter sizes.
   3. Wire numbers:
      a. Manufacturer’s catalog data for wire labels and label printer.

C. Record documents:
   1. Update the conduit schedule to reflect the exact quantity of wire numbers including spares and destination points for all wires.
1.06 QUALITY ASSURANCE (NOT USED)

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16000 and other pertinent sections of the Plans and Specifications.

1.08 PROJECT SITE CONDITIONS (NOT USED)

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 16000.

1.12 SYSTEM STARTUP

A. As specified in Section 16000.

1.13 OWNER’S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Nameplates and signs:
   1. One of the following or equal:
      a. Brady.
      b. Seton.

B. Conductor and cable markers:
   1. Heat-shrinkable tubing:
      a. One of the following or equal:
         1) Raychem.
         2) Brady.
         3) Thomas & Betts.
         4) Kroy.

C. Conduit and raceway markers:
   1. One of the following or equal:
      a. Almetek: Mini Tags.
      b. Lapp Group: Maxi System.

2.02 EXISTING PRODUCTS (NOT USED)
2.03 MATERIALS

A. Nameplates:
   1. Fabricated from white-center and Black face laminated plastic engraving stock:
      a. 3/32 inch thick material.
      b. Two-ply.
      c. With chamfered edges.
      d. Block style engraved characters of adequate size to be read easily from a distance of 6 feet:
         1) No characters smaller than 1/8 inch in height.

B. Signs:
   1. Automatic equipment and high voltage signs:
      a. Suitable for exterior use.
      b. In accordance with OSHA regulations.

C. Conductor and cable markers:
   1. Machine printed black characters on white tubing.
   2. Ten point type or larger.

D. Conduit and raceway markers:
   1. Non-metallic:
      a. UV resistant holder and letters.
      b. Black letters on yellow background.
      c. Minimum letter height: 1/2 inch.
      d. Adhesive labels are not acceptable.

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

A. Nameplates:
   1. Provide all nameplates for control panel operator devices (e.g., pushbuttons, selector switches, pilot lights, etc.):
      a. Same material and same color and appearance as the device nameplates, in order to achieve an aesthetically consistent and coordinated system.
PART 3  EXECUTION

3.01  EXAMINATION (NOT USED)

3.02  PREPARATION (NOT USED)

3.03  INSTALLATION

A. As specified in Section 16000.

B. Nameplates:
   1. Attach nameplates to equipment with rivets, bolts, or sheet metal screws, approved waterproof epoxy-based cement or install in metal holders welded to the equipment.
   2. On NEMA Type 4, NEMA Type 4X, or NEMA Type 7 enclosures, use epoxy-based cement to attach nameplates.
   3. Nameplates shall be aligned and level or plumb to within 1/64 inch over the entire length:
      a. Misaligned or crooked nameplates shall be remounted, or provide new enclosures at the discretion of the Engineer.

C. Conductor and cable markers:
   1. Apply all conductor and cable markers before termination.
   2. Heat-shrinkable tubing:
      a. Tubing shall be shrunk using a heat gun that produces low temperature heated air.
      b. Tubing shall be tight on the wire after it has been heated.
      c. Characters shall face the open panel and shall read from left to right or top to bottom.
      d. Marker shall start within 1/32 inch of the end of the stripped insulation point.

D. Conduit markers:
   1. Furnish and install conduit markers for every conduit in the electrical system that is identified in the conduit schedule or part of the process system:
      a. Conduit markings shall match the conduit schedule; as indicated on the Drawings.
   2. Mark conduits at the following locations:
      a. Each end of conduits that are greater than 10 feet in length.
      b. Where the conduit penetrates a wall or structure.
      c. Where the conduit emerges from the ground, slab, etc.
      d. The middle of conduits that are 10 feet or less in length.
   3. Mark conduits after the conduits have been fully painted.
   4. Position conduit markers so that they are easily read from the floor.
   5. Attach non-metallic conduit markers with nylon cable ties:
      a. Provide ultraviolet resistant cable ties for conduit markers exposed to direct sunlight.
   6. Mark conduits before construction review by Engineer for punch list purposes.
   7. Label intrinsically safe conduits in accordance with the requirements of the NEC.
E. Medium voltage raceway labels:
   1. Apply at 50 foot intervals stating the voltage level contained within the raceway.

F. Signs and labeling:
   1. Furnish and install permanent warning signs at mechanical equipment that may be started automatically or from remote locations:
      a. Fasten warning signs with round head stainless steel screws or bolts.
      b. Locate and mount in a manner to be clearly legible to operations personnel.
   2. Furnish and install permanent and conspicuous warning signs on equipment (front and back), doorways to equipment rooms, pull boxes, manholes, etc., where the voltage exceeds 600 volts.
   3. Furnish and install warning signs on equipment that has more than one source of power.
      a. Warning signs to identify every panel and circuit number of the disconnecting means of all external power sources.
   4. Place warning signs on equipment that has 120 VAC control voltage source used for interlocking.
      a. Identify panel and circuit number or conductor tag for control voltage source disconnecting means.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL
   A. Replace any nameplates, signs, conductor markers, cable markers, or raceway labels that in the sole opinion of the Engineer do not meet the Engineer's aesthetic requirements.

3.08 ADJUSTING (NOT USED)

3.09 CLEANING (NOT USED)

3.10 DEMONSTRATION AND TRAINING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION
SECTION 16123
600 VOLT OR LESS WIRES AND CABLES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. 600 volt class wire and cable.
   2. Instrumentation class wire and cable.
   3. Network cable.
   4. Fire alarm wire and cable.
   5. Telephone wire and cable.
   6. 600 volt class tray cable.
   7. 600 volt class armored cable.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as
      binding as if called for by all.
   2. It is the Contractor’s responsibility for scheduling and coordinating the Work of
      subcontractors, suppliers, and other individuals or entities performing or
      furnishing any of Contractor’s Work.
   3. The following sections are related to the Work described in this Section. This
      list of related sections is provided for convenience only and is not intended to
      excuse or otherwise diminish the duty of the Contractor to see that the
      completed Work complies accurately with the Contract Documents.
      a. Submittal Procedures.
      b. Section 16000 – Common Work Results for Electrical.
      c. Section 16060 – Grounding and Bonding.
      d. Section 16075 – Electrical Identification.

1.02 REFERENCES

A. As specified in Section 16000.

B. ASTM International (ASTM):
      Conductors, Hard, Medium-Hard, or Soft.

C. CSA International (CSA).

D. Insulated Cable Engineers Association (ICEA):
   1. NEMA WC 70/ICEA S-95-658-1999 – Standard for Nonshielded Power Cables
      Rated 2000 Volts or Less for the Distribution of Electrical Energy.
   2. NEMA WC 57/ICEA S-73-532 – Standard for Control, Thermocouple
      Extension, and Instrumentation Cables.

E. National Electrical Code (NEC).
F. National Electrical Manufacturers Association (NEMA):
   1. 250 – Enclosures for Electrical Equipment (1000 V Maximum).

G. National Fire Protection Association (NFPA):
   1. 72 – National Fire Alarm and Signaling Code.

H. Telecommunications Industry Association/Electronics Industry
   Association (TIA/EIA):
   1. 568-C.2 – Balanced Twisted-Pair Telecommunication Cabling and
      Components Standard.

I. Underwriter's Laboratories Inc., (UL):
   1. 44 – Thermoset-Insulated Wires and Cables.
   3. 1569 – Standard for Metal-Clad Cables.
   5. 2225 – Standard for Cables and Cable-Fittings for Use in Hazardous
      (Classified) Locations.

1.03 DEFINITIONS

A. As specified in Section 16000.

B. Definitions of terms and other electrical considerations as set forth in the:
   1. ASTM.
   2. ICEA.

C. NEMA:
   1. Type 4 enclosure in accordance with NEMA 250.
   2. Type 4X enclosure in accordance with NEMA 250.

1.04 SYSTEM DESCRIPTION

A. Furnish and install the complete wire and cable system.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 16000 and other
   pertinent sections of the plans and specifications.

B. Product data:
   1. Manufacturer of wire and cable.
   2. Insulation:
      a. Type.
      b. Voltage class.
   3. American wire gauge (AWG) size.
   4. Conductor material.
   5. Pulling compounds.

C. Shop drawings:
   1. Show splice locations.
D. Test reports:
   1. Submit test reports for meg-ohm tests.

E. Calculations:
   1. Submit cable pulling calculations to the Engineer for review and comment for all cables that will be installed using mechanical pulling equipment. Show that the maximum cable tension and sidewall pressure will not exceed manufacturer recommended values:
      a. Provide a table showing the manufacturer’s recommended maximum cable tension and sidewall pressure for each cable type and size included in the calculations.
      b. Submit the calculations to the Engineer a minimum of 2 weeks before conduit installation.

1.06 QUALITY ASSURANCE

A. As specified in Section16000 and other pertinent sections of the plans and specifications.
B. All wires and cables shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section16000 and other pertinent sections of the plans and specifications.

1.08 PROJECT OR SITE CONDITIONS (NOT USED)

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section16000 and other pertinent sections of the plans and specifications.

1.12 SYSTEM START-UP

A. As specified in Section16000 and other pertinent sections of the plans and specifications.

1.13 OWNER’S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal (XHHW-2):
   1. 600 volt class wire and cable:
      a. General Cable.
b. Okonite Company.
c. Southwire Company.
d. Encore.
2. Instrumentation class wire and cable:
a. Alpha Wire Company.
b. Belden CDT.
c. General Cable BICC Brand.
d. Okonite Company.
e. Rockbestos Surprenant Cable Corporation.
3. Network cables:
a. Belden CDT.
b. Panduit.
c. TE Connectivity.
4. Fire alarm wire and cable:
a. West Penn Wire.
b. Olympic Wire and Cable.
c. Rockbestos Surprenant Cable Corporation.
d. Draka Lifeline.
5. Telephone wire and cable:
b. West Penn Wire.
c. Olympic Wire and Cable.
d. Superior Essex Inc.
e. Draka Comteq.
f. General Cable.
6. Tray cables:
a. General Cable, BICC Brand.
b. Southwire Company.
c. Okonite.
7. Armored cables.
a. Okonite Company.
b. Rockbestos Surprenant Cable Corporation.
c. Southwire Company.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. Conductors:
   1. Copper in accordance with ASTM B 3.

2.04 MANUFACTURED UNITS

A. General:
   1. Provide new wires and cables manufactured within 1 year of the date of delivery to the Site.
   2. Permanently mark each wire and cable with the following at 24-inch intervals:
      a. AWG size.
      b. Voltage rating.
      c. Insulation type.
      d. UL symbol.
      e. Month and year of manufacture.
      f. Manufacturer's name.
3. Identify and mark wire and cable as specified in Section 16075:
   a. Use integral color insulation for Number 2 AWG and smaller wire.
   b. Wrap colored tape around cable larger than Number 2 AWG.

B. 600 volt class wire and cable:
   1. Provide AWG or kcmil sizes as indicated on the Drawings or in the
      Feeder/Branch Circuit Schedules:
      a. When not indicated on the Drawings, size wire as follows:
         1) In accordance with the NEC:
            a) Use 75 degree Celsius ampacity ratings.
            b) Ampacity rating after all derating factors, equal to or greater than
               rating of the overcurrent device.
         2) Provide Number 12 AWG minimum for power conductors.
         3) Provide Number 14 AWG minimum for control conductors.
   2. Provide Class B stranding in accordance with ASTM B 8:
      a. Provide Class C stranding where extra flexibility is required.
   3. Insulation:
      a. XHHW-2.
      b. 90 degrees Celsius rating.
   4. Multi-conductor cables:
      a. Number and size of conductors as indicated on the Drawings or in the
         Feeder/Branch Circuit Schedules.
      b. Individual conductors with XHHW-2 insulation.
      c. Overall PVC jacket.
      d. Tray cable rated.
      e. Color-coding for control wire in accordance with ICEA Method 1, E-2 in
         accordance with NEMA WC 57/ICEA S-73-532.
      f. Ground conductor: Bare or Insulated, green:
         1) Sized in accordance with NEC.

C. Instrumentation class cable:
   1. Type TC.
   2. Suitable for use in wet locations.
   4. Temperature rating:
      a. 90 degrees Celsius rating in dry locations.
      b. 75 degrees Celsius rating in wet locations.
   5. Conductors:
      a. Insulation:
         1) Flame-retardant PVC, 15 mils nominal thickness, with nylon jacket
            4 mils nominal thickness.
         b. Number 16 AWG stranded and tinned.
      c. Color code:
         1) Pair: Black and white.
         2) Triad: Black, white and red.
         3) Multiple pairs or triads:
            a) Color-coded and numbered.
   6. Drain wire:
      a. 18 AWG.
      b. Stranded, tinned.
   7. Jacket:
      a. Flame retardant, moisture and sunlight resistant PVC.
b. Ripcord laid longitudinally under jacket to facilitate removal.

8. Shielding:
   a. Individual pair/triad:
      1) Minimum 1.35-mil double-faced aluminum foil/polyester tape overlapped to provide 100 percent coverage.
   b. Multiple pair or triad shielding:
      1) Group shield: Minimum 1.35-mil double-faced aluminum foil/polyester tape overlapped to provide 100-percent coverage.
      2) Completely isolate group shields from each other.
      3) Cable shield: 2.35 mils double-faced aluminum and synthetic polymer backed tape overlapped to provide 100-percent coverage.
   c. All shielding to be in contact with the drain wire.

D. Network cables:
1. Category 6E (Category 6 Enhanced):
   a. General:
      1) Provide all Cat 6E cables meeting the most recently published standards set by ANSI/TIA/EIA for installation and testing of communication cabling and connectors.
   b. Conductors:
      1) 23 AWG solid bare copper conductors.
   c. Insulation:
      1) Polyolefin.
      2) 4 non-bonded twisted pair cables formed into a cable core.
   d. Color code:
      1) Pair 1: White/blue stripe and blue.
      2) Pair 2: White/orange stripe and orange.
      3) Pair 3: White/green stripe and green.
      4) Pair 4: White/brown stripe and brown.
   e. Outer jacket:
      1) PVC with ripcord color Blue.
   f. Electrical characteristics:
      1) Frequency range: 0.772-550 MHz.
      2) Attenuation: 32.1 dB/100 m.
      3) Near-end crosstalk (NEXT): 39.3 dB.
      4) Power sum NEXT: 37.3 dB.
      5) Attenuation to crosstalk ratio (ACR): 7.2 dB.
      6) Power sum attenuation to crosstalk ratio (PSACR): 5.3 dB/100 m.
      7) Equal level far-end crosstalk (ELFEXT): 22.8 dB.
      8) Power sum ELFEXT: 19.8 dB/100 m.
      9) Return loss: 17.3 dB.
      10) Propagation delay: 537 ns/100 m.
      11) Delay skew: 45 ns/100 m.
      12) Propagation delay (skew), max: 2.5 ns/100 m.
2. DeviceNet cable:
   a. Provide DeviceNet cables in the following cable types as indicated on the Drawings and in the Specifications:
      1) Thick.
      2) Thin.
   b. General:
      1) NEC/UL Type TC or TC-ER.
2) Compliant with all ODVA specifications, and shall pass the ODVA established conformance test.

3) Approved to bear the ODVA Conformance Tested Service Mark.

c. Thick cable types shall consist of 2 shielded pairs for data and power:
   1) Shielded data pair:
      a) Tinned, copper conductors minimum with 19 by 30 stranding (minimum).
      b) Flame retardant polypropylene insulated.
      c) Aluminum foil-polyester tape.
      d) One pair AWG #18 for signal (minimum).
      e) Color: Blue and white.
   2) Shielded DC power pair:
      a) Tinned, copper conductors with 19 by 28 stranding (minimum).
      b) Polyvinyl chloride insulated.
      c) Aluminum-foil polyester tape.
      d) One pair AWG #16 for power. (minimum).
      e) Color: Black and red.
   3) 100-percent coverage each pair foil shielded with overall 65-percent coverage tinned copper braid.
   4) Outer shield tinned copper drain wire.
   5) Sunlight/oil resistant polyvinyl chloride outer jacket.
   6) 600-volt insulation level.
   7) Nominal OD 0.48 inch (minimum).
   8) Use CPE insulated cable for direct burial.

d. Thin cable types shall consist of 2 shielded pairs for data and power:
   1) Shielded data pair:
      a) Tinned, copper conductors with 19 by 32 stranding (minimum).
      b) Foam polyethylene (FPE).
      c) Aluminum foil-polyester tape.
      d) One pair AWG #20 for signal (minimum).
      e) Color: Blue and white.
   2) Shielded DC power pair:
      a) Tinned, copper conductors with 19 by 30 stranding (minimum).
      b) Polyvinyl chloride insulated.
      c) Aluminum foil-polyester tape.
      d) One pair AWG #18 for power.
      e) Color: Black and red.
   3) 100 percent coverage each pair foil shielded with overall 65-percent coverage tinned copper braid.
   4) Outer shield tinned copper drain wire.
   5) Sunlight/oil resistant polyvinyl chloride outer jacket.
   6) 300-volt insulation level.
   7) Nominal OD 0.378 inch.
   8) Use CPE insulated cable for direct burial.

3. RS-485 cable:

   a. Two-wire:
      1) Shielded twisted pair.
      2) Tinned, copper conductors minimum with 7 by 30 stranding.
      3) AWG #22.
      4) Insulation:
         a) FHDPE: Foam high-density polyethylene.
         b) 300-volt insulation level.
5) Outer shield:
   a) 100-percent coverage.
   b) Tape/braid.
   c) Aluminum foil-polyester tape.
   d) Tinned copper braid.
6) Outer shield drain wire:
   a) Tinned, copper conductor minimum with 7 by 30 stranding.
   b) AWG #22.
7) Outer jacket PVC:
   a) Sunlight resistant.
8) UL/CSA flame tested.
9) Minimum bending radius 2.5 inches.
10) Nominal OD 0.284 inch.

E. Tray cable:
1. Provide minimum size Number 1/0 AWG for single wires:
   a. Listed and identified on its surface as suitable for cable tray use,
      Type TC cable in accordance with the NEC.
2. Provide multi-conductor cable listed and identified on its surface as suitable for
   cable tray use, Type TC cable in accordance with the NEC.
   a. Provide with an integral white insulated conductor where a neutral is
      required.
3. Ambient temperature adjustment in accordance with the NEC.

F. Fire alarm cable:
1. Number of pairs: As necessary for the application.
2. Voltage rating: 300 V minimum.
3. Two-hour fire rating in accordance with UL 2196.
4. Provide fire alarm cable in accordance with the requirements of UL 1424.
5. Provide Type FPLP (power-limited plenum rated) for all cabling within ducts,
   plenums, and all spaces used for air handling:
   a. Cable must meet NEC standards, and must have adequate fire-resistant
      and low smoke-producing characteristics.
6. Provide Type FPLR (power-limited riser rated) for all vertical runs that pass
   from floor to floor:
   a. FPLR cable must meet NEC standards, and must have fire-resistant
      characteristics capable of preventing the carrying of fire from floor to floor.
7. FPL (power-limited general purpose) is only suitable for general-purpose fire
   alarm use and shall not be used for risers, ducts, plenums, and in air-handling
   spaces:
   a. FPL cable must meet NEC standards, and must be listed as resistant to
      the spread of fire.
8. Cable substitutions are not permitted unless approved by Engineer.
10. Conductor insulation:
    a. Low smoke PVC.
    b. Minimum 105 degrees Celsius rating.
11. Conductor jacket:
    a. Low smoke PVC.
    b. Ripcord and surface-printed with year of manufacture and cable
       description at maximum 24-inch intervals.
    c. Minimum 105 degrees Celsius rating.
G. Telephone cable:
   1. Number of twisted pairs: As indicated on the Drawings.
   2. Voltage rating: 300 volts.
   3. Insulation: Thermoplastic, color coded in accordance with telephone industry standards.
   4. Insulation:
      b. Plenum-rated: FEP.
   5. Jacket:
      a. Non-plenum: PVC.
      b. Plenum-rated: Low smoke PVC.
      c. Surface-printed with year of manufacture and cable description at maximum 24-inch intervals.
   6. Shield: 8 mil aluminum or copper, overlapped to provide 100-percent coverage, covered totally on both sides with copolymer or equal coating able to provide an effective moisture barrier.
   7. Conductors: ASTM B3, solid, soft, bare copper.
   8. Use minimum Number 24 AWG conductors, unless otherwise indicated on the Drawings.
   9. Twist insulated conductors into pairs with varying lengths of lay.
   10. Apply non-hygroscopic core tape over cable core as a dielectric and heat barrier.
   11. Provide plenum-rated cable for wiring within ducts, plenums, and all spaces used for air handling.

H. Armored cable:
   1. Tight-fitting, continuously welded, corrugated impervious aluminum armor sheath applied over the cable core in accordance with UL 1569.
   2. PVC outer jacket.
   3. Comply with UL-2225 if within hazardous classification area.
   4. For multi-conductor cable, include a separate ground conductor in the cable:
      a. An internal ground conductor shall meet NEC requirements for equipment ground conductor size.
      b. The cable armor is not acceptable as a ground conductor.
   5. Rated for 90 degrees Celsius in wet or dry locations.
   6. Color-coding for control wire in accordance with ICEA Method 1, E-2.
   7. Color-coding for power cables as specified above.
   8. Individual conductors in accordance with this Specification:
      a. Provide the number and size of conductors as indicated on the Drawings.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

A. Wire ties:
   1. One of the following or equal:
      a. T&B "Ty-Rap" cable ties.
      b. Panduit cable ties.
B. Wire markers:
   1. As specified in Section 16075.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

   A. Assembly and testing of cable shall comply with the applicable requirements of

   B. Test Type XHHW-2 in accordance with the requirements of UL 44.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

   A. As specified in Section 16000.

   B. Color-coding:
      1. Color-coding shall be consistent throughout the facility.
      2. The following color code shall be followed for all 240/120 volt and 208/120 volt
         systems:
         a. Phase A – Black.
         b. Phase B – Red.
         c. Phase C – Blue.
         d. Single phase system – Black for one hot leg, red for the other.
         e. Neutral – White.
         f. High phase or wild leg – Orange.
         g. Equipment ground – Green.
      3. The following color code shall be followed for all 480/277 volt systems:
         a. Phase A – Brown.
         b. Phase B – Orange.
         c. Phase C – Yellow.
         e. Equipment ground – Green.
      4. The following color code shall be followed for all 120 VAC control wiring:
      5. The following color code shall be followed for all general purpose DC control
         circuits:
         a. Grounded conductors – White with blue stripe.
         b. Ungrounded conductors – Blue.
      6. Switch legs shall be violet. Three-way switch runners shall be pink.
      7. Wires in intrinsically safe circuits shall be light blue.
8. Wire colors shall be implemented in the following methods:
   a. Wires manufactured of the desired color.
   b. Continuously spiral wrap the first 6 inches of the wire from the termination point with colored tape:
      1) Colored tape shall be wrapped to overlap 1/2 of the width of the tape.

C. Install conductors only after the conduit installation is complete, and all enclosures have been vacuumed clean, and the affected conduits have been swabbed clean and dry:
   1. Install wires only in approved raceways.
   2. Do not install wire:
      a. In incomplete conduit runs.
      b. Until after the concrete work and plastering is completed.

D. Properly coat wires and cables with pulling compound before pulling into conduits:
   1. For all Number 4 AWG and larger, use an approved wire-pulling lubricant while cable is being installed in conduit:
      a. Ideal Products.
      b. Polywater Products.
      c. 3M Products.
      d. Greenlee Products.
      e. Or equal as recommended by cable manufacturer.
      f. Do not use oil, grease, or similar substances.

E. Cable pulling:
   1. Prevent mechanical damage to conductors during installation.
   2. For cables Number 1 AWG and smaller, install cables by hand.
   3. For cables larger than Number 1 AWG, power pulling winches may be used if they have cable tension monitoring equipment.
   4. Provide documentation that maximum cable pulling tension was no more than 75 percent of the maximum recommended level as published by the cable manufacturer. If exceeded, the ENGINEER may, at his discretion, require replacement of the cable.
   5. Ensure cable pulling crews have all calculations and cable pulling limitations while pulling cable.
   6. Make splices or add a junction box or pull box where required to prevent cable pulling tension or sidewall pressure from exceeding 75 percent of manufacturer’s recommendation for the specified cable size:
      a. Make splices in manholes or pull boxes only.
      b. Leave sufficient slack to make proper connections.

F. Use smooth-rolling sheaves and rollers when pulling cable into cable tray to keep pulling tension and bending radius within manufacturer’s recommendations.

G. Install and terminate all wire in accordance with manufacturer’s recommendations.

H. Neatly arrange and lace conductors in all switchboards, panelboards, pull boxes, and terminal cabinets by means of wire ties:
   1. Do not lace wires in gutter or panel channel.
   2. Install all wire ties with a flush cutting wire tie installation tool:
      a. Use a tool with an adjustable tension setting.
   3. Do not leave sharp edges on wire ties.
I. Terminate solid conductors at equipment terminal screws with the conductor tightly wound around the screw so that it does not protrude beyond the screw head:
   1. Wrap the conductor clockwise so that the wire loop is closed as the loop is tightened.
   2. Do not use crimp lugs on solid wire.

J. Terminate stranded conductors on equipment box lugs such that all conductor strands are confined within the lug:
   1. Use ring type lugs if box lugs are not available on the equipment.

K. Splices:
   1. Provide continuous circuits from origin to termination whenever possible:
      a. Obtain Engineer’s approval prior to making any splices.
   2. Lighting and receptacle circuit conductors may be spliced without prior approval from the Engineer.
   3. Where splices are necessary because of extremely long wire or cable lengths that exceed standard manufactured lengths:
      a. Splice box NEMA rating requirements as specified in Section 16050.
      b. Make splices in labeled junction boxes for power conductors.
      c. Make splices for control and instrument conductors in terminal boxes:
         1) Provide terminal boards with setscrew pressure connectors, with spade or ring lug connectors.
   4. Power and control conductors routed in common raceways may be spliced in common junction boxes.
   5. Clearly label junction and terminal boxes containing splices with the word "SPLICE."
   6. Leave sufficient slack at junction boxes and termination boxes to make proper splices and connections. Do not pull splices into conduits.
   7. Install splices with compression type butt splices and insulate using a heat-shrink sleeve:
      a. In NEMA Type 4 or NEMA Type 4X areas, provide heat-shrink sleeves that are listed for submersible applications.
   8. Splices in below grade pull boxes, in any box subject to flooding, and in wet areas shall be made waterproof using:
      a) A heat shrink insulating system listed for submersible applications.
      b) Or an epoxy resin splicing kit.

L. Apply wire markers to all wires at each end after being installed in the conduit and before meg-ohm testing and termination.

M. Instrumentation class cable:
   1. Install instrumentation class cables in separate raceway systems from power cables:
      a. Install instrument cable in metallic conduit within non-dedicated manholes or pull boxes.
      b. Install cable without splices between instruments or between field devices and instrument enclosures or panels.
   2. Do not make intermediate terminations, except in designated terminal boxes as indicated on the Drawings.
   3. Shield grounding requirements as specified in Section 16060.
N. Multi-conductor cable:
   1. Where cable is not routed in conduit with a separate ground conductor, use one conductor in the cable as a ground conductor:
      a) Use an internal ground conductor, if it is no smaller than as indicated on the Drawings and in accordance with NEC requirements for equipment ground conductor size.
      b) Where 2 parallel cables are used, and the internal ground conductor in each cable does not meet NEC requirements for the combined circuit, use 4-conductor cable, with one of the full-sized conductors serving as ground.

O. Armored cable:
   1. Where 2 parallel cables are used, and the internal ground conductor in each cable does not meet NEC requirements for the combined circuit, use 4-conductor cable, with 1 of the full-sized conductors serving as ground.
   2. The cable armor is not acceptable as a ground conductor.
   3. Where armored cable terminates at a device, switchboard, panel, etc., use armored cable connector.
   4. Where armored cable run continues in conduit, strip jacket and armor for portions in conduit, and terminate cable and jacket with an armored cable connector threaded into a coupling or conduit box.

P. Telephone cable:
   1. Install telephone cables in dedicated metallic raceways, including raceways in ductbanks, manholes, and pull boxes.

Q. Fire alarm cable:
   1. Install fire alarm cable in dedicated metallic raceways as indicated on the Drawings.

R. Signal cable:
   1. Separate and isolate electrical signal cables from sources of electrical noise and power cables by minimum 12 inches.

S. Submersible cable in wet wells:
   1. Provide Kellem’s grip or stainless steel wire mesh to support cable weight and avoid stress on insulation.

T. Wiring allowances:
   1. Equipment locations may vary slightly from the drawings. Include an allowance for necessary conductors and terminations for motorized equipment, electrical outlets, fixtures, communication outlets, instruments, and devices within 10 linear feet of locations indicated on the Drawings.
   2. Locations for pull boxes, manholes, and duct banks may vary slightly from the drawings. Include an allowance for necessary conductors and related materials to provide conductors to all pull boxes, manholes and duct banks within 20 linear feet of locations indicated on the Drawings.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)
3.07 FIELD QUALITY CONTROL
   A. As specified in Section 16000 and other pertinent sections of the plans and specifications.
   B. Grounding:
      1. As specified in Section 16060.

3.08 ADJUSTING (NOT USED)

3.09 CLEANING (NOT USED)

3.10 DEMONSTRATION AND TRAINING (NOT USED)

3.11 PROTECTION
   A. As specified in Section 16000.

3.12 SCHEDULES (NOT USED)

END OF SECTION
SECTION 16134

BOXES

PART 1  GENERAL

1.01  SUMMARY

A.  Section includes:
   1.  Device boxes.
   2.  Raceway system boxes.

B.  Related sections:
   1.  The Contract Documents are complementary; what is called for by one is as
       binding as if called for by all.
   2.  It is the Contractor’s responsibility for scheduling and coordinating the Work of
       subcontractors, suppliers, and other individuals or entities performing or
       furnishing any of Contractor’s Work.
   3.  The following sections are related to the Work described in this Section. This
       list of related sections is provided for convenience only and is not intended to
       excuse or otherwise diminish the duty of the Contractor to see that the
       completed Work complies accurately with the Contract Documents.
       a.  Submittal Procedures.
       b.  Section 16000 – General Electrical Specifications.

1.02  REFERENCES

A.  As specified in Section 16000.

B.  ASTM International (ASTM):
   2.  D 149 – Standard Test Method for Dielectric Breakdown Voltage and Dielectric
       Strength of Solid Electrical Insulating Materials at Commercial Power
       Frequencies.
   3.  D 495 – Standard Test Method for High-Voltage, Low-Current, Dry Arc
       Resistance of Solid Electrical Insulation.
       Flexural Load in the Edgewise Position.
   6.  D 790 – Standard Test Methods for Flexural Properties of Unreinforced and
       Reinforced Plastics and Electrical Insulating Materials.
   7.  D 792 – Standard Test Methods for Density and Specific Gravity (Relative
       Density) of Plastics by Displacement.

C.  Joint Industry Conference (JIC).

D.  Underwriters Laboratories, Inc. (UL):
   1.  94 – Standard for Tests for Flammability of Plastic Materials for Parts in
       Devices and Appliances.
1.03 DEFINITIONS

A. As specified in Section 16000.

B. Specific definitions:
   1. Arcing parts: Circuit breakers, motor controllers, switches, fuses, or any device intended to interrupt current during its operation.
   2. Raceway system boxes: Boxes that are used for wire and cable pullboxes, conduit junction boxes, or terminal boxes.

1.04 SYSTEM DESCRIPTION

A. Provide outlet boxes for devices such as switches, receptacles, telephone and computer jacks, security systems, junction, and pullboxes for use in the raceway systems, etc.

B. Provide boxes and conduit bodies as indicated on the Drawings or as needed to complete the raceway installation.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Product data:
   1. Manufacturer.
   3. Dimensions:
      a. Height.
      b. Width.
      c. Depth.
      d. Weight.
      e. NEMA rating.
   4. Conduit entry locations.
   5. Catalog cut sheets.
   6. Installation instructions.

C. Shop drawings:
   1. Include identification and sizes of pull boxes.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. Regulatory requirements:
   1. Outlet boxes shall comply with all applicable standards of:
      a. JIC.
      b. NEC.
      c. NEMA.
      d. UL.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16000.
1.08 PROJECT OR SITE CONDITIONS
   A. As specified in Section 16000.

1.09 SEQUENCING
   A. As specified in Section 16000.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY
   A. As specified in Section 16000.

1.12 SYSTEM START-UP
   A. As specified in Section 16000.

1.13 OWNER’S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. One of the following or equal:
      1. Pressed steel boxes:
         a. Steel City.
         b. Appleton.
         c. Crouse – Hinds.
         d. Thomas & Betts.
      2. Plastic and/or fiberglass boxes:
         a. Hoffman.
         b. Carlon.
         c. Stahlin.
      3. Plastic coated steel boxes:
         a. Rob Roy.
         b. OCAL.
      4. Cast device boxes:
         a. Appleton.
         b. Crouse – Hinds.
         c. OZ/Gedney.
      5. Floor outlet boxes with 1 inch conduit knockouts:
         a. Steel City, 640 Series.
         b. Hubbell type B25 with S2530 cover plate.
      6. Floor outlet boxes in open areas:
7. Formed steel enclosures:
   a. Hoffman.
   b. Thomas and Betts.
   c. Stahlin.
   d. Rittal.
8. Stainless steel enclosures:
   a. Hoffman.
   b. Stahlin.
   c. Rittal.
9. Pressed steel boxes and concrete boxes:
   a. Appleton.
   b. Steel City.
   c. Cooper/Crouse Hinds.
   d. OZ Gedney.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS

A. Pressed steel boxes:
   1. One-piece galvanized pressed steel.
   2. Knockout type boxes.
   3. Minimum size 4 inch square by 2-1/8 inch deep.

B. Concrete boxes:
   1. For outlets and pull boxes in concrete construction.
   2. Pressed steel or cast construction, concrete tight.
   3. Knockout sizes range from 1/2 inch to 1 inch.
   4. Depth as needed.
   5. Types:
      a. Four inch octagon.
      b. Four inch octagon ceiling boxes with hanging bars.
      c. Gangable masonry boxes:
         1) 3-1/2 inch deep, 3-3/4 inch high, length as required:
            a) 2-1/2 inch deep boxes may be used where wall thickness precludes the use of the deeper boxes.
         2) With partitions as needed.

C. Threaded-hub boxes:
   1. Construction:
      a. With internal green ground screw.
      b. Furnished with a suitable gasketed cover.
      c. With integral cast mounting lugs when surface mounted.
      d. Conduit sizes range from 3/4 inch to 1 inch.
      e. Tapered threaded hubs with integral bushing.
   2. Aluminum (copper free) boxes:
      a. High strength copper free 4/10 of 1 percent maximum alloy for use with aluminum rigid conduit.
   3. Malleable iron boxes:
      a. Conforming to ASTM A 47 Grade 32510.
D. Plastic coated threaded-hub boxes:
   1. Construction:
      a. With internal green ground screw.
      b. Furnished with a suitable gasketed cover.
      c. With integral cast mounting lugs when surface mounted.
      d. Conduit sizes range from 3/4 inch to 1 inch.
      e. Double coated with a nominal 0.002 inch (2 mil) urethane on both the interior and exterior before application of PVC coating.
      f. With a minimum 0.040 inch (40 mil) PVC coating bonded to exterior.
      g. With pressure sealing sleeve to protect the connection with conduit.

E. Class I Division 1 areas:
   1. Provide boxes designed and listed for Class I Division 1 locations and group type atmosphere in which they will be used:
      a. The approval ratings must be permanently marked on each item.

F. Class I, Division 2 areas:
   1. For boxes not containing arcing parts:
      a. As specified in Section 16000.
      b. Pressed metal boxes are not allowed.
   2. For boxes containing arcing parts provide:
      a. Boxes designed and listed for Class I Division 1 locations and group type atmosphere in which they will be used:
         1) The approval ratings must be permanently marked on each item.
   3. Cast iron box and cover.
   4. Precision machined flame path between box and cover with neoprene O-ring.
   5. Bolt-on stainless steel slotted mounting feet for horizontal or vertical mounting.
   6. For applications requiring hinged cover, provide flexible hinge mounting either left or right side.
   7. External flange.
   9. Ground lug.

G. Fiberglass boxes:
   1. NEMA Type 4X.
   2. Constructed of molded fiberglass reinforced polyester.
   3. Integral neoprene gasket on cover attached with an oil-resistant adhesive.
   4. Enclosures to have internal pads for mounting optional panels and terminal kits.
   5. Covers:
      a. Screw cover enclosures:
         1) Covers held in place with captive, stainless steel, or Monel screws.
         2) Covers attached to body with internal zinc-plated steel hinges.
      b. Quick release latches covers:
         1) Corrosion resistant fiberglass hinges.
         2) Spring loaded fiberglass latches with a Monel or stainless steel bail attached with Monel or stainless steel screws.
         3) With a Type 316 stainless steel padlock hasp.
   6. With external mounting feet.
   7. Meeting the following minimum standards and tests:
<table>
<thead>
<tr>
<th>Physical Property</th>
<th>Value</th>
<th>ASTM Method</th>
</tr>
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<tbody>
<tr>
<td>Flexural strength</td>
<td>12,000 psi</td>
<td>D 790</td>
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<tr>
<td>Heat distortion</td>
<td>400° Fahrenheit</td>
<td>D 648</td>
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<tr>
<td>Water absorption (24 hrs)</td>
<td>0.5 percent</td>
<td>D 570</td>
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<td>Tensile strength</td>
<td>5000 psi</td>
<td>D 651</td>
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<tr>
<td>Specific gravity</td>
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<tr>
<td>Flammability</td>
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<td>UL 94</td>
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<tr>
<td>Dielectric strength</td>
<td>4000 V.P.M.</td>
<td>D 149</td>
</tr>
<tr>
<td>Arc resistance</td>
<td>180 second</td>
<td>D 495</td>
</tr>
</tbody>
</table>

H. Formed steel enclosures:
   1. Steel:
      a. NEMA Type 12.
      b. Fabricated from 14-gauge steel, minimum.
      c. All seams continuously welded ground smooth.
      d. Door:
         1) Rolled lip around 3 sides.
         2) Attached to enclosure by means of a continuous stainless steel hinge and pin.
      e. Neoprene door gasket to provide a watertight, dust-tight, oiltight seal:
         1) Attached with an adhesive.
         2) Retained by a retaining strip.
      f. Fabricate all external removable hardware for clamping the door to the enclosure body from zinc-plated heavy gauge steel:
         1) With a hasp and staple for padlocking.
      g. Provide large enclosures with door and body stiffeners for extra rigidity.
      h. No holes or knockouts.
      i. Finish:
         1) ANSI-61 gray electrostatically applied polyester powder inside and out over cleaned and primed surfaces.
         2) White electrostatically applied polyester powder mounting plate.
      j. Heavy gauge steel external mounting brackets when surface mounted.
   2. Stainless steel:
      a. NEMA Type 4X:
         1) Boxes in locations subject to flooding or temporary submersion:
            a) NEMA Type 6.
      b. Fabricated from 14-gauge Type 316 stainless steel.
      c. All seams continuously welded.
      d. Door:
         1) Rolled lip around 3 sides.
         2) Attached to enclosure by means of a continuous stainless steel hinge and pin.
      e. Neoprene door gasket to provide a watertight seal:
         1) Attached with an adhesive.
         2) Retained by a retaining strip.
      f. Fabricate all external removable hardware for clamping the door to the enclosure body from heavy gauge stainless steel:
         1) With a hasp and staple for padlocking.
g. Provide large enclosures with door and body stiffeners for extra rigidity.

h. No holes or knockouts.

i. Finish:
   1) Brushed.

j. Stainless steel external mounting brackets when surface mounted.

I. Cast iron junction boxes:
   1. NEMA Type 4.
   2. Recessed cover boxes.
   3. Suitable for use outdoors where subject to rain, dripping, or splashing water.
   4. Designed for flush mounting in walls or floors:
      a. Can be surface mounted using mounting lugs.
   5. Construction:
      a. Cast iron box.
      b. Covers:
         1) Checkered plate covers suitable for foot traffic.
         2) When used in areas subject to vehicular traffic H-20 loading.
      c. Hot dip galvanized.
      d. Neoprene gasket.
      e. Stainless steel screw covers.

J. Floor outlet boxes:
   1. Watertight cast iron, semi adjustable.
   2. Telephone outlets shall be fitted with 6 inch bushed nipples.
   3. Provide a pedestal housing for floor outlets in open areas.
   4. Suitable for receptacles, communications, and data outlets as specified and indicated on the Drawings, complete with gaskets and cover plates:
      a. Dual-gang, heavy-duty cast iron, suitable for wiring devices to be installed to make a complete and operable system and installation.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

A. Fasteners:
   1. Electroplated or stainless steel in boxes with wiring devices.
   2. Screws, nuts, bolts, and other threaded fasteners:
      a. Stainless steel.

B. Provide breather and drain fittings where appropriate.

C. Internal panels:
   1. Provide internal panels where required for mounting of terminal strips or other equipment.
   2. With plated steel shoulder studs.
   3. Steel with white polyester powder finish.

D. Floor stand kit when shown:
   1. Fabricated from 12-gauge steel.
   2. Bottom plate 11 gauge.
3. Heights:
   a. 12 inches.
4. Do not provide external mounting brackets, when a floor stand kit is used.

2.08 MIXES (NOT USED)
2.09 FABRICATION (NOT USED)
2.10 FINISHES (NOT USED)
2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

   A. As specified in Section 16000.

   B. General:
   1. Provide materials and construction suitable for environmental conditions at the location of the box as specified in Section 16050.
   2. Provide outlet box materials to match the conduit system:
      a. EMT – Pressed metal boxes.
      b. GRC – Cast ferrous boxes.
      c. RAC – Aluminum (copper free) boxes.
      d. PCS – PVC coated cast ferrous boxes.
      e. PVC – PVC boxes.
      f. PCA – PVC coated aluminum boxes.
   3. Solid type gang boxes:
      a. For more than 2 devices.
      b. For barriered outlets.
   4. Support all wall mounted NEMA Type 4 or NEMA Type 4X boxes to maintain a minimum of 7/8 inch free air space between the back of the enclosure and the wall:
      a. Use machined spacers to maintain air space; built-up washers are not acceptable.
      b. Use stainless steel or nylon materials for spacers.
   5. Use cast malleable iron boxes when box must support other devices.
   6. Boxes serving luminaires or devices:
      a. Use as pull boxes wherever possible.
   7. In finished areas:
      a. Provide specific pull or junction boxes only as indicated on the Drawings or as directed.
   8. Fit all cast boxes and pressed steel boxes for flush mounting in concrete with cast, malleable box covers and gaskets.
   9. In terminal boxes, furnish terminals as indicated on the Drawings, with a minimum of 50 percent spare terminals:
      a. Furnish wireways for discrete and analog/DC wiring.
      b. Separate analog wiring from 120 V discrete or power wiring.
10. Size boxes in accordance with NEC requirements and to provide sufficient room for the future components and cables indicated on the Drawings.

11. For fire-rated construction, provide materials and installation for use in accordance with the listing requirements of the classified construction.

C. Outlet boxes:
   1. Locate outlet boxes as indicated on the Drawings:
      a. Adjust locations so as not to conflict with structural requirements or other trades.
   2. Use deep threaded-hub malleable iron or aluminum boxes:
      a. In hazardous areas.
      b. Where exposed to the weather.
      c. In unheated areas.
      d. Where subject to mechanical damage:
         1) Defined as exposed boxes less than 10 feet above the floor.
      e. To act as a pull box for conductors in a conduit system.
      f. Accommodate wiring devices.
   3. Use deep threaded-hub plastic coated malleable iron boxes in corrosive and NEMA Type 4X area and when the conduit system is PVC coated steel.
   4. Outlet boxes may be used as junction boxes wherever possible.

D. Pull boxes and junction boxes:
   1. Size pull boxes in accordance with NEC requirements and to provide sufficient room for any future conduits and cables as indicated on the Drawings.
   2. Install pull boxes such that access to them is not restricted.

E. For boxes not indicated:
   1. Provide types and mountings as required to suit the equipment and that will be consistent with the conduit system and environmental conditions as indicated in Section 16050.
   2. Outlet, switch, and junction boxes for flush-mounting in general purpose locations:
      a. One-piece, galvanized, pressed steel.
   3. Ceiling boxes for flush mounting in concrete:
      a. Deep, galvanized, pressed steel.
   4. Outlet, switch, and junction boxes where surface mounted in exposed locations:
      a. Cast ferrous boxes with mounting lugs, zinc or cadmium plating finish.
   5. Outlet, control station, and junction boxes for installation in corrosive locations:
      a. Fiberglass reinforced polyester, stainless steel, or plastic coated steel to match the conduit system.
      b. Furnished with mounting lugs.
   6. Boxes for concealed conduit system:
      a. Non-fire rated construction:
         1) Depth: To suit job conditions and comply with the NEC.
         2) For luminaries: Use outlet boxes designed for the purpose:
            a) 50 pounds or less: Box marked “For Fixture Support.”
            b) More than 50 pounds: Box listed and marked with the weight of the fixture to be supported (or support luminaire independent of the box.)
3) For junction and pull boxes: Use galvanized steel boxes with flush covers.

4) For switches, receptacles, etc.:
   a) Plaster or cast-in-place concrete walls: Use 4 inch or 4-11/16 inch galvanized steel boxes with device covers.
   b) Walls other than plaster or cast-in-place concrete: Use type of galvanized steel box which will allow wall plate to cover the opening made for the installation of the box.

7. Recessed boxes in fire rated (2 hours maximum) bearing and nonbearing wood or steel stud walls (gypsum wallboard facings):
   a. Use listed single and double gang metallic outlet and switch boxes.
      1) The surface area of individual outlet or switch boxes shall not exceed 16 square inches.
   b. The aggregate surface area of the boxes shall not exceed 100 square inches per 100 square feet of wall surface.
   c. Securely fasten boxes to the studs.
      1) Verify that the opening in the wallboard facing is cut so that the clearance between the box and the wallboard does not exceed 1/8 inch.
   d. Separate boxes located on opposite sides of walls or partitions by a minimum horizontal distance of 24 inches.
      1) This minimum separation distance may be reduced when wall opening protective materials are installed according to the requirements of their classification.
   e. Use wall opening protective material in conjunction with boxes installed on opposite sides of walls or partitions of staggered stud construction in accordance with the classification requirements for the protective material.

8. Other fire rated construction: Use materials and methods to comply with the listing requirements for the classified construction.

F. Recessed boxes:
   1. Support recessed boxes in suspended ceilings or stud partitions with galvanized steel box hangers of types made specifically for the purpose or attach directly to wood members or blocking.
   2. Secure hangers or boxes to wood with 1 inch long cadmium-plated Type A pan head screws:
      a. Fully or partially hammer-driven screws are not acceptable.

G. Hazardous locations:
   1. All metallic boxes, fittings, and joints shall utilize threaded connections to the conduit system.
   2. All threaded connections shall be wrench tightened so that at least 5 threads are fully engaged.
   3. Conduits entering and exiting metallic boxes in Class I Division 2 areas shall utilize approved grounding bushings to bond the conduits together.
   4. Provide the following types of conduit bodies and boxes:
      a. Malleable iron bodies and boxes with GRC or IMC conduit systems.
      b. PVC coated conduit bodies and boxes with PCS conduit systems.
3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 REINSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL
   A. As specified in Section 16000.

3.08 ADJUSTING (NOT USED)

3.09 CLEANING
   A. As specified in Section 16000.

3.10 DEMONSTRATION AND TRAINING (NOT USED)

3.11 PROTECTION
   A. As specified in Section 16000.

3.12 SCHEDULES (NOT USED)

   END OF SECTION
PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Switches.
   2. Receptacles.
   3. Plates.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor’s responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor’s Work.
   3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Submittal Procedures.
      b. Section 16000 – General Electrical Specifications

1.02 REFERENCES

A. As specified in Section 16000.

B. Federal Specifications (FS):
   2. W-S 896/2 – Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).

C. National Electrical Manufacturers Association (NEMA):
   1. WD1 – General Color Requirements for Wiring Devices.
   2. ICS 5 – Industrial Control and Systems, Control Circuit and Pilot Devices.
   3. OS1 – Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
   4. WD6 – Wiring Devices Dimensional Specifications.

D. National Fire Protection Association (NFPA):
   1. 70 – National Electric Code (NEC).

E. Underwriters Laboratories Inc. (UL):
   1. 20 – General Use Snap Switches.
   2. 498 – Standard for Attachment Plugs and Receptacles.
   5. 1472 – Solid State Dimming Controls.
1.03 DEFINITIONS

A. As specified in Section 16000.

B. Specific definitions:
   1. GFCI: Ground fault circuit interrupter.
   2. P-S: Pass and Seymour.
   3. Cooper: Cooper Wiring Devices, a division of Cooper Industries.
   4. T&B: Thomas and Betts.

1.04 SYSTEM DESCRIPTION

A. Switches, receptacles, and plates as indicated on the Drawings wired and operable to form a complete system.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 16000 and other pertinent sections of the Plans and Specifications

B. Product data:
   1. Catalog cut sheets.

C. Shop drawings:
   1. Engraving schedule:
      a. Furnish complete engraving schedule for engraved nameplates.

1.06 QUALITY ASSURANCE

A. As specified in Section 16000.

B. Wiring devices shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16000.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16000.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 16000.

1.12 SYSTEM START-UP

A. As specified in Section 16000.
PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Switches:
   1. General purpose switches: One of the following or equal:
      a. Hubbell.
      b. Leviton.
      c. Cooper.
   2. Switches for office areas: One of the following or equal:
      a. Hubbell.
      b. Leviton.
      c. Cooper.
   3. Switches for photocells: One of the following or equal:
      a. Hubbell.
      b. Cooper.
   4. Switches for hazardous areas: One of the following or equal:
      a. Appleton.
      b. Crouse-Hinds.
   5. Occupancy Sensor Switches: The following or equal:
      a. WattStopper.
      b. Cooper.
   6. Dimmer switches: The following or equal:
      a. Lutron.
      b. Cooper.

B. Receptacles:
   1. General purpose receptacles: One of the following or equal:
      a. Hubbell.
      b. Leviton.
      c. Cooper.
   2. Receptacles for hazardous areas: One of the following or equal:
      a. Crouse-Hinds.
      b. Appleton.
   3. 250 VAC receptacles: One of the following or equal:
      a. Hubbell.
      b. Cooper.
   4. 480-Volt, 3-phase receptacles: One of the following or equal:
      a. Crouse-Hinds.
      b. Hubbell.
      c. Russellstol™.

C. Plates:
   1. General location: The following or equal:
      a. P-S.
      b. Cooper.
2. Wet or corrosive areas: One of the following or equal:
   a. Hubbell.
   b. Cooper.
   c. T&B.
   d. P-S.
3. In-use covers: One of the following or equal:
   a. TayMac.
   b. Cooper.
   c. P-S.
   d. T&B.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS

A. Switches:
   1. General:
      a. 120-277 VAC.
      b. 20 ampere.
      c. Listed in accordance with UL 20.
      d. Designed and constructed in accordance with FS W-S-896/2.
      e. Back and side wired unless otherwise indicated.
      f. Integral grounding terminal.
      g. Totally enclosed:
         1) Color-coded body with color corresponding to ampere rating.
      h. Provide switches with the operator style and contact arrangement as indicated on the Drawings and as required for proper operation.
      i. Color:
         1) Ivory in finished areas.
         2) Brown in all other areas.
   2. General purpose switches:
      a. Toggle type.
   3. Switches for office areas:
      a. Rocker type.
   4. Switches for use with photocell:
      a. Maintained contact.
      b. Two circuit.
      c. Three position:
         1) Center off.
   5. Switches for hazardous areas:
      a. Suitable for use in Class I Division 1 and Class I Division 2 locations.
      b. Factory sealed.
      c. Through-feed or dead-end as required.
   6. Occupancy sensor switches:
      a. Wall switch with dual-technology passive infrared and ultrasonic sensor.
         1) Configured such that lights turn on only when both infrared and ultrasonic sensors detect activity, but do not turn off as long as either sensor detects activity.
b. Selectable “automatic-on” mode activated by sensors or “manual-on” mode activated by pushbutton.
c. Adjustable 5-30 minute time delay.
d. Selectable audible alert as a warning before lights turn off.
e. Rated for fluorescent lighting loads of up to 800W.
f. True multi-way switching allowing identical controls at any location for multi-way switching applications.

7. Dimmer switches:
   a. Shall be rectangular design with LED light level indicators.
   b. Suitable for use with type of lamp switched.

B. Receptacles:
1. General purpose receptacles:
   a. Single or duplex as indicated on the Drawings.
   b. 125 VAC.
   c. 20 ampere or as indicated on the Drawings.
   d. NEMA Type 5-20R configuration for 20 ampere receptacles.
   e. Other NEMA configurations as indicated on the Drawings.
   f. Listed in accordance with UL 498.
   g. Designed and constructed in accordance with FS W-C-596.
   h. Back and side wired.
   i. One-piece, rivet-less mounting strap.
   j. Color:
      1) Ivory in finished areas.
      2) Brown in all other areas.
      3) Orange when powered by a UPS.

2. Ground fault interrupter receptacles (GFCI):
   a. 125 VAC.
   b. 20 ampere.
   c. Trip level 4-6 milliampere.
   d. Individual and feed through protection.
   e. UL 943 and UL 498 listed.
   f. NEMA Type 5-20R configuration.
   g. For damp or wet locations:
      1) Weather resistant, in accordance with UL 498.

3. Isolated:
   a. Duplex as indicated on drawings.
   b. 125 VAC.
   c. 20 ampere.
   d. Isolated and insulated from box.

4. Receptacles for hazardous areas (As per NFPA 820):
   a. 125 VAC.
   b. 20 ampere.
   c. Factory sealed.
   d. Single receptacle.
   e. 2-wire, 3-pole.
   f. Grounded through extra pole and shell.
   g. Dead-front construction.
   h. Interlocked to prevent plug from being withdrawn until circuit has been broken.
5. **250 VAC receptacles:**
   a. 2-pole, 3-wire grounding for 240 VAC circuits.
   b. 3-pole, 4-wire grounding for 208 VAC 3-phase circuits.
   c. Ampere rating as indicated on the Drawings.
   d. Provide NEMA configuration as required by the equipment connected to
      the outlet.

6. **480 VAC receptacles:**
   a. 3-pole, 4-wire grounding.
   b. Ampere rating as indicated on the Drawings.
   c. Spring door on receptacle.
   d. Furnish one matching plug for each 480-volt power receptacle.

7. All outdoor receptacles not in hazardous areas shall be weather proof
   GFI type (5-20R).

8. Receptacles in Classified locations shall be Explosion Proof, Hazardous
   Location Rated, 20 amp, 125 VAC/250 VAC, 5-20R. Receptacle shall be
   ANSI/UL943, 1203 listed.

C. Plates:
   1. General location:
      a. Type 302 or 304 stainless steel.
      b. Brushed satin finish.
      c. Minimum thickness: 0.032 inches.
      d. Rectangular or square shape.
      e. Engraving:
         1) Engrave each plate with the following information:
            a) Area served.
            b) Circuit number.
         2) Treat engraving to improve visibility and, except for stainless steel
            plates, to prevent corrosion.
         3) Characters shall be block letter pantograph engraved with a
            minimum character height of 1/8-inch.
      f. Coordinate the number of gangs, number and type of openings with the
         specific location.

2. Outdoor and wet areas requiring NEMA Type 4 or NEMA Type 4X enclosures:
   a. General:
      1) UL listed for wet locations.
      2) Gasketed.
      3) Die cast metal:
         a) Match material to box material.
   b. Switches:
      1) Lever operated:
         a) Provide toggle switch.
   c. Receptacles:
      1) Weather proof in-use cover:
         a) Die cast metal construction with electrostatic powder coating for
            corrosion resistance.
         b) Gasketed.
         c) Lockable.
         d) UL listed and in accordance with NEC.
3. Corrosive areas:
   a. Neoprene.
   b. Gasketed.
   c. Weatherproof.

D. Data and communications jacks:
   a. Process network jacks – panel/enclosure mounted:
      1) Network jacks located in process areas shall have a NEMA Type 4 rating (with closure cap).
      2) Mounting of network jacks in control panels shall be accomplished using bulkhead connectors and environmental enclosure caps, which are permanently attached to the bulkhead fitting.
      3) Network jacks shall have RJ-45 connections on both sides of connector (bulkhead pass through) allowing for direct connection to the network switch and computer with standard patch cords. No punch down PC board connections shall be allowed.
      4) Manufactured by Woodhead Connectivity RJLNXX.

2. Process network jacks – conduit body mounted:
   a. Network jacks located in process areas shall have a NEMA Type 4 rating (with closure cap).
   b. Mounting of network jacks in conduit bodies adapter (with Minifast connector) shall be accomplished using conduit body insert and environmental enclosure caps.
   c. PC board connections are not to be allowed.
   d. Furnish 10 RJ-45 to minifast connector patch cable 3 feet in length.
   e. Manufactured by InterlinkBT RSS series.

3. Network/phone jacks:
   a. Network jacks located in computer rooms shall be installed per the installation details indicated on the Drawings.
   b. Standard Decora wall plates shall be used with QuickPort modules and inserts.
   c. Plugs shall be color coded as indicated in the installation details indicated on the Drawings.
   d. Manufactured by Leviton Quickport series.

2.05 EQUIPMENT (NOT USED)
2.06 COMPONENTS (NOT USED)
2.07 ACCESSORIES (NOT USED)
2.08 MIXES (NOT USED)
2.09 FABRICATION (NOT USED)
2.10 FINISHES (NOT USED)
2.11 SOURCE QUALITY CONTROL (NOT USED)
PART 3 EXECUTION
3.01 EXAMINATION (NOT USED)
3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 16000.

B. Mounting heights:
   1. Process and production areas:
      a. Switches and receptacles 48 inches from finished floor to top of plate.
   2. Offices and finished areas:
      a. Switches: 48 inches from finished floor to top of plate.
      b. Receptacles: 18 inches from finished floor to center of plate.

C. Switches:
   1. Over 300 Volts:
      a. Where switches used in systems of more than 300 volts between conductors, are to be ganged in outlet boxes, provide switches having no exposed live parts or use barriers between the individual switches.

D. Receptacles:
   1. Provide GFCI receptacles as indicated on the Drawings.
      a. Provide weather resistant GFCI receptacles in all wet or damp areas.
      1) As specified in Section 16050.
   2. Mount non-weatherproof receptacles vertically:
      a. Ground slot down.
   3. Mount weatherproof receptacles horizontally:
      a. Neutral slot up.
   4. 3-phase receptacles shall be consistent with respect to phase connection at the receptacle terminals. Correct errors in phasing at the source and not the receptacle.

E. Ensure all plates make a firm seal with wall for recessed mounted devices:
   1. Outside edges of plates parallel with building lines.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 REINSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL

A. As specified in Section 16000.

3.08 ADJUSTING (NOT USED)

3.09 CLEANING (NOT USED)

3.10 DEMONSTRATION AND TRAINING

A. As specified in Section 16000.
B. Demonstrate the following to the Engineer and Owner:
   1. Switching is as indicated on the Drawings.
   2. All circuits conform to the panel schedules.
   3. All ground fault receptacles operate at levels below or equal to OSHA maximum allowable fault levels.

3.11 PROTECTION

A. As specified in Section 16000.

3.12 SCHEDULES (NOT USED)

END OF SECTION
PART 1  GENERAL

1.01  SUMMARY

A.  Section includes:
   1.  Enclosed dry-type transformers:
      a.  Rated 1 to 1,000 kilovolt-amperes, single and 3-phase.
      b.  Primary voltage 600 volts and below.

B.  Related sections:
   1.  The Contract Documents are complementary; what is called for by one is as
       binding as if called for by all.
   2.  It is the Contractor’s responsibility for scheduling and coordinating the Work of
       subcontractors, suppliers, and other individuals or entities performing or
       furnishing any of Contractor’s Work.
   3.  The following sections are related to the Work described in this Section. This
       list of related sections is provided for convenience only and is not intended to
       excuse or otherwise diminish the duty of the Contractor to see that the
       completed Work complies accurately with the Contract Documents.
      a.  Section 16000

1.02  REFERENCES

A.  As specified in Section 16000 and other pertinent sections of the plans and
     specifications.

B.  American National Standards Institute (ANSI):
   2.  389 – IEEE Recommended Practice for Testing Electronics Transformers and
       Inductors.

C.  Institute of Electrical and Electronics Engineers (IEEE):
   1.  C57.12.01 – Standard General Requirements for Dry-Type Distribution and
       Power Transformers Including Those with Solid Cast and/or Resin
       Encapsulated Windings.
   2.  C57.12.91 – Standard Test Code for Dry-Type Distribution and Power
       Transformers.

D.  National Electrical Manufacturers Association (NEMA):
       Transformers.
   2.  TP-2 – Standard Test Method for Measuring the Energy Consumption of
       Distribution Transformers.

E.  Underwriters Laboratory (UL):
   1.  1561 – Standard for Dry-Type General Purpose and Power Transformers.
1.03 DEFINITIONS

A. As specified in Section 16000 and other pertinent sections of the plans and specifications.

1.04 SYSTEM DESCRIPTIONS

A. Provide 3-phase or 1-phase, 60 hertz dry-type with voltage ratings, kilovolt-ampere capacities, and connections as indicated on the Drawings:
   1. Transformers shall provide full capacity at the Project elevation and environmental conditions as specified in Section 16050 after all derating factors have been applied.
   2. Suitable for continuous operation at full rating with normal life expectancy in accordance with ANSI C57.96.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 16000 and other pertinent sections of the plans and specifications.

B. Product data:
   1. Catalog cut sheets.
   2. Nameplate data.
   3. Dimensions:
      a. Height.
      b. Width.
      c. Depth.
   4. Inrush current.
   5. Insulation system and temperature constraints.
   6. Number and rating of taps.
   7. Sound levels.
   8. Connection diagrams:
      a. Primary.
      b. Secondary.
   9. BIL rating.
   10. Required clearances.
   11. Percent impedance.
   12. Efficiency.
   13. Certification of low temperature rise design.
   14. Certification of full capacity capability at the Project elevation and ambient conditions.
   15. For equipment installed in structures designated as seismic design category C, D, E, or F submit the following as specified in Section 16050:
      a. Manufacturer's statement of seismic qualification with substantiating test data.
      b. Manufacturer's special seismic certification with substantiating test data.

C. Installation instructions:
   1. Detail the complete installation of the equipment including rigging, moving, and setting into place.
   2. For equipment installed in structures designated as seismic design category A or B:
      a. Provide manufacturer's installation instructions and anchoring details for connecting equipment to supports and structures.
3. For equipment installed in structures designated as seismic design category C, D, E, or F:
   a. Provide project-specific installation instructions and anchoring details based on support conditions and requirements to resist seismic and wind loads as specified in Section 16050.
   b. Submit anchoring drawings with supporting calculations.
   c. Drawings and calculations shall be stamped by a professional engineer registered in the state where the Project is being constructed.

1.06 QUALITY ASSURANCE
   A. As specified in Section 16000 and other pertinent sections of the plans and specifications.

1.07 DELIVERY, STORAGE, AND HANDLING
   A. As specified in Section 16000 and other pertinent sections of the plans and specifications.

1.08 PROJECT OR SITE CONDITIONS
   A. As specified in Section 16000 and other pertinent sections of the plans and specifications.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY
   A. As specified in Section 16000 and other pertinent sections of the plans and specifications.

1.12 SYSTEM START-UP
   A. As specified in Section 16000 and other pertinent sections of the plans and specifications.

1.13 OWNER’S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. One of the following or equal:
      1. General Electric.
      2. Schneider Electric/Square D.
4. ABB.
5. Siemens.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. Cores:
   1. Non-aging, grain-oriented silicon steel.
   2. Magnetic flux densities below the saturation point.

B. Windings:
   1. High-grade magnet wire.
   2. Impregnated assembly with non-hydroscopic, thermo-setting varnish:
      a. Cured to reduce hot-spots and seal out moisture.
   3. Material electrical grade:
      a. Copper.

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT

A. General:
   1. 10 kilovolts BIL for 600-volt class windings.
   2. Sound levels, in accordance with ANSI 389 test conditions, not to exceed:

<table>
<thead>
<tr>
<th>Kilovolt-Amperes Range</th>
<th>Audible Sound Level (db)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-9</td>
<td>40</td>
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<tr>
<td>10-50</td>
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<tr>
<td>501-700</td>
<td>62</td>
</tr>
<tr>
<td>701-1000</td>
<td>64</td>
</tr>
</tbody>
</table>

   3. Taps:
      a. 15 kilovolt-amperes and less:
         1) Two 5 percent full capacity primary taps below rated voltage.
      b. 25 kilovolt-amperes and larger:
         1) Four 2.5 percent full capacity primary taps below rated voltage.
         2) Two 2.5 percent full capacity primary taps above rated voltage.
      c. Operated by a tap changer handle or tap jumpers accessible through a panel.

4. Terminals:
   a. UL listed for either copper or aluminum conductors.
   b. Rated for 75 degrees Celsius.

5. Daily overload capacities, at rated voltage and without reduction in life, in accordance with ANSI C57.96.

B. Transformers less than 15 kilovolt-amperes:
   1. Insulation class: 185 degrees Celsius.
   2. Temperature rise: 115 degrees Celsius.
C. Energy efficient transformers 15 kilovolt-amperes and larger:
   1. Insulation class: 220 degrees Celsius.
   2. Temperature rise: 115 degrees Celsius, except as noted below:
      a. 150-degree Celsius rise for dry-type transformers located in motor control centers.
   3. Efficiency:
      a. In accordance with NEMA TP-1.
      b. Measured in accordance with NEMA TP-2.

D. Low temperature rise transformers 15 kilovolt-amperes and larger:
   1. Insulation class: 220 degrees Celsius.
   2. Temperature rise: 115 degrees Celsius.
   3. Efficiency:
      a. Minimum of 96 percent for 115 degree rise.

E. K-factor transformers:
   1. Provide K-factor transformers with ratings as indicated on the Drawings.
   2. Insulation class: 220 degrees Celsius.
   3. Temperature rise: 115 degrees Celsius.
   5. Electrostatic shielding between the primary and secondary windings.

F. Enclosures:
   1. Heavy gauge steel:
      a. Outdoor: Moisture and water resistant with rodent screens over all openings and in a weather-protected enclosure, NEMA Type 3R.
      b. Indoor: NEMA Type 1.
   2. Louvers to limit coil temperature rise to the value stated above, and case temperature rise to 50 degrees Celsius.
   3. Built-in vibration dampeners to isolate the core and coils from the enclosure:
      a. Neoprene vibration pads and sleeves.

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

A. Nameplates:
   1. Non-corrosive metal or UL listed non-metallic:
      a. Stamped, engraved or printed with the following information:
         1) Phases.
         2) Frequency.
         3) Kilovolt-ampere rating.
         4) Voltage ratings.
         5) Temperature rise.
         6) Impedance.
         7) Insulation class.
         8) BIL rating.
         9) Connection diagram.
         10) Weight.
         11) Manufacturer.
         12) The identification “transformer.”
         13) Classes of cooling.
14) Tap voltage(s).
15) Vector diagram.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES

A. Finish to consist of de-greasing, phosphate cleaning, and an electrodeposited manufacturer’s standard gray enamel rust-inhibiting paint.

2.11 SOURCE QUALITY CONTROL

A. Factory tests:
   1. Applied voltage test to each winding and from each winding to the core:
      a. 600-volt class winding 4.5 kilovolt.
   2. Induced voltage test at 2 times normal voltage and 400 hertz for 1,080 cycles.
   3. Voltage ratio and polarity.
   4. Sound level, performed in a test room with ambient sound level not exceeding 24 db.
   5. Perform all tests in accordance with UL 1561.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 16000 and other pertinent sections of the plans and specifications.

B. Install the equipment in accordance with the accepted installation instructions and anchorage details to meet the seismic and wind load requirements at the Project site.

C. General:
   1. Floor, wall, platform, motor control center, packaged power supply, or roof mounted, as indicated on the Drawings.
   2. Locate where not in direct contact with building structure.
   3. Install on double-deflection mounts selected for maximum isolation manufactured by Korfund or equal.
   4. Make any necessary connections to the enclosure with liquidtight, flexible conduit having neoprene gaskets and insulated ground bushings.
   5. Ground the enclosure:
      a. To an equipment ground conductor in the conduit.
      b. To the facility grounding electrode system.
6. Floor mounted transformers:
   a. Install transformers on 3-1/2-inch housekeeping pads.
   b. Install transformers with adequate space from walls or other enclosures for proper ventilation in accordance with the manufacturer’s recommendations.

3.04 ERECTION, INSTALLATION, APPLICATIONS, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL
   A. As specified in Section 16000 and other pertinent sections of the plans and specifications.

3.08 ADJUSTING
   A. Set the transformer taps as required to obtain nominal output voltage on the secondary terminals.

3.09 CLEANING
   A. As specified in Section 16000 and other pertinent sections of the plans and specifications.

3.10 DEMONSTRATION AND TRAINING (NOT USED)

3.11 PROTECTION
   A. As specified in Section 16000 and other pertinent sections of the plans and specifications.

3.12 SCHEDULES (NOT USED)
SECTION 16285
SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. High-energy surge protective devices.
B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Submittal Procedures.
      b. Section 16000 – Common Work Results for Electrical.

1.02 REFERENCES

A. As specified in Section 16000.
B. Institute of Electrical and Electronics Engineers (IEEE):
C. Underwriters Laboratory:

1.03 DEFINITIONS
A. As specified in Section 16000.
B. Specific definitions:
   1. SPD: Surge protective device.
   2. SAD: Silicon avalanche diode.
   3. MOV: Metal oxide varistor.
   4. MCOV: Maximum continuous operating voltage.
   5. Iₙ: Nominal discharge current.
   6. VPR: Voltage protection rating.
7. SCCR: Short circuit current rating.

1.04 SYSTEM DESCRIPTION

A. Surge protective devices as an integral component of the electrical equipment.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 16000 and other pertinent sections of plans and specifications.

B. Product data:
   1. Furnish complete product data confirming detailed compliance or exception statements to all provisions of this Section.
   2. Manufacturer’s catalog cut sheets indicating:
      a. Manufacturer and model numbers.
      b. Ratings of each SPD including but not limited to:
         1) Short circuit current rating.
         2) Nominal discharge current.
         3) Maximum continuous operating voltage.
         4) Voltage protection rating.
         5) System voltage.
         6) System frequency.
         7) Surge current capacity.
   3. Submit independent test data from a nationally recognized testing laboratory verifying the following:
      a. Overcurrent protection.
      b. UL 1449.

C. Shop drawings:
   1. Provide electrical and mechanical drawings by the manufacturer that detail:
      a. Unit dimensions.
      b. Weights.
      c. Components.
      d. Field connection locations.
      e. Mounting provisions.
      f. Connection details.
      g. Wiring diagram.

D. Operation and maintenance manuals:
   1. Provide the manufacturer’s manual with installation, start-up, spare parts lists, and operating instructions for the specified system.

1.06 QUALITY ASSURANCE

A. As specified in Section 16000 and other pertinent sections of plans and specifications.

B. Provide SPD units that are designed, manufactured, tested and installed in compliance with the following codes and standards:
   1. Institute of Electrical and Electronics Engineers (IEEE C62.41, C62.45, C62.62).

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16000 and other pertinent sections of plans and specifications.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16000 and other pertinent sections of plans and specifications.

1.09 SEQUENCING

A. Coordinate with and provide SPD equipment to the electrical equipment manufacturer before final assembly and factory testing.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 16000 and other pertinent sections of plans and specifications.

B. Extended warranty:
   1. Furnish a manufacturer’s full 5-year parts and labor warranty from date of shipment against any part failure when installed in compliance with manufacturer’s written instructions, UL listing requirements, and any applicable national, state, or local electrical codes.
   2. Warranty shall include:
      a. Direct, factory trained employees must be available within 48 hours for assessment of the problem.
      b. A 24-hour toll-free 800-number for warranty support.

1.12 SYSTEM START-UP

A. As specified in Section 16000 and other pertinent sections of plans and specifications.

1.13 OWNER’S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Liebert.
   3. Schneider Electric/Square D.
5. Siemens.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS

A. Provide units as required for the locations indicated on the Drawings.

B. Electrical requirements:
   1. SPD ratings are to be consistent with the nominal system operating voltage, phase, and configuration as indicated on the Drawings.
   2. MCOV:
      a. For the SPD and all components in the suppression path (including all MOVs, SADs, and selenium cells): Greater than 115 percent of the nominal system operating voltage.
   3. Operating frequency:
      a. 47 to 63 hertz.
   4. SCCR:
      a. 100 kAIC minimum, but not less than the equipment it is connected to as indicated on the Drawings.
      b. The SCCR shall be marked on the SPD in accordance with UL 1449 and the NEC.
   5. Nominal discharge current \( I_n \):
      a. 20 kA.
   6. Maximum VPR:

<table>
<thead>
<tr>
<th>Modes</th>
<th>240/120</th>
<th>208Y/120</th>
<th>480Y/277</th>
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</thead>
<tbody>
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<td>L-N, L-G, N-G</td>
<td>900</td>
<td>900</td>
<td>1,500</td>
</tr>
<tr>
<td>L-L</td>
<td>1,800</td>
<td>1,200</td>
<td>2000</td>
</tr>
</tbody>
</table>

7. Peak surge current:
   a. Service entrance switchboard locations:
      1) 300 kA per phase minimum.
      2) 120 kA per mode minimum.
   b. Switchboards and IMCC (Intelligent Motor Control Centers)
      1) 200kA per phase minimum switchboard.
   c. Panel locations:
      1) 150 kA per phase, minimum.
      2) 60 kA per mode minimum.

C. Protection modes:
   1. Provide SPD protection modes as follows:
      a. Line to Neutral (L-N) where applicable.
      b. Line to Ground (L-G).
      c. Neutral to Ground (N-G), where applicable.
      d. Directly connected MOV(L-L), where applicable.
D. Environmental requirements:
   1. Storage temperature:
      a. -40 degrees to +50 degrees Celsius.
   2. Operating temperature:
      a. -0 degrees to +60 Celsius.
   3. Relative humidity:
      a. 5 percent to 95 percent.
   4. Audible noise:
      a. Less than 45 dBA at 5 feet (1.5 m).
   5. Operating altitude:
      a. Zero to 12,000 feet above sea level.

E. Provide surge protective devices that are suitable for application in IEEE C62.41.
   Entrance as tested to IEEE C62.45.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS

A. Enclosure:
   1. Located in electrical equipment as indicated on the Drawings.
   2. External mounting:
      a. NEMA Type 12 enclosure:
         1) No ventilation openings.
      b. Hinged cover requiring a tool for internal access.
      c. Internal drawing pocket.
      d. All monitoring indications must be visible without opening the door.

B. Internal connections:
   1. Provide low impedance copper plates for intra-unit connections:
      a. Attach surge modules using bolted connections to the plates for low-
         impedance connections.
   2. Size all connections, conductors, and terminals for the specified surge current
      capacity.

C. Surge diversion modules:
   1. MOV:
      a. Where multiple MOVs are used in parallel, utilize computer matched
         MOVs to within 1 volt variance and tested for manufacturer's defects.

D. Overcurrent protection:
   1. Individually fuse all components, including suppression, filtering, and
      monitoring components:
      a. Rated to allow maximum specified nominal discharge current capacity.
      b. Overcurrent protection that limits specified surge currents is not
         acceptable.

E. Connections:
   1. Provide terminals to accommodate wire sizes up to #2 AWG.
2.07 ACCESSORIES

A. Unit status indicators:
   1. Provide red and green solid-state indicators, with printed labels, on the front cover to redundantly indicate on-line unit status:
      a. The absence of the green light and the presence of the red light indicate that surge protection is reduced and service is needed to restore full operation.
      b. Indicates the status of protection on each mode or phase.

B. Dry contacts for remote monitoring:
   1. Electrically isolated Form C dry contacts (1 A/125 VAC) for remote monitoring of system integrity, and indication of under voltage, phase and/or power loss.

C. Provide an audible alarm which activates under any fault condition.
   1. Provide an alarm On/Off switch to silence the alarm.
   2. A visible LED will confirm whether alarm is On or Disabled.
   3. Locate both switches and the audible alarm on the unit’s front cover.

D. Provide transient counter to count transient voltage surges:
   1. LCD readout located on the unit’s front cover.
   2. Counter to utilize batteries with a 10-year nominal life or non-volatile memory to maintain accurate counts in the event of power loss.
   3. If a dedicated breaker for the SPD is not provided in the switchboard, the service entrance SPD shall include an integral UL listed disconnect switch. A dedicated breaker shall serve as means of disconnecting for distribution SPDS.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

A. Permanently affix surge rating to the SPD.

B. Perform Manufacturer's standard factory test.
   1. Perform testing in accordance with UL 1449.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)
3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 16000 and other pertinent sections of the plans and specifications.

B. Follow the manufacturer's recommended installation practices and comply with all applicable codes.
C. Special techniques:
   1. Install the SPD with as short and straight conductors including ground conductor as practically possible:
      a. Twist the input conductors together to reduce input conductor inductance.
   2. Interconnect the SPD to the power system using a Manufacturer-supplied interconnection cable consisting of low impedance coaxial cables installed in a flexible conduit.
   3. Do not subject SPD to insulation resistance testing.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL
   A. As specified in Section 16950.

3.08 ADJUSTING (NOT USED)

3.09 CLEANING (NOT USED)

3.10 DEMONSTRATION AND TRAINING (NOT USED)

3.11 PROTECTION
   A. As specified in Section 16050.

3.12 SCHEDULES (NOT USED)

END OF SECTION
PART 1  GENERAL

1.01  SUMMARY

A. Section includes:
   1. Fusible and non-fusible disconnect switches.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Submittal Procedures.
      b. Commissioning and Process Start-up.
      c. Section 16000 - Common Work Results for Electrical.
      d. Section 16075 - Identification for Electrical Systems.
      e. Section 16305 - Electrical System Studies.

1.02  REFERENCES

A. As specified in Section 16000.

B. Underwriters Laboratories Inc. (UL):
   1. 20 - General-Use Snap Switches.
   2. 98 - Enclosed and Dead-Front Switches.
   3. 508 - Standard for Industrial Control Equipment.

C. National Electric Manufacturer's Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment.

1.03  DEFINITIONS

A. As specified in Section 16000.

B. Specific definitions:
   1. Safety switches and disconnect switches are to be considered synonymous.
1.04 SYSTEM DESCRIPTION

A. Provide heavy-duty type disconnect switches as indicated on the Drawings and specified in the Contract Documents.

B. Provide disconnect switches with the number of poles, voltage, current, short circuit, and horsepower ratings as required by the load and the power system.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 16000 and other pertinent sections of the plans and specifications.

B. Product data:
   1. Manufacturer.
   2. Manufacturer's specifications and description.
   3. Ratings:
      a. Voltage.
      b. Current.
      c. Horsepower.
      d. Short circuit rating.
   4. Fused or non-fused.
   5. NEMA enclosure type.
   6. Dimensions:
      a. Height.
      b. Width.
      c. Depth.
   7. Weight.
   8. Cross-referenced to the disconnect schedule indicated on the Drawings.

C. Shop drawings:
   1. Manufacturer's installation instructions:
      a. Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance, Regulatory Requirements below.
      b. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
   2. Identify motor or equipment served by each switch; indicate nameplate inscription.

D. Installation instructions:
   1. Provide anchorage instructions and requirement based on the seismic requirements at the Project Site as specified in Section 16050 and calculations:
      a. Stamped by a professional engineer registered in the state where the Project is being constructed.

1.06 QUALITY ASSURANCE

A. As specified in Sections 16000 and other pertinent sections of the plans and specifications.

B. Regulatory requirements:
   1. NEMA KS1- Enclosed and Miscellaneous Distribution Switches (600 V Maximum).
2. UL 98 - Enclosed and Dead-Front Switches.

C. Disconnect switches shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Sections 16000 and other pertinent sections of the plans and specifications.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Sections 16000 and other pertinent sections of the plans and specifications.

1.09 SEQUENCING

A. Conduct the initial fault current study as specified in Section 16305 and submit results for Engineer’s review.

B. After successful review of the initial fault current study, submit complete equipment submittal.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Sections 16000 and other pertinent sections of the plans and specifications.

1.12 SYSTEM START-UP

A. As specified in Sections 16000 and other pertinent sections of the plans and specifications.

B.

1.13 OWNER’S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Schneider Electric/Square D Company.
   4. Siemens.
   5. Appleton.

2.02 EXISTING PRODUCTS (NOT USED)
2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT

A. Switch mechanism:
   1. Quick-make, quick-break heavy-duty operating mechanisms:
      a. Provisions for padlocking the switch in the Off position.
      b. A minimum of 90-degree handle travel position between Off and On positions:
         1) Provide handle position indicators to identify the handle position.
      c. Full cover interlock to prevent opening of the switch door in the On position and to prevent closing the switch mechanism with the door open:
         1) With an externally operated override.

B. Switch interior:
   1. Switch blades visible when the switch is Off and the cover is open.
   2. Lugs:
      a. Front accessible.
      b. Removable.
      c. UL listed for 60/75-degree Celsius copper conductors.
   3. Current carrying parts completely plated to resist corrosion.
   4. Removable arc suppressors to facilitate easy access to line side lugs.
   5. Furnish equipment ground kits for every switch.

C. Fused switches:
   1. Furnish with fuses as indicated on the Drawings:
      a. Provide fuses as specified in Section 16494.
   2. UL approved for field conversion from standard Class H fuse spacing to Class J fuse spacing:
      a. Ratings 100 amperes through 600 amperes at 240 volts.
      b. Ratings 30 amperes through 600 amperes at 600 volts.
      c. Provide spring reinforced and plated fuse clips.

D. Ratings:
   1. UL horsepower rated for AC or DC with the rating not less than the load served.
   2. Current:
      a. 30 to 1,200 amperes.
   3. Voltage:
      a. 250 volts AC, DC.
      b. 600 volts (30 A to 200 A, 600 volts DC).
   4. Poles:
      a. 2, 3, 4, and 6 poles.
   5. UL listed short circuit ratings:
      a. 10,000 RMS symmetrical amperes when used with or protected by Class H or K fuses (30-600 amperes).
      b. 200,000 RMS symmetrical amperes when used with or protected by Class R or J fuses (30-600 amperes employing appropriate fuse rejection).
      c. 200,000 RMS symmetrical amperes when used with or protected by Class L fuses (800-1,200 amperes).
   6. Where not indicated on the Drawings, provide switches with the NEMA ratings specified in Section 16050 for the installed location.

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E. Size, fusing and number poles as indicated on the Drawings or as required:
   1. Provide solid neutral where indicated on the Drawings.

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

A. Disconnect switches to have provisions for a field installable “B” type electrical interlock for position indication as indicated on the Drawings.

B. Disconnect switches to have provisions for a field installed insulated groundable neutral kit as indicated on the Drawings.

C. NEMA Type 7 and 9 enclosures furnished with drain and breather kit when used in outdoor applications.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Sections 16000 and other pertinent sections of the plans and specifications.

B. Install the equipment in accordance with the accepted installation instructions and anchorage details to meet the seismic and wind load requirements at the Project site.

C. General:
   1. Use Myers hubs or bolt-on hubs for all conduit penetrations on NEMA Type 12, Type 4, and Type 4X enclosures.
   2. Provide all mounting brackets, stands, supports and hardware as required:
      a. Match finish and materials for all brackets, stands, and hardware with the switch installed.
      b. Provide adequate supporting pillar(s) for disconnect switches in accordance with the approved seismic calculations, and locate aboveground or above decks, where there is no structural wall or surface for box.
   3. When possible, mount switches rigidly to exposed building structure or equipment structural members:
      a. For NEMA Type 4 and Type 4X locations, maintain a minimum of 7/8 inch air space between the enclosure and supporting surface.
b. When mounting on preformed channel, position channel vertically so that water may freely run behind the enclosure.

4. Provide a nameplate for each disconnect switch:
   a. Provide per requirements specified in Section 16075.
   b. Identify voltage, circuit, fuse size, and equipment served on the nameplate.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING AND PROCESS START-UP
   A. As specified in pertinent Sections

3.08 FIELD QUALITY CONTROL
   A. As specified in Sections 16000 and other pertinent sections of the plans and specifications.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING
   A. As specified in Sections 16000 and other pertinent sections of the plans and specifications.

3.11 PROTECTION
   A. As specified in Sections 16000 and other pertinent sections of the plans and specifications.

3.12 SCHEDULES (NOT USED)

END OF SECTION
SECTION 16444
LOW VOLTAGE MOTOR CONTROL CENTERS

PART 1  GENERAL

1.01  SUMMARY

A.  Section includes:
   1.  Low voltage intelligent motor control centers.

B.  Related sections:
   1.  The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2.  It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3.  The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a.  Section 01330 – Submittal Procedures.
      b.  Section 16000 – Common Work Results for Electrical.
      c.  Section 16075 – Electrical Identification.
      d.  Section 16123 – 600 Volt or Less Wires and Cables.
      e.  Section 16150 – Low Voltage Wire Connections.
      f.  Section 16262 – Variable Frequency Drives 0.50 – 50 Horsepower.
      g.  Section 16264 – Variable Frequency Drives 60-500 Horsepower.
      h.  Section 16272 – Dry Type Transformers.
      i.  Section 16281 – Harmonic Filters.
      j.  Section 16285 – Surge Protective Devices.
      k.  Section 16305 – Electrical System Studies.
      l.  Section 16412 – Low Voltage Molded Case Circuit Breakers.
      m.  Section 16422 – Motor Starters.
      n.  Section 16445 – Panelboards.
      o.  Section 16494 – Low Voltage Fuses.

1.02  REFERENCES

A.  As specified in Section 16000.

B.  National Electrical Manufacturer's Association (NEMA):
   1.  ICS 18-2001 – Motor Control Centers.
   2.  ICS 2-322.

C.  Underwriters Laboratories (UL):
   1.  845 – Motor Control Centers.
   2.  489 – Molder Case Circuit Breakers.
1.03 DEFINITIONS

A. As specified in Section 16000.

B. Intelligent Motor Control Center- Motor Control Center incorporating motor control, protection, power monitoring, communication and automation interfacing for each motor management device.

1.04 SYSTEM DESCRIPTION

A. Factory assembled, factory wired and factory tested intelligent motor control centers:
   1. Motor control centers and major components to be products of a single manufacturer including, but not limited:
      a. Starters.
      b. VFD.
      c. RVSS.
      d. Power Management Devices.
      e. IMCC PLC.
      f. Human Machine Interface Panel (HMI).
      g. Network Gateway.
      h. Power Supplies.
      i. Surge Protection Devices (SPDs).
      j. Pilot Lights, Selector Switches, Relays, and Accessories.
      k. Active harmonic filters for 6-pulse variable frequency drives, as referred in spec section 16281.
      l. Related equipment specified in the Contract Documents or indicated on the Drawings.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 16000 and other pertinent sections of the Plans and Specifications.

B. Product data:
   1. Manufacturer of motor control center.
   2. Manufacturer of motor control center parts.
   3. Nameplate schedule.
   4. Bill of material.
   5. Enclosure:
      a. NEMA rating.
      b. Finish color.
   6. Ratings:
      a. Voltage.
      b. Phase.
      c. Current:
         1) Horizontal bus ampacity.
         2) Vertical bus ampacity.
         3) Ground bus ampacity.
      d. Short circuit withstand rating.
      e. Protective device interrupting rating.
   7. List of recommended spare parts.
8. Catalog cut sheets:
   a. Submit complete Manufacturer’s catalog information:
      1) Clearly indicate the features of the equipment including any options necessary to meet the required functionality.

9. Furnish circuit breaker submittals as specified in Section 16412. For equipment installed in structures designated as seismic design category C, D, E, or F submit the following as specified in Section 16000:
   a. Manufacturer’s statement of seismic qualification with substantiating test data.
   b. Manufacturer’s special seismic certification with substantiating test data.


11. Internal communication media and communicating protocol.


13. Power supply product data.


C. Shop drawings:
   1. Layout drawings:
      a. Provide fully dimensioned and to scale layout drawings which include:
         1) Dimensions:
            a) Overall length.
            b) Overall width.
            c) Overall height.
            d) Overall weight and weight of individual shipping splits.
   2. Interfaces to other equipment.
   3. Shipping splits.
   4. Allowable top and bottom conduit windows.
   5. Complete component and unit layout drawings.
   6. Indicate lug sizes, type, and Manufacturer based on the cable size specified in the Contract Documents and as indicated on the Drawings.
   7. Elementary schematics:
      a. Provide one custom schematic diagram for each compartment:
         1) Include all remote devices.
         2) Show wire numbers on the schematics:
            a) Provide wire numbering as specified in Section 16075.
   8. External connection diagram showing the wiring to the external controls and devices associated with the motor control center.
   9. One-line diagrams:
      a. Provide complete one-line diagrams for each motor control center, including but not limited to: protective devices, starters, drives, metering, and other equipment.
      b. Indicate electrical ratings of the equipment shown on the one-line diagrams.

D. Installation instructions:
   1. Detail the complete installation of the equipment including rigging, moving, and setting into place.
   2. For equipment installed in structures designated as seismic design category A or B:
      a. Provide manufacturer’s installation instructions and anchoring details for connecting equipment to supports and structures.
3. For equipment installed in structures designated as seismic design category C, D, E, or F:
   a. Provide project-specific installation instructions and anchoring details based on support conditions and requirements to resist seismic and wind loads as specified in Section 16050.
   b. Submit anchoring drawings with supporting calculations.
   c. Drawings and calculations shall be stamped by a professional engineer registered in the state where the Project is being constructed.

E. Operation and maintenance manuals:
   1. Provide complete operating and maintenance instructions presenting full details for care and maintenance of all types of equipment furnished and/or installed under this Section. Include the following:
      a. Electrical ratings:
         1) Phase.
         2) Wire.
         3) Voltage.
         4) Ampacity.
         5) Bus bracing and protective device interrupting ratings.
      b. Manufacturer’s operating and maintenance instructions for the motor control center and all component parts, including:
         1) Starters.
         2) Overload relays and heater elements.
         3) Variable frequency drives.
         4) Protective devices including, but not limited to, fuses, circuit breakers, and protective relays.
         5) Pilot devices.
      c. Complete renewal parts list.

F. Record Documents:
   1. Elementary schematics:
      a. Furnish as-built elementary schematics indicating final:
         1) Wire numbers.
         2) Interfaces with other equipment.
      b. Provide one custom schematic diagram for each compartment:
         1) Include all remote devices.
         2) Show wire numbers on the schematics.
      c. Layout drawings: Provide complete dimensioned component and unit layout drawings.
   2. The Record Documents shall reflect all modifications made during the submittal review process and during construction.

G. Calculations:
   1. Detailed calculations or details of the actual physical testing performed on the motor control center to prove the motor control center is suitable for the seismic requirements at the Project site.

1.06 QUALITY ASSURANCE

A. As specified in Section 16000 and other pertinent sections of the Plans and Specifications.
B. All portions of the motor control center, vertical bays, and components shall be UL listed and labeled.

1.07 DELIVERY, STORAGE AND HANDLING

A. As specified in Section 16000 and other pertinent sections of the Plans and Specifications.

B. Ship the motor control center and associated equipment to the job site on a dedicated air ride vehicle that will allow the Contractor to utilize on-site off-loading equipment.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16000 and other pertinent sections of the Plans and Specifications.

1.09 SEQUENCING

A. Conduct the initial fault current study as specified in Section 16305 and submit results for Engineer’s review.

B. After successful review of the initial fault current study, as specified in Section 16305, submit complete equipment submittal as specified in the Submittals article of this Section for Engineer’s review.

C. Conduct internal factory test to ensure that systems and equipment are functional and submit certified test results for Engineer’s review.

D. Assemble equipment in the field.

E. Conduct field acceptance test and submit results for Engineer’s review.

F. Submit manufacturer’s certification that the equipment has been properly installed and is fully functional for Engineer’s review.

G. Conduct Owner’s training sessions.

H. Formally energize, start-up and commission equipment.

1.10 SCHEDULING

A. As specified in Section 16000 and other pertinent sections of the Plans and Specifications.

1.11 WARRANTY

A. As specified in Section 16000 and other pertinent sections of the Plans and Specifications.

1.12 SYSTEM START-UP

A. Provide with onsite services as specified in section 01756.
PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with performance and dimensional criteria, approved manufactures shall be one of the following or equal:
   1. Allen-Bradley.
   3. Schneider Electric/Square D.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT

A. General:
   1. Furnish motor control centers as specified in the Contract Documents and indicated on the Drawings.
   2. Arrange the equipped sections side by side and/or back-to-back to form continuous motor control center lineups as indicated on the Drawings:
      a. Identify any deviations from the Drawings in writing and submit for approval.
   3. Provide wire markers at each end of every wire as specified in Section 16075.
   4. Provide complete and functional motor control centers.
   5. Provide devices or accessories not specified in this Section but necessary for the proper installation and operation of the equipment.

B. Design and construct motor control center to operate at the voltage level and configuration indicated on the Drawings.

C. Bus system:
   1. Material:
      a. Tin-plated copper.
      b. Short-circuit rating:
         1) All power bus shall be braced to withstand a fault current equal to or greater than the AIC rating indicated on the Drawings.
      c. Bus bar supports:
         1) High impact strength, non-tracking glass-polyester material that is impervious to moisture and gases.
   2. Horizontal power bus:
      a. Fully sized to carry 100% of the rated current indicated on the drawings the entire length of the iMCC. Tapered horizontal bus not acceptable.
b. Mounting:
   1) Mount horizontal bus bars edgewise at the top of the MCC, one above the other, and fully isolated from all wireways and units.

c. Temperature rise:
   1) In accordance with UL 845.
   2) De-rate the temperature rating of the bus for the specified conditions of ambient temperature and altitude as specified in Section 16050.

3. Vertical power bus:
   a. Current-carrying capacity of not less than 300 amps.
   b. Mounting:
      1) Enclose the vertical bus in a polyester-glass cover with small openings to permit unit stabs to mate with the bus:
         a) Provide automatic shutter mechanism to cover the stab openings when plug-in units are removed. Unused stab openings shall be provided with automatic shutter mechanisms.
      2) Provide top and bottom bus covers for insulation and isolation of the ends of the bus.
   c. Isolated from the unit compartments by a full-height barrier.

4. Neutral bus:
   a. Provided in 4-wire motor control centers as indicated on the Drawings.
   b. Current carrying capacity of 100 percent of horizontal power bus.
   c. Mounting:
      1) Bus shall extend the full width of the motor control center.
   d. Pre-drilled and furnished with lugs for attachment of neutral conductors:
      1) Furnish a minimum of 50 percent spare lugs in each vertical section of motor control center.

5. Ground bus:
   a. Horizontal ground bus:
      1) Current-carrying capacity of not less than 600 amps.
      2) Mounting:
         a) Full-width, firmly secured to each vertical section structure:
            (1) Located in the top or bottom wireway.
         b) Pre-drilled and furnished with lugs for connection to equipment ground wires:
            (1) Furnish a minimum of 10 lugs per vertical section of MCC.
   b. Vertical ground bus:
      1) Mounting:
         a) Furnish in each vertical section.
         b) Bolted to the horizontal ground bus.
         c) Install parallel to the vertical power bus.
         d) Mount vertical ground bus such that plug-in units engage the ground bus before any connection to the power bus is made. Upon removal of plug-in units, ground stabs are disconnected from the ground bus after the power stabs have been disconnected.
         e) Ground bus shall be equipped with load terminals.

6. Bus splice bars:
   a. Provided to join the bus at the splits.
   b. Connected to each horizontal bus bar with a minimum of two bolts.
   c. Employ conical or spring washers at connections, designed to maintain constant pressure against the splice joint.
   d. Same ampacity rating as the horizontal bus.
   e. Connecting hardware shall be designed to be tightened from the front of
the iMCC without applying any tools to the rear of the connection.
7. Provide bus system configured for back-to-back MCCs, where required.

D. Enclosures:
1. Each motor control center shall consist of 1 or more vertical sections bolted together:
   a. Freestanding.
   b. Totally enclosed.
   c. Dead-front assembly.
   d. Designed for modification and/or addition of future vertical sections.
   e. Form each vertical section of heavy gauge steel.
   f. Designed for back-to-back arrangement installation, where required and/or as indicated on the Drawings.
2. Enclosure rating:
   a. Indoor:
      1) NEMA Type 1 with gasketed doors.
3. Standard section dimensions:
   b. Nominal depth: 20 inches.
   c. Vertical section width as indicated on the Drawings.
4. Wireways:
   a. Provide each vertical section with a horizontal wireway at the top and bottom of the section:
      1) Arranged to provide a full-width metal enclosed wiring trough across the entire motor control center assembly.
   b. Provide each vertical section with a full-height vertical wireway. The rear surface of the wireway shall be painted white.
   c. Completely isolated from the vertical and horizontal bus bars.
   d. Provide a removable, hinged door.
5. Shipping splits:
   a. No more than 3 vertical sections and not more than 60 inches in width.
   b. Solid bussing between vertical sections in a shipping split is not acceptable.
6. Lifting angles:
   a. Furnish each vertical section and/or shipping split with a removable lifting angle mounted to the top of the enclosure:
      1) Extending the entire width of the shipping split.
7. Mounting channels:
   a. Mount each vertical section and/or shipping split on an external 1.5-inch by 3-inch mounting channel.

E. Units:
1. A plug-in unit consists of:
   a. Unit assembly.
   b. Unit support rails.
   c. Unit door assembly.
2. Completely enclosed and isolated from adjacent units, buses, and wireways, except for conductor entries into the unit, by a metal enclosure.
3. Constructed so that any fault will be contained in the unit compartment.
4. Supported and guided by a removable unit support pan:
   a. Re-arrangement of units and the removal of a unit so that a new and possibly larger unit can be added without the removal of an in-service unit to gain access to the unit support pan.
5. Held in place by screws or other positive locking means after insertion.
6. Provide a test position with the unit supported in the structure but disengaged from the bus.
7. Integral plug-in ground stab.
8. Stabs:
   a. Free floating.
   b. Self-aligning.
   c. Backed by spring steel clips to ensure high pressure contacts:
   d. Electrolytically tin-plated copper.
9. Handle:
   a. Provide a flange mounted handle mechanism to operate each disconnect switch or circuit breaker.
   b. Door mounted operators or operator handles are not acceptable.
   c. Engaged with the disconnect device at all times as an integral part of the unit independent of the door position.
   d. Lockable in the “OFF” position with up to 3 padlocks.
   e. Mechanically interlocked so that the door cannot be opened with the handle in the “ON” position.
      1) Provide a means for qualified personnel to defeat this interlock.
   f. Interlocked so the unit cannot be inserted or withdrawn with the handle in the “ON” position.
   g. Lockable in the “ON” position:
      1) This shall not prevent the circuit breaker from operating and opening the contacts in the event of a fault condition.
   h. Color-coded to indicate position.
   i. Located so the center of the grip when it is in its highest position is not more than 6 feet 7 inches above the finished floor, including the height of the housekeeping pad and mounting channels.
10. Where indicated on the Drawings, provide units for spaces and future equipment:
   a. Equip these units to accept a future plug-in unit without modification to the vertical sections.
11. Pilot device contacts shall be rated at 10A, 600VAC (NEMA A600).
12. Unit identification nameplate shall be provided for each unit in accordance with Section 16075 on the front of the unit.

F. Communication equipment:
1. Furnish motor control centers with a factory installed Ethernet/IP communications network.
2. Provide internal gateways, Ethernet switches (Non-managed), and repeaters as required.
3. The Ethernet/IP network shall include a complete and tested cabling system compliant with and approved by the ODVA (Open Device Vendors Association) Ethernet/IP Standard.
4. Ethernet/IP network:
   a. CAT6E cable.
5. Accessories:
   a. Provide the motor control center with a 24 volt DC power supply to provide power to all communication devices in the motor control center:
      1) Installed in a motor control center compartment.
      2) Furnished with a disconnect switch, supplementary protection and a cable tap box to prevent damage to/from other power supplies on the network.

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3) Capable of communicating on the EtherNet/IP network and act as one node on the Ethernet/IP network.

b. Furnish 2 male and 2 female terminating resistors.

6. Harmonics:
   1) A harmonic distortion analysis shall be performed and priced as a separate line item by the AC Drive manufacturer based upon system documentation supplied by the contractor. The documentation shall consist of one-line diagrams, distribution transformer information (kVA, %Z, and X/R ration) and emergency standby generator performance specifications. The harmonic distortion analysis report shall be part of the approval drawing process, submitted to the engineer for approval. If the calculations determine that harmonic distortion values are higher than the voltage and current values specified in IEEE 519-1992, the drive manufacturer shall provide line reactors of sufficient percent impedance to meet the IEEE specified values. The line reactor shall be ventilated in the iMCC and shall be completely factory wired and tested with the AC Drive controller unit. Coordinate and report with Section 16305 and 16264.

2.06 COMPONENTS

A. Provide components contained within the motor control center as specified in:
   1. Section 16075.
   2. Section 16123.
   3. Section 16150.
   4. Section 16262.
   5. Section 16272.
   6. Section 16285.
   7. Section 16412.
   8. Section 16422.
   9. Section 16445.
  10. Section 16494.
  11. Section 17710.

2.07 ACCESSORIES

A. Wiring:
   1. Wire the motor control center in accordance with the following NEMA Class and Type as defined by NEMA ICS 18-2001:
      a. NEMA Class II-S:
         1) Furnish wiring diagrams for individual units consisting of drawings that identify electrical devices, electrical connections, and indicate terminal numbering designations.
         2) Furnish individual unit diagrams with each unit and include inter-wiring between units, i.e. electrical interlocking, etc.
         3) Provide custom drawings with unique terminal numbering designations in lieu of standard Manufacturer drawings.
      b. NEMA Type B wiring:
         1) Control wiring:
            a) Type B-T pull-apart terminal blocks.
         2) Power wiring:
            a) Type B-T for Size 1 starters.
            b) Type B-T or B-D for Size 2 and 3 starters.
            c) Type B for Size 4 and larger starters and feeder units.
B. Lugs and terminals:
1. For all external connections of No. 6 AWG wire or larger:
   a. UL listed for copper or aluminum conductors.
2. Compression type, requiring a hydraulic press and die for installation.
3. Provide 20 percent spare control block terminals.

C. Nameplates:
1. Provide nameplates as specified in Section 16075:
   a. Identifying the motor control center designation as indicated on the Drawings.
2. Identifying each vertical section:
   a. Mounted and centered on the top horizontal wireway of the vertical section.
3. Furnish individual nameplates for each unit indicated on the Drawings:
   a. 1 nameplate to identify the unit designation.
   b. 1 nameplate to identify the load served.
   c. Furnish space units with blank nameplates.
4. Manufacturer's labels:
   a. Furnish each vertical section with a label identifying:
      1) Serial number.
      2) Bus rating.
      3) Vertical section reference number.
      4) Date of manufacture.
      5) Catalog number of section.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES
A. Finish metal surfaces and structural parts with phosphatizing, or equal, treatment before painting.
B. Finish interior surfaces including bus support angles, control unit back plates, and top and bottom barrier plates with baked white enamel.

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)
3.03 INSTALLATION

A. As specified in Section 16050.

B. Install the equipment in accordance with the accepted installation instructions and anchorage details to meet the seismic and wind load requirements at the Project site.

C. General:
   1. Furnish all cables, conduit, lugs, bolts, expansion anchors, sealants, and other accessories necessary to completely install the motor control center for the line, load, and control connections.
   2. Assemble and install the motor control center in the locations and with the layouts as indicated on the Drawings.
   3. Make bus splice connections.
   4. Perform work in accordance with manufacturer’s instruction and shop drawings.
   5. Furnish all components, and equipment necessary to complete the installation.
   6. Replace hardware, lost or damaged during installation or handling, in order to provide a complete installation.
   7. Install the iMCC on a 3-1/2-inch raised concrete housekeeping pad:
      a. Provide structural leveling channels in accordance with the manufacturer’s recommendations to provide proper alignment of the units.
         1) Remove the manufacturer’s supplied mounting channels as required by the manufacturer’s installation instructions.
      b. Weld and/or bolt the motor control center frame to leveling channels.

D. Provide openings in the top or bottom of the motor control center for conduit only.
   1. No additional openings will be accepted:
      a. Mis-cut holes will require that the entire vertical section or removable panel be replaced.
      b. No hole closers or patches will be accepted.

E. Bundle circuits together and terminate in each unit:
   1. Tie with nylon wire ties as specified in Section 16123.
   2. Label all wires at each end with wire markers as specified in Section 16075 as shown on the approved elementary schematics.

3.04 ERECTION, INSTALLATION, APPLICATION CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 REINSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL

A. As specified in Section 16050.

B. Provide the services of a manufacturer’s representative to:
   1. Inspect, verify, and certify that the motor control center installation meets the manufacturer’s requirements.
3.08 ADJUSTING
   A. Make all adjustments as necessary and recommended by the manufacturer, Engineer, or testing firm.

3.09 CLEANING
   A. As specified in Section 16050.

3.10 DEMONSTRATION AND TRAINING
   A. As specified in Section 16050.
   B. Demonstrate the operation of the motor control center to the Engineer’s and Owner’s satisfaction.
   C. Training:
      1. Provide training for motor control center components as specified in the individual component specifications.

3.11 PROTECTION
   A. As specified in Section 16050.

3.12 SCHEDULES (NOT USED)

END OF SECTION
SECTION 16600
ELECTRICAL ACCEPTANCE TESTING

PART 1 GENERAL

1.01 SCOPE:

A. Perform acceptance testing of electrical apparatus and circuits described herein to determine suitability for energization and operation. It is the intent of these specifications to assure that the completed electrical installation is installed in accordance with the design drawings and specifications and is operational with industry and manufacturer's tolerance.

B. Provide all material, equipment, labor and technical supervision to perform tests and inspections as described herein.

1.02 REFERENCES:

A. All inspections and field tests shall be in accordance with the latest edition of the following codes, standards, and specifications except as provided otherwise herein.

1. American National Standards Institute- ANSI

   ASTM D 971. Test Method for Interfacial Tension of Oil Against Water by the Ring Method.
   ASTM D 974. Test Method for Acid and Base Number by Color-Indicator Titration.


ANSI/IEEE C57, *Distribution, Power and Regulating Transformers.*

ANSI/IEEE C62, *Surge Protection*

ANSI/IEEE Std. 43. *IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery.*

ANSI/IEEE Std. 48. *IEEE Standard Test Procedures and Requirements for High-Voltage AC Cable Terminations*


ANSI/IEEE Std. 95. *IEEE Recommended Practice for Insulation Testing of Large AC Rotating Machinery with High Direct Voltage.*


ANSI/IEEE Std. 242. *IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Book).*

ANSI/IEEE Std. 399. *IEEE Recommended Practice for Power Systems Analysis (Brown Book).*


ANSI/IEEE Std. 446. *IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications (Orange Book).*


1.03 QUALIFICATIONS OF TESTING FIRM:

A. The testing firm shall be a independent testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.

B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

C. The lead, on site, technical person shall be currently certified by the International Electrical Testing Association (NETA) or the National Institute for...
Certification in Engineering Technologies (NICET) in electrical power distribution system testing.

D. The testing firm shall utilize technicians who are regularly employed by the firm for testing services.

E. The testing firm shall submit proof of the above qualifications in accordance with Par. 1.06.

1.04 TEST EQUIPMENT:

A. Suitability of Test Equipment

1. All test equipment shall be in good mechanical and electrical condition.

2. Split-core current transformers and clamp-on or tong-type ammeters require careful consideration of the following in regard to accuracy:
   a. Position of the conductor within the core.
   b. Clean, tight fit of the core pole faces.
   c. Presence of external fields.
   d. Accuracy of the current transformer ratio in addition to the accuracy of the secondary meter.

3. Selection of metering equipment should be based on a knowledge of the waveform of the variable being measured. Digital multimeters may be average or RMS sensing and may include or exclude the dc component. When the variable contains harmonics or dc offset and, in general, any deviation from a pure sine wave, average sensing, RMS scaled meters may be misleading.

4. Field test metering used to check power system meter calibration must have an accuracy higher than that of the instrument being checked.

5. Accuracy of metering in test equipment shall be appropriate for the test being performed but not in excess of two percent of the scale used.

6. Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and tested equipment.

B. Test Instrument Calibration

1. The testing form shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

2. The accuracy shall be directly traceable to the National Institute of Standards and Technology (NIST).

3. Instruments shall be calibrated in accordance with the following frequency schedule:
   a. Field instruments: Analog, 6 months maximum; Digital, 12 months maximum
   b. Laboratory instruments: 12 months
c. Leased specialty equipment: 12 months where accuracy is guaranteed by lessor.

d. Dated calibration labels shall be visible on all test equipment.

e. Records, which show date and results of instruments calibrated or tested, must be up-to-date and shall be submitted in accordance with Par. 1.06.

f. Up-to-date instrument calibration instructions and procedures shall be maintained for each test instrument.

g. Calibrating standard shall be of higher accuracy than that of the instrument tested.

1.05 DIVISION OF RESPONSIBILITY:

A. The independent testing contractor shall perform all tests as listed in this Section.

B. The installation contractor may perform tests which are described in other specification sections. These include insulation resistance and continuity tests on low voltage equipment and circuits and high potential testing of medium voltage cable.

1.06 SUBMITTALS- FOR APPROVAL:

A. Qualifications Statement:

1. Experience record on proposed testing firm to include client contact names and telephone numbers.

2. Experience record on technicians who will perform testing work.

B. Test Equipment

1. Schedule of test equipment to be used for project.

2. Calibration records for each item of test equipment.

1.07 SUBMITTALS- FOR CLOSE OUT

A. Field Test Reports- Submit the following data bound and indexed in a 3 ring loose leaf binder.

1. Summary of project.

2. Description of equipment tested and nameplate data.

3. Description of tests.

4. Test results.

5. List of deficiencies observed and corrective action taken, if any.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 FIELD TESTS

A. Perform field tests and listed herein. Test procedures shall be in accordance with NETA Acceptance Testing Specifications. Dielectric test voltages applied to circuits and to equipment shall not exceed values or duration recommended by the equipment manufacturer.

B. Low Voltage Motor Starters:

1. Visual and Mechanical Inspection
   a. Compare equipment nameplate data with drawings and specifications.
   b. Inspect physical and mechanical condition.
   c. Inspect and adjust contact gap, wipe, alignment, and pressure in accordance with manufacturer's published data.
   d. Motor-Running Protection
      1) Compare overload element rating with motor full-load current rating to verify correct sizing.
      2) If power-factor correction capacitors are connected on the load side of the overload protection, include the effect of the capacitive reactance in determining appropriate overload element size.
      3) If motor-running protection is provided by fuses, verify correct rating considering motor characteristics and power-factor correction capacitors.
   e. Inspect all bolted electrical connections for high resistance using one of the following methods:
      1) Use of low-resistance ohmmeter.
      2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
      3) Perform thermographic survey.

2. Electrical Tests
   a. Insulation Tests
      1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.
      2) Measure insulation resistance of each combination starter, phase-to-phase and phase-to-ground, with the starter contacts closed and the protective device open. Refer to manufacturer's instructions for devices with solid-state components.
      3) Measure insulation resistance of each control circuit-to-ground.
      4) Perform an insulation resistance test at 1000 volts de on all control wiring. For units with solid-state components, follow manufacturer's recommendations.
b. Test the motor overload relay elements by injecting primary current through the overload circuit and monitoring trip time of the overload element. 

NOTE: Test times for thermal trip units will, in general, be longer than manufacturer's curve if single-pole testing is performed. Optionally test with all poles in series for time test and each pole separately for comparison. (Refer to ANSI/NEMA ICS 2, Part 4.)

c. Test circuit breakers, including motor circuit protectors, in accordance with Section 7.6.1.1.

d. Perform operational tests by initiating control devices.

3. Test Values

a. Compare bolted connection resistance to values of similar connections.

b. Bolt-torque levels should be in accordance with values specified by manufacturer.

c. Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values which deviate from similar connections by more than 50 percent of the lowest value.

d. Insulation-resistance values shall be in accordance with accepted values.

e. Control wiring insulation test resistance should be a minimum of 500 megohms.

f. Overload trip times shall be in accordance with manufacturer's published data.

C. Cables - Low-Voltage, 600 Volt Maximum

1. Visual and Mechanical Inspection

a. Compare cable data with drawings and specifications.

b. Inspect exposed sections of cables for physical damage and correct connection in accordance with single-line diagram.

c. Inspect all bolted electrical connections for high resistance using one of the following methods:

1) Use of low-resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.

d. Perform thermographic survey.

e. Inspect compression-applied connectors for correct cable match and indentation.

f. Verify cable color coding with applicable specifications and the National Electrical Code.

2. Electrical Tests

a. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Test duration shall be one minute.

b. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

c. Perform continuity test to insure correct cable connection.

3. Test Values
a. Compare bolted connection resistance to values of similar connections.
b. Bolt-torque levels should be in accordance with values specified by the manufacturer.
c. Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values which deviate from similar connections by more than 50 percent of the lowest value.
d. Minimum insulation-resistance values should not be less than 500 megohms.
e. Investigate deviations between adjacent phases.

D. Switchgear and Switchboard Assemblies
   1. Visual and Mechanical Inspection
      a. Compare equipment nameplate data with drawings and specifications.
      b. Inspect physical and mechanical condition.
      c. Verify appropriate anchorage, required area clearances, physical damage, and correct alignment
      d. Inspect all doors, panels, and sections for corrosion, dents, scratches, fit, and missing hardware.
      e. Verify that fuse and/or circuit breaker sizes and types correspond to drawings and coordination study as well as to the circuit breaker's address for microprocessor-communication packages.
      f. Inspect all bolted electrical connections for high resistance using one of the following methods:
         1) Use of low-resistance ohmmeter.
         2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
         3) Perform thermographic survey.
      g. Verify that current and potential transformer ratios correspond to drawings.
      h. Compare equipment nameplate data with latest one-line diagram when available.
      i. Confirm correct operation and sequencing of electrical and mechanical interlock systems.
         2) Make key exchange with devices operated in off-normal positions.
      j. Thoroughly clean switchgear prior to testing.
      k. Lubrication
         1) Verify appropriate contact lubricant on moving current-carrying parts.
         2) Verify appropriate lubrication on moving and sliding surfaces.
            i. Inspect insulators for evidence of physical damage or contaminated surfaces.
      m. Verify correct barrier and shutter installation and operation.
      n. Exercise all active components.
      o. Inspect all mechanical indicating devices for correct operation.
      p. Verify that filters are in place and/or vents are clear.
q. Perform visual and mechanical inspection on all instrument transformers.

r. Inspect control power transformers.
   1) Inspect physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
   2) Verify that primary and secondary fuse ratings or circuit breakers match drawings.
   3) Verify correct functioning of drawout disconnecting and grounding contacts and interlocks.

2. Electrical Tests
   a. Perform tests on all instrument transformers.
   b. Perform ground-resistance tests.
   c. Perform resistance tests through all bus joints with a low-resistance ohmmeter, if applicable.
   d. Perform insulation-resistance tests on each bus section, phase-to-phase and phase-to-ground, for one minute.
   e. Perform an overpotential test on each bus section, each phase to ground with phases not under test grounded, in accordance with manufacturer’s published data. The test voltage shall be applied for one minute.
   f. Perform insulation-resistance tests at 1000 volts dc on all control wiring. For units with solid-state components, follow manufacturer’s recommendations.
   g. Perform control wiring performance test.
   h. Perform current injection tests on the entire current circuit in each section of switchgear.
      1) Perform current tests by primary injection, where possible, with magnitudes such that a minimum of 1.0 ampere flows in the secondary circuit.
      2) Where primary injection is impractical, utilize secondary injection with a minimum current of 1.0 ampere.
      3) Test current at each device.
   i. Determine accuracy of all meters and calibrate watthour meters. Verify multipliers.
   j. Perform phasing check on double-ended switchgear to insure correct bus phasing from each source.

k. Control Power Transformers
   1) Perform insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground.
   2) Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to correct secondary voltage. Confirm potential at all devices.
   3) Verify correct secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.
   4) Verify correct function of control transfer relays located in switchgear with multiple power sources.

l. Voltage Transformers

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Square E Engineering LLC
1) Perform insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground.
2) Perform secondary wiring integrity test. Confirm correct potential at all devices.
3) Verify secondary voltages.
m. Verify operation of switchgear/switchboard heaters.

3. Test Values
a. Compare bus connection resistances to values of similar connections.
b. Bolt-torque levels shall be in accordance those specified by manufacturer.
c. Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values which deviate from similar bus by more than 50 percent of the lowest value.
d. Insulation-resistance values for bus, control wiring, and control power transformers shall be in accordance with manufacturer's published data. Values of insulation resistance less than manufacturer's minimum shall be investigated. Overpotential tests should not proceed until insulation resistance levels are raised above minimum values.
e. The insulation shall withstand the overpotential test voltage applied.

E. Circuit Breakers - Low-Voltage - Insulated Case/Molded Case
1. Visual and Mechanical Inspection
a. Compare nameplate data with drawings and specifications.
b. Inspect circuit breaker for correct mounting.
c. Operate circuit breaker to insure smooth operation.
d. Inspect case for cracks or other defects.
e. Inspect all bolted electrical connections for high resistance using one of the following methods:
   1) Use of low-resistance ohmmeter.
   2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer’s published data.
   3) Perform thermographic survey.
f. Inspect mechanism contacts and arc chutes in unsealed units.

2. Electrical Tests
a. Perform a contact-resistance test.
b. Perform an insulation-resistance test at 1000 volts dc from pole-to-pole and from each pole-to-ground with breaker closed and across open contacts of each phase
d. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.
e. Perform insulation resistance tests at 1000 volts dc on all control wiring. Do not perform the test on wiring connected to solid state components.
f. Perform adjustments for final settings in accordance with coordination study supplied by owner.
g. Perform long-time delay time-current characteristic tests by passing 300 percent rated primary current through each pole separately unless series testing is required to defeat ground fault functions.
h. Determine short-time pickup and delay by primary current injection.
i. Determine ground-fault pickup and time delay by primary current injection.
j. Determine instantaneous pickup current by primary injection using run-up or pulse method.
k. Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and antipump function.
l. Verify the calibration of all functions of the trip unit by means of secondary injection.

3. Test Values
   a. Compare bolted connection resistance to values of similar connections.
   b. Bolt-torque levels should be in accordance those specified by manufacturer.
   c. Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values which deviate from similar connections by more than 50 percent of the lowest value.
   d. Circuit breaker insulation resistance should be in accordance manufacturer's published data.
   e. Control wiring insulation resistance should be a minimum of 500 megohms.
   f. Trip characteristic of breakers shall fall within manufacturer's published time-current characteristic tolerance band, including adjustment factors. Circuit breakers exceeding specified trip time at 300 percent of pickup shall be tagged defective.
   g. Instantaneous pickup values of molded-case circuit breakers shall be within tolerances.

F. AC Motors
   1. Visual and Mechanical Inspection
      a. Compare equipment nameplate data with drawings and specifications.
      b. Inspect physical and mechanical condition.
      c. Confirm correct application of manufacturer's recommended lubricants.
      d. Inspect anchorage, and grounding.
      e. Inspect all bolted electrical connections for high resistance using one of the following methods:
         1) Use of low-resistance ohmmeter.
         2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
         3) Perform thermographic survey.
      f. When applicable, perform special tests such as air gap spacing and pedestal alignment.
      g. Verify the absence of unusual mechanical or electrical noise or signs of overheating during initial test run.
   2. Electrical Tests- Induction Motors
a. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.
   1) Motors larger than 200 horsepower: Test duration shall be for ten minutes. Calculate polarization index.
   2) Motors 200 horsepower and less: Test duration shall be for one minute. Calculate the dielectric-absorption ratio.
c. Perform de overpotential tests on motors in accordance with ANSI/IEEE Standard 95.
d. Perform insulation power-factor or dissipation-factor tests.
e. Perform surge comparison tests.
f. Perform insulation-resistance test on pedestal in accordance with manufacturer's published data.
g. Test surge protection devices.
h. Test motor starter.
i. Verify that resistance temperature detector (RTD) circuits conform to drawings. Verify that metering or relaying devices using the RTD's have the correct rating.
j. Verify that the motor space heater is functional.
k. Perform a rotation test to insure correct shaft direction.
l. Measure running current and evaluate relative to load conditions and nameplate full-load amperes.

3. Electrical Tests- Synchronous Motors
a. Perform all tests as indicated above for induction motors.
b. Perform a voltage-drop test on all salient poles.
c. Perform insulation-resistance tests on the main rotating field winding, the exciter-field winding, and the exciter-armature winding in accordance with ANSI/IEEE Standard 43.
d. Perform a high-potential test on the excitation system in accordance with ANSI/IEEE Standard 421B.
e. Measure and record resistance of motor field winding, exciter-stator winding, exciter-rotor windings, and field discharge resistors.
f. Perform front-to-back resistance tests on diodes and gating tests of silicon controlled rectifiers for field application semiconductors.
g. Prior to initial start, apply voltage to the exciter supply and adjust exciter-field current to nameplate value.
h. Verify that the field application timer and the enable timer for the power-factor relay have been tested and set to the motor drive manufacturer's recommended values.
i. Record stator current, stator voltage, and field current by strip chart recorder for the complete acceleration period including stabilization time for a normally loaded starting condition. From the recording determine the following information:
   1) Bus voltage prior to start.
   2) Voltage drop at start.
   3) Bus voltage at motor full-load.
   4) Locked-rotor current.
   5) Current after synchronization but before loading.
   6) Current at maximum loading.
   7) Acceleration time to near synchronous speed.
   8) RPM just prior to synchronization.
   9) Field application time.
   10) Time to reach stable synchronous operation.
j. Plot a V-curve of stator current versus excitation current at approximately 50 percent load to check correct exciter operation.

k. If the range of exciter adjustment and motor loading permit reduce excitation to cause power factor to fall below the trip value of the power-factor relay. Verify relay operation.

4. Test Values
   a. Compare bolted connection resistance to values of similar connections.
   b. Bolt-torque levels should be in accordance with values specified by manufacturer.
   c. Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values which deviate from similar connections by more than 50 percent of the lowest value.
   d. Insulation-resistance test results shall be in accordance with manufacturer's published data. Investigate dielectric absorption ratios less than 1.4 and polarization index ratios less than 2.0 for Class B insulation and Class F insulation. NOTE: Overpotential, and surge comparison tests shall not be made on motors having values lower than those indicated above.
   e. Stator winding de overpotential test voltage shall be in accordance with NEMA publication MG 1, paragraph 3.01. Test results are dependent on ambient conditions, and evaluation is on a withstand basis. If phase windings can be separately tested, values of leakage current may be compared for similar windings.
   f. Vibration amplitudes shall not exceed values shown in manufacturer's published data.
   g. Salient pole voltage drop shall be equal for each pole.
      NOTE: For de tests each pole (or pair of poles) shall not vary more than two percent from the average. An ac test is more sensitive than a de test in determining shorted turns. A pole with shorted turns will have a substantially lower voltage than sound coils. Coils adjacent to coils with shorted turns will exhibit slightly lower voltage.
   h. The measured resistance values of motor-field windings, exciter-stator windings, exciter-rotor windings, and field-discharge resistors shall be compared to manufacturer's recommended values.

G. Adjustable Speed Drive Systems

1. Visual and Mechanical Inspection
   a. Compare equipment nameplate data with drawings and specifications.
   b. Inspect physical and mechanical condition.
   c. Ensure vent path openings are free from debris and that heat transfer surfaces are not fouled by oil, dust, or dirt.
   d. Motor Running Protection
      1) Compare drive overcurrent setpoints with motor full-load current rating to verify correct settings.
      2) If drive is used to operate multiple motors, compare individual overload element ratings with motor full-load current ratings.
      3) Apply minimum and maximum speed setpoints. Confirm setpoints are within limitations of the load coupled to the motor.
   e. Inspect all bolted electrical connections for high resistance using one of the following methods:
      1) Use of low-resistance ohmmeter.
2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.

3) Perform thermographic survey.

2. Electrical Tests
   a. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.
   b. Test the motor overload relay elements by injecting primary current through the overload circuit and monitoring trip time of the overload element. NOTE: Test times for thermal trip units will, in general, be longer than the manufacturer's curve if single-pole testing is performed. Optionally test with all poles in series for time test and each pole separately for comparison (Refer to ANSI/NEMA ICS 2, Part 4.)
   c. Perform startup of drive in accordance with manufacturer's published data. Calibrate drive to the system's minimum and maximum speed control signals.
   d. Perform operational tests by initiating control devices.
      1) Check motor rotation operating on the drive and on the bypass.
      2) Slowly vary drive speed between minimum and maximum. Observe motor and load for unusual vibration. If excessive vibration occurs enter these critical frequencies into the drive's programmed step-over frequencies so operation at these speeds will not occur.
      3) Verify operation of drive from remote start/stop and speed control signals.
      4) Measure and record total harmonic distortion of current and voltage in accordance with IEEE 1159-1995.
   e. Test input circuit breaker by primary injection.
   f. Test for the following parameters in accordance with relay calibration procedures for protective relays:
      1) Input phase loss protection.
      2) Input overvoltage protection.
      3) Output phase rotation.
      4) Overtemperature protection.
      5) DC overvoltage protection.
      6) Overfrequency protection.
      7) Drive overload protection.
      8) Fault alarm outputs.

3. Test Values
   a. Overload test trip times at 300 percent of overload element rating shall be in accordance with manufacturer's published time-current curve.
   b. Harmonic values at the point of common coupling shall be in accordance with ANSI/IEEE 519.
   c. When critical test points are specified, the relay shall be calibrated to specified critical points even though other test points may be out of tolerance.
   d. Bolt-torque levels shall be in accordance with Table 10.12 unless otherwise specified by the manufacturer.
H. Grounding Systems
   1. Visual and Mechanical Inspection
      Verify ground system is in compliance with drawings and specifications.
   2. Electrical Tests
      a. Perform fall-of-potential test or alternative in accordance with IEEE Standard 81 on the main grounding electrode or system.
      b. Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.
   3. Test Values
      a. The resistance between the main grounding electrode and ground should be no greater than five ohms for commercial or industrial systems and one ohm or less for generating or transmission station grounds unless otherwise specified by the owner. (Reference: ANSI/IEEE Standard 142.)
      b. Investigate point-to-point resistance values which exceed 0.5 ohm.

I. Fiber-Optic Cables
   1. Visual and Mechanical Inspection
      a. Compare cable, connector, and splice data with drawings and specifications.
      b. Inspect cable and connections for physical and mechanical damage.
      c. Verify that all connectors and splices are correctly installed.
   2. Electrical Tests
      a. Perform cable length measurement, fiber fracture inspection, and construction defect inspection using an optical time domain reflectometer.
      b. Perform connector and splice integrity test using an optical time domain reflectometer.
      c. Perform cable attenuation loss measurement with an optical power loss test set.
      d. Perform connector and splice attenuation loss measurement from both ends of the optical cable with an optical power loss test set.
   3. Test Values
      a. The optical time domain reflectometer signal should be analyzed for excessive connection, splice, or cable backscatter by viewing the reflected power/distance graph.
      b. Attenuation loss measurement shall be expressed in dB/km. Losses shall be within the manufacturer's recommendations when no local site specifications are available.

END OF SECTION
SECTION 16610

CHART RECORDER

PART 1  GENERAL

1.01  DESCRIPTION

A. The requirements of the General Conditions, Supplementary Conditions, Division I, and Drawings apply to all work herein.

B. Requirements of Division 16.

1.02  SCOPE

A. Provide one Honeywell circular chart recorder for the Final Effluent Flow and NPW Flow including Totalizers to be located in Lab Building.

1.03  QUALITY ASSURANCE

A. Manufacturer Honeywell

PART 2  PRODUCTS

2.01  CHART RECORDER

A. Unit shall have two pens and be capable of accepting up to two inputs. Two pens shall record Plant Effluent Flow and NPW Flow. Unit shall accept a 4-20 ma process variable. Power requirements shall be 120/240 VAC, 50/60 Hz with 20 watts maximum power consumption.

B. The recorder shall have a digital display that continuously displays process variables. Unit shall draw record on a large 10-inch-diameter chart suitable for filing. Unit shall be configurable for one revolution of chart in 8 hours, 24 hours, and 7 days, or X hours per revolution, from 6 to 744.

C. Unit shall be housed in a NEMA 3 molded foamed Noryl case, which can be panel or surface mounted. A plastic windowed, gasketed door shall protect internal components from harsh industrial environments.

D. Provide a package of preprinted charts with a range of 0 to 100 rated for a chart speed of one revolution per 24.
3.01 SUBMITTALS

A. Provide shop drawings as follows:

1. Cut sheets.

2. Dimensioned drawings.

END OF SECTION --
SECTION  16620

Multi-Functional Level Control
System

General

Scope
This section describes the requirements for a multi-functional level controller system. Under this item, the contractor shall furnish and install the multi-functional level controller system, and all associated equipment and accessories as indicated on the plans and as herein specified.

Submittals
The following information shall be included in the submittal for this section:

- Data sheets and catalog literature for system components.
- Interconnection and dimensional drawings.

Basic System Description
The multi-functional level control system (level system) shall employ acoustic echo-ranging technology to determine the distance between the transducer and monitored surface, as a basis for display, output, and digital communication. The level system shall consist of a microprocessor based level controller and an ultrasonic transducer (transducer) for single point operation. The level controller shall be operator configurable to meet specific application requirements by implementation of available signal processing and process control functions, in any allowable combination.

Level Controller Functions

Signal Processing
The level controller shall:

- Employ an ultrasonic transceiver suitable for providing excitation to, and processing resultant signals from the attached ultrasonic transducer.
- Create a digitized echo profile, and apply patented Sonic Intelligence echo processing techniques to select and verify the echo representing the reflective surface monitored.
- Shall employ Auto False Echo Suppression with the ability to automatically reject signals created by obstructions in the sound wave beam path and determine true material level.
- Calculate the distance between the transducer face and reflective surface based on the echo selected. The calculated distance may be converted to represent: material level, differential level*, average level*, space, material volume, vessel ullage, pumped volume, or head, open channel flow rate, and/or total flow volume. (* Additional transducer required.)
- Compensate temperature-induced variation in the acoustic wave propagation velocity in air. This compensation shall be based on the
signals received from the ultrasonic transducer, and/or a TS-3
temperature sensor, or an operator entered value representing the air
temperature of the transmission medium.

- Include a calibration method and/or enable manual operator value entry,
to set a fixed acoustic wave propagation velocity for transmission
mediums other than air.

**Process Control I/O**
The level controller shall provide:

- Two analog signal outputs, directly or inversely proportional and scalable
to the configured process variable.
- Six relay contact outputs based on the level conversion or other process
variable as set by the user configurable relay parameters.
- Two discrete inputs that may be configured to override normal Process
Control Functions.
- One analog signal input that may be scaled to a monitored process
variable, to be used as a basis for level controller Process Control
Functions.

**Process Control Functions**
The level controller shall provide an assortment of process control functions that
may be user implemented in any allowable combination.

**Standard Process Control Functions**

- 0/4–20 mA output directly / inversely proportional and scalable to:
  - level, space, or distance
  - volume (geometric, piecewise linear, or cubic spline approximation
derived)
  - head or flow (exponential, defined flume or weir, or approximation
derived)
  - volume rate (derived from change in volume per time interval)
  - dual point average or dual point differential level (two transducers
required).
- 0/4-20 mA input configurable to represent level measured by alternate
device
- Pre-configured application selections for:
  - duplex wetwell or reservoir pump control by level or rate of change
  - screen rake control
  - general alarms
- Alarms based on on/off setpoints:
  - High, Low, High High, or Low Low level
  - Level in bounds, out of bounds, rate of change
  - Temperature
- Loss of Echo or Cable Fault alarm
- Pump Control - fixed roster, alternating duty assist or back-up, service
  ratio duty assist or back-up, or FIFO duty assist
- Pump Control Modifiers – pump run-on, pump start and power
  resumption delays, wall cling reduction, independent pump group
  rotations, and pump cycle activated flush operation.
- Pump Control Overrides based on discrete inputs such as point level
  switches or pump fault sensors
- Special Device Control – remote totalizer, flow sampler
- Remote relay state control via communications
- Failsafe operation on measurement loss, including independent mA output and relay operation configuration.

Digital Communications
The level controller shall:

- Store data related to the digitized echo profiles, distance calculation, signal processing functions, process control functions, and system configuration.
- Map stored data to Modbus type read/write and read only registers, as defined by the level controller supplier.
- Provide access to stored data via:
  - RS232 port with RJ-11 connector for use with SIMATIC PDM.
  - RS-485 port with screw terminals for external connection to the RS-485 modem or any compatible RS-485 communications network.
  - SmartLinx port for use with an interchangeable SmartLinx card for direct connection to the corresponding industrial bus protocol.

User Interface
The level controller shall enable user access to read only and read/write enabled data, using any of the following methods:

- Direct or scroll access to data stored in numerical parameters, using the hand programmer and graphic LCD display.
- IBM PC compatible computer access to data and digital echo profiles, using the SIMATIC PDM instrument configuration package.
- HMI, SCADA, PLC, or DCS system access to data stored in Modbus registers via digital communications.

Transducer Functions

Acoustic / Electrical Energy Conversion
The transducer shall employ a piezoelectric driver element to convert the electrical excitation supplied by the level controller, to acoustic energy radiated axially and perpendicular from the transducer face. The piezoelectric driver shall also convert acoustic excitation to an electrical signal for processing by the level controller.

Integral Temperature Sensor
The transducer shall also employ an internal temperature sensor that shall provide a signal to the level controller representing the temperature measured at the transducer face.
System Performance

Conditions
The following system performance specifications pertain to normal industrial applications for which the system is designed; when installed, configured, and calibrated, in accordance to the level controller supplier instructions, based on prior application review and approval.

System Specifications
Range: 0.3 to 15 m (1 to 50') dependent on transducer
Accuracy: 0.25% of range or 6 mm (0.24"), whichever is greater
Resolution: 0.1% of span, or 2 mm (0.08"), whichever is greater
Programming: Primary: Handheld programmer,
Secondary: PC running Dolphin Plus software
Temp. Comp.: Range: -50 to 150°C (-58 to 302°F)
Source: Integral transducer sensor, and/or
TS-3 temperature sensor, or
Programmable fixed temperature
Temp. Error:
Sensor: 0.09% of range
Fixed: 0.17% per °C deviation from programmed value

Level Controller Specifications
Power: AC version: 100-230 Vac ± 15%, 50 / 60 Hz, 36 VA (17W)
DC version: 12-30 Vdc, 20W
Enclosure: Polycarbonate, Indoor/Outdoor
Type 4X / NEMA 4X / IP 65
240mm (9.5") x 1.75mm (6.9")
1.37 kg (3.02 lb)
Ambient Temp: -20 to 50°C (-5 to 122°F)
Memory: 1MB static RAM with battery backup
512kB flash EPROM
Display: Back lit LCD
Excitation: Transducer: 315V peak, 44 kHz nominal frequency
Differential or average level algorithm (Additional transducer required)
mA O/P: 0-20 mA or 4-20 mA, directly or inversely proportional, scalable and configurable
750 ohm maximum load, isolated
+- 0.1% resolution
Relays: All relays rated 5A at 250Vac, non-inductive
4 Form A control relays, 2 Form C alarm relays
Discrete I/P: 2 discrete inputs configurable to override control functions
Logical 0 = < 0.5 Vdc; logical 1 = 10 to 50 Vdc
3 mA maximum draw
mA I/P: 0-20 or 4-20 mA, configurable as level input from another device (availability model dependent)
Comm’s: RS-232 running Modbus RTU and ASCII via RJ-11 connector
RS-485 running Modbus RTU and ASCII via terminal block
Industrial bus protocol via SmartLinx card (optional)
Transducer Specifications

Transducer Model Variations
The ultrasonic transducer used with the level controller shall be available in distinct models to suit various application conditions.

Minimum Specifications
Range: 0.6 to 8 meters (2 to 26 feet)
Beamwidth: 12 degrees
Temperature: -20 to 60C (-5 to 140F)
Temp Sensor: Integral
Cable: Length of shielded twisted pair, suitable for temperature rating
Extendable by installer to 365 meters (1200 feet) total length
Approvals: CE compliant, CSA, FM, Cenelec, ATEX

Specification Variation Available by Model (not necessarily in combination)
Range: 0.3 to 15 meters (1 to 50 feet)
Beamwidth: 6 degrees
Temperature: -40 to 145C (-40 to 293F)
Construction: A) Tefzel base and lid with epoxy joint,
2” NPT, BSP, PF2 process connection options.
Flange adapter or submergence hood available.
B) Kynar Flex body with Hypalon face.
1” NPT, (1”BPS available on some models).
Flanges or submergence hood available.
C) Kynar, hermetically sealed,
1” NPT or 1” BPS conduit connection.
Flanges or submergence hood available.
D) Kynar, hermetically sealed,
1” NPT or 1” BPS conduit connection
Teflon faced factory flange

Equipment

Level Controller:
HydroRanger (manufactured by Siemens Milltronics Process Instruments Inc.)
Model 200 with factory configured variations as required to meet signal processing and process control requirements.

Transducer(s):
Echomax (manufactured by Siemens Milltronics Process Instruments Inc.) Model XRS-5, XPS-10, XPS-15, XCT-8, XCT-12, or ST-H, as required to meet process conditions and application requirements.

Additional Equipment:
The following additional equipment shall be available at additional cost.

- A TS-3 temperature sensor for determining the temperature at a location other than that provided by, or in conjunction with, the ultrasonic transducer.
- Infrared hand programmer for local instrument access and configuration.
- SIMATIC PDM instrument configuration package for local or remote instrument access and configuration using an IBM compatible PC.
- SmartLinx communications protocol module for access and configuration via an industrial data communication network.
- RS-485 External Modem Kit for remote access and configuration via leased or land line telemetry.
- Prefabricated mounting brackets for transducer mounting.
- Easy Aimer mounting device for transducer aiming.
- Additional instruction manuals.

**Installation:**
All equipment shall be installed, configured, interconnected, and commissioned by qualified persons, in accordance with the manufacturers instructions and guidelines, and in compliance with all governing regulations and accepted engineering practices.

**Warranty Terms**

The manufacturer of the above specified equipment shall guarantee for twelve (12) months from equipment startup or eighteen (18) months from date of shipment, whichever occurs first, that the equipment shall be free from defects in design, workmanship or materials.
SECTION 16630
DISSOLVED OXYGEN SENSOR

PART 1  GENERAL

1.1 Section includes:
   A. A modular single or dual channel controller that works with analog sensor modules and/or digital sensors.

1.2 Measurement Procedures
   A. Microprocessor-based sensor controller.
   B. Change digital sensors connected to the controller by unplugging and plugging in sensors as necessary.
   C. Change analog sensor modules connected to the controller by unplugging and plugging analog sensor modules as necessary.
   D. The controller accepts 4 different analog sensor modules in any combination to measure the following:
      1. pH/ORP module
         a. Combination pH/ORP
      2. Conductivity module
         a. Contacting conductivity
         b. Inductive conductivity
         c. Cationic conductivity (Calculated pH)
      3. Dissolved Oxygen/Oxygen Scavengers module
         a. Amperometric dissolved oxygen
         b. Amperometric oxygen scavengers
      4. Analog mA IN module

1.3 Alternates
   A. Parameter-specific controllers that do not allow changing parameter configurations in the field are unacceptable.

1.4 System Description
   A. Performance Requirements
      B. pH/ORP sensor module
         1. Measurement range:
            a. pH: -2.0 to +14.0 or -2.00 to 14.00 pH
            b. mV: -2100 to +2100 mV
         2. Repeatability: 0.1% of range or better
         3. Response time (t90%): 0.5 s
         4. Temperature range:
            a. PT100/PT1000: -20 to 200 °C
            b. Accuracy: ±0.05 °C
   C. DO sensor module
      1. Measurement range:
         a. 0 to 2000 ppb
      2. Repeatability: ±0.5 ppb or ±5% whichever is greater
      3. Response time (t90%) for step change between 1-40 ppb: <30s
      4. Temperature range: 0-45°C (32-113°F)
D. Oxygen Scavengers sensor module
   1. Measurement range:
      a. 0 to 500 ppb of dissolved N$_2$H$_4$
      b. 0 to 100 ppb of carbohydrazide
      c. Repeatability: <2% of the measured value or <1 ppb, whichever is greater
      d. Response time (t90%): <60 seconds
      e. Temperature range: 5-45°C (41-113°F)

E. Contacting conductivity sensor module
   1. Measurement range:
      a. Conductivity: 0-20,000 µS/cm
      b. Resistivity: 0-50 Ω·cm
      c. TDS: 0-9999 ppm or 0-9999 ppb
   2. Repeatability:
      a. ±1% of reading or 0.002 µS/cm below 0.2 µS/cm, whichever is higher
   3. Response time (t90%): 0.5 s
   4. Temperature range: -20 to 200 °C
      a. Accuracy: ±0.05 °C

F. Inductive conductivity sensor module
   1. Measurement range:
      a. Conductivity: 0.5-10,000 mS/cm
      b. % concentration: 0-99.99 or 0-200.0%
      c. TDS: 0-9999 ppm
   2. Repeatability:
      a. 0.5-10,000 mS/cm: ±2%
   3. Response time (t90%): 1 s
   4. Temperature range: -2 to 200 °C
      a. Accuracy: ±0.05 °C

1.5 Certifications
   A. EMC: CE compliant for conducted and radiated emissions CISPR 11 (Class A limits), EMC Immunity EN 61326-1 (Industrial limits)
   B. Safety: General Purpose UL/CSA 61010-1 with cETLus safety mark
   C. Australian C-TICK and Korean KC Markings

1.6 Environmental Requirements
   A. Operational Criteria
      1. Temperature: -4.0 to 140.0 °F (-20.0 to 60.0 °C)
      2. Relative humidity: 0 to 95%, non-condensing

1.7 Warranty
   A. Warranted for two years from date of shipment from manufacturer defects.

1.8 Maintenance Service
   A. Clean controller keypad
   B. Calibrate mA output signals
PART 2 PRODUCTS

2.1 Manufacturer

A. Hach Company, Loveland, Colorado and Hach Lange GmbH, Berlin, Germany
   1. Hach model sc200 Controller

2.2 Manufactured Unit

A. The controller is available with the following power requirements:
   1. AC powered: 100 to 240 Vac ±10%, 50/60 Hz; 15 W with 7 W sensor/network card load, 37 W
      with 25 W sensor/network card load.
   2. 24 VDC powered: 24 VDC, -15%, +20%; 16 W with 7 W sensor/network card load, 34 W with
      25 W sensor/network card load (optional Modbus RS232/RS485 and Profibus DPV1 network
      connection).
B. The controller uses a menu-driven operation system.
C. The controller display is graphic dot matrix LCD with LED backlighting.
D. The controller is equipped with a real-time clock.
E. The controller is equipped with two security levels.
F. The controller is equipped with a data logger with RS-232 capability.
G. The controller shall have worded operation menus in 19 languages.
H. The controller is equipped with an SD card reader for data download and controller software upload.
I. Four electromechanical, UL rated, SPDT relays (Form C) are provided for user-configurable contacts
   rated 100 to 230 Vac, 5 Amp at 30 VDC resistive maximum.
   1. The following can be programmed:
      a. Alarm
      b. Warning
      c. Timer/scheduled cleaning
      d. Feeder control
      e. Event control
      f. Pulse width modulation
      g. Frequency modulation
   2. The following can be assigned:
      a. Primary value measurement I
      b. Secondary value measurement I
      c. Tertiary value measurement I
      d. Quaternary value measurement I
      e. Primary value Measurement II
      f. Secondary value measurement II
      g. Tertiary value measurement II
      h. Quaternary value measurement II
      i. Real time clock
      j. Calculated values
J. Two analog 0/4-20 mA outputs are provided with a maximum impedance of 500 ohms.
   1. The controller can be equipped with three additional 4-20 mA outputs with a maximum
      impedance of 500 ohms.
   2. The following can be programmed:
      a. Alarms:
         1) Low alarm point
2) Low alarm point deadband
3) High alarm point
4) High alarm point deadband
5) Off delay
6) On delay
b. Controls:
   1) Linear
   1) Bi-linear
   2) Logarithmic
   3) PID
1. The following can be assigned:
   a. Primary value measurement I
   b. Secondary value measurement I
   c. Tertiary value measurement I
   d. Quaternary value measurement I
   e. Primary value measurement II
   f. Secondary value measurement II
   g. Tertiary value measurement II
   h. Quaternary value measurement II
   i. Calculated values
K. The controller can be equipped with the following forms of communication:
   1. MODBUS RS-232
   2. MODBUS RS-485
   3. Profibus DP
L. All user settings of the controller are retained for 10 years in flash memory.
M. The controller is equipped with a system check for:
   1. Power up test (monitoring and shutdown)
   2. Total power draw
   3. Memory devices
   4. Temperature mother board
N. The controller has the option of graphical measurement that tracks measurement values over time.

2.3 Equipment

A. Materials
   1. Housing: polycarbonate, aluminum (powder coated), and stainless steel
   2. Rating: NEMA 4X enclosure, rated IP66
B. Conduit openings: 0.5 in. NPT

2.4 Components

A. Standard equipment
   1. Controller
   2. Mounting hardware for wall, pipe, and panel mounting
B. Dimensions: 144 x 144 x 180 mm (5.7 x 5.7 x 7.1 in.)
C. Weight: 1.6 kg (3.5 lbs.)
2.5 Accessories

A. Weather protection shield
B. Sun screen
C. RS-232 / RS-485 MODBUS output card
D. PROFIBUS DP output card
E. HART output card
F. Additional mA input card
G. Additional mA output card

PART 3 EXECUTION

3.1 Preparation

A. The sensor may need to be installed with additional accessories depending on its application.
   1. Mount on rail, panel, pipe, or wall.
   2. Sensor to analyzer distance: 300 m (985 ft.)

3.2 Installation

A. Contractor will install the analyzer in strict accordance with the manufacturer’s instructions and recommendation.
B. Manufacturer’s representative will include a half-day of start-up service by a factory-trained technician, if requested.
   1. Contractor will schedule a date and time for start-up.
   2. Contractor will require the following people to be present during the start-up procedure.
      a. General contractor
      b. Electrical contractor
      c. Hach Company factory trained representative
      d. Owner’s personnel
      e. Engineer

3.3 Manufacturer’s Service and Start-Up

A. Contractor will include the manufacturer’s services to perform start-up on instrument to include basic operational training and certification of performance of the instrument.
B. Contractor will include a manufacturer’s Service Agreement that covers all the manufacturer’s recommended preventative maintenance, regularly scheduled calibration and any necessary repairs beginning from the time of equipment startup through to end user acceptance / plant turnover and the first 12 months of end-user operation post turnover.
C. Items A and B are to be performed by manufacturer’s factory-trained service personnel. Field service and factory repair by personnel not employed by the manufacturer is not allowed.
D. Use of manufacturer’s service parts and reagents is required. Third-party parts and reagents are not approved for use.
PART 4 CONTROL PANEL

4.1 Description
A. Dissolved Oxygen Control Panel to be installed to provide speed pacing control to Blowers #1, #2 and #3 for Aeration Basins A & B based on Set-points to be determined by Owner.

4.2 Requirements
A. Panel to be 316 stainless steel sized as required to accommodate controls for DO Sensors at Aeration Basin A & B
B. Panel to include local Digital displays of DO Sensor readings
C. Panel to include Selector Switches to provide Owner the ability to select Blower to be controlled by DO Sensor Set-points
D. Panel to be located as per Electrical Plans

4.3 Control Description
A. Dissolved Oxygen Control panel to be designed to control Blower VFDs speed based on operator entered set-points for HI and LOW Dissolved Oxygen Level at each Aeration Basin A and B
B. Speed control to be an Analog Pacing Signal from Dissolved Oxygen Control Panel to each Blower VFD located in the Blower Control Panel
C. Blower VFDs are to be selectable from the Dissolved Oxygen Control Panel thus:
   a. Blower 1 to Aeration Basin A or B
   b. Blower 2 to Aeration Basin A or B
   c. Blower 3 to Aeration Basin A or B

4.4 Submittals
A. Contractor to submit design for Dissolved Oxygen control panel
   a. Cut sheets
   b. Dimension Drawings
   c. Wiring diagram

4.5 Installation
A. Contractor will install the Dissolved Oxygen Control Panel as per plans and Specifications.
B. Contractor will include a full day start-up service and training.
   1. Contractor will schedule a date and time for start-up.
   2. Contractor will require the following people to be present during the start-up procedure.
      a. General contractor
      b. Electrical contractor
      d. Owner’s personnel
      e. Engineer
   3. Contractor will require the following people to be present during the training procedure.
      a. Owners personal as required
      b. Electrical contractor
      c. Training Log of attending personnel to be turned over to Owner at completion of training.

END OF SECTION
VII. REFERENCE DOCUMENTS
AMENDMENT NO. 1
GEOTECHNICAL ENGINEERING STUDY
UNITEC WWTP IMPROVEMENTS
0.36 MGD EXPANSION
LAREDO, WEBB COUNTY, TEXAS

CONDUCTED FOR:

City of Laredo

PREPARED BY:

CASTLE ENGINEERING & TESTING, LLC
3302 CUATRO VIENTOS DRIVE, SUITE NO. 12
LAREDO, TEXAS 78046
TBPE REGISTRATION No. F-10341
June 4, 2018

Mr. Riazul I. Mia, P.E., CFM
Utilities Director
City of Laredo-Utilities Department
5816 Daugherty Avenue
Laredo, Texas 78041

Re: Amendment No. 1
Geotechnical Engineering Report
City of Laredo-Utilities Department
Unitec WWTP Improvements
0.36 MGD Expansion
Laredo, Webb County, Texas
CET Project No.: 17M085 Report No.: 021

Dear Mr. Mia:

Castle Engineering & Testing, LLC (CET) is pleased to submit the enclosed Amendment No. 1 Geotechnical Engineering Report for the above referenced project.

We appreciate the opportunity to assist in this phase of the project, and we look forward to providing construction materials testing and observation services as the project progresses.

Should you have any questions concerning our findings or if you desire additional information, please do not hesitate to call our office.

Respectfully,

Castle Engineering & Testing, LLC

Jesse P. Rodriguez, P.E.
President

Copies Submitted: (3) City of Laredo – Utilities Department; Mr. Riazul I. Mia, P.E., CFM
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APPENDIX
1. INTRODUCTION

1.1 Authorization and Scope

Mr. Riazul I. Mia, P.E. with City of Laredo-Utilities Department authorized this geotechnical engineering study through an authorization letter dated April 23, 2018 and completed in general accordance with CET Contract Amendment No. 1 for Project No. 17M085-021. The purposes of this study were to determine and evaluate the stratification and engineering properties of the site subsurface soils and to develop geotechnical engineering recommendations and guidelines for use in site preparation, wastewater structural foundation design recommendations, slab-on-grade foundations, and related site improvements planned for this project.

1.2 Project Description

Based on the information provided to us, we understand that construction design documents are underway for the UNITEC WWTP Improvements 0.36 MGD Expansion Project located in Laredo, Webb County, Texas.

We understand that the UNITEC WWTP Improvements will include new headworks Degritter and Splitter Box, upgrade equipment at the existing RAS station, new aeration basin, upgrade the existing aeration blower facilities, new clarifier, upgrade the existing chlorine basin, new sludge digester holding tank, and other incidental improvements required for facility operations. The majority of the structures will be partially embedded below final plan ground surface. The wastewater treatment structures will be designed as reinforced concrete structures.

2. FIELD AND LABORATORY TESTING

2.1 Field Testing

The project site was explored by drilling a total of four (4) soil test borings within the proposed wastewater assignment areas. The field investigation to determine the engineering characteristics of the subsurface materials included a reconnaissance of the project site, drilling of borings, performing the appropriate drilling method for the soils encountered that included standard penetration tests (SPT) and obtaining disturbed split-barrel samples, and grab auger samples. Soil samples were obtained at selected intervals in the soil test borings.

Undisturbed soil samples were not obtained with ASTM D-1587 (Shelby Tube – Thin Walled Tube Sampling of Soils) because the soil mixtures encountered were cemented and could not be penetrated with the Shelby tube.

Sedimentary rock was encountered; however, Rock Quality Determination (RQD) values were not possible due to the sample being disintegrated during the drilling rock core operations because of the inherent soil matrix makeup being primarily fine sands and silts.

Also, pocket penetrometer testing could not be performed on the cemented soil.
Disturbed soil samples were obtained in accordance with ASTM D-1586 Split Barrel – Standard Penetration Test method using a standard split-spoon sampler. A split-spoon sampler is a 2-inch O.D. tube that is driven into the soil to be sampled that can be split open lengthwise for easy removal and visual inspection of the soil obtained.

The results of the standard penetration test indicate the relative density and comparative consistency of the soils, and thereby provide a basis for determining the relative strength and compressibility of the soil profile components.

Also; soil samples were field bagged and secured prior to transporting them to our laboratory for carrying out our approved laboratory testing program for the project.

### 2.2 Laboratory Testing

CET maintains all equipment, personnel qualifications (CEUs), and laboratory procedures in strict accordance with all applicable ASTM Standards.

Selected laboratory tests performed included ASTM D-2216 (Moisture Content), ASTM D-4318 (Atterberg Limits), ASTM D-422 Grain Size Analysis), pH, Sulfates, Chlorides, and Conductivity (Resistivity).

Laboratory testing was carried out in the selected soil samples in order to acquire necessary information with regards to the physical and mechanical properties of the soil layers and further on to evaluate and determine the parameters required for the calculations. Atterberg limits, moisture content and percent fines tests were performed to assist in classifying the soils and to provide indicators of soil strength and behavior. All phases of the laboratory-testing program were performed in general accordance with the applicable ASTM Specifications.

A summary of the laboratory test results is presented in the Appendix. The samples collected will be stored for 30 days from the date of issue of this report, and then disposed of unless otherwise instructed in writing by the client.

### 3. SITE AND SUBSURFACE CONDITIONS

#### 3.1 Site Conditions

The proposed wastewater treatment facility is located in the most northern limits of the City of Laredo east of IH 35 at the terminus of Unitec Drive, where Copper Drive starts and which intersect with an unnamed road leading to the plant site. Topographic elevations varied approximately twenty (20') feet in total vertical relief from 670 (msl) to 650 (msl).

#### 3.2 Subsurface Conditions

The subsurface conditions encountered are depicted by the soil borings shown in the boring records found in the Appendix. The subsurface soils at the site consisted of fat Clay (CH) and clay (CL). The soils encountered are underlain by cemented claystone in all the test borings to end of boring drilled. The results of our field exploration and laboratory testing indicate that the soils have high expansive potential.
These subsurface exploration records represent an interpretation of subsurface conditions at the test locations and soil conditions may vary from different locations.

The field and laboratory data acquired during this study indicate that the soil layers encountered are as a whole considered low expansive or non-plastic soil mixtures.

**Table No. 1 - Major Strata**

<table>
<thead>
<tr>
<th>Stratum</th>
<th>Depth, feet*</th>
<th>Description and Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>B1 (0 – 25), B2 (5.5 – 25), B3 (5.5 – 45), B4 (5.5 – 38)</td>
<td>Fat Clay (CH); <strong>Cemented below 15 feet</strong>, Grayish Brown, Gray, Reddish Gray, Olive Gray</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>B2 (0 – 2.5), B3 (5.5 – 45)</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>B2 (2.5 – 5.5) &amp; (2.5 – 5.5), B4 (0 – 6.5) &amp; (33 – 45)</td>
</tr>
</tbody>
</table>

* The depths and thicknesses of the strata presented are based on information at the borehole locations and variations outside of the ranges of depth and thickness could occur between borehole locations.

### 3.3 Groundwater

Groundwater was not encountered during the drilling operations. It is noted that groundwater levels will fluctuate with seasonal climatic variations; however, groundwater should not be a factor affecting design or construction at this site. Groundwater levels could be significantly higher after a major rainfall or in rainy season. As such, the water table must be checked immediately prior to construction to assess its effect on dewatering and other construction activities. The boreholes were backfilled using on-site soil cuttings.

### 3.4 Wet Chemistry Testing

**Table No. 2 - Soil Chemical Characteristics**

<table>
<thead>
<tr>
<th>Bore ID</th>
<th>Depth ft.</th>
<th>Chlorides mg/L (ppm)</th>
<th>Sulfates mg/L (ppm)</th>
<th>Total Solids mg/L (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>4.5 – 6</td>
<td>1,600</td>
<td>488</td>
<td>1,860</td>
</tr>
<tr>
<td>B2</td>
<td>2.5 – 4</td>
<td>940</td>
<td>338</td>
<td>1,380</td>
</tr>
<tr>
<td>B3</td>
<td>4.5 – 6</td>
<td>540</td>
<td>536</td>
<td>1,050</td>
</tr>
</tbody>
</table>

* Chloride maximum limit = 500 mg/L: for Pre-stressed concrete, bridge decks & superstructure.
### Table No. 3 - Requirements for Concrete Exposed to Sulfates Attack

<table>
<thead>
<tr>
<th>Sulfate Exposure</th>
<th>Water Soluble Sulfate (SO₄) in Soil, Percent by Weight</th>
<th>Sulfate (SO₄) in Water (ppm)</th>
<th>Cement Type</th>
<th>Maximum Water-Cement Ratio by Weight, Normal Weight Aggregate Concrete</th>
<th>Minimum f’c Normal Weight and Light Weight Aggregate Concrete (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negligible</td>
<td>0 - 0.1</td>
<td>0 - 150</td>
<td>ASTM C-150</td>
<td>ASTM C-595</td>
<td>---</td>
</tr>
<tr>
<td>Moderate</td>
<td>0.1 - 0.2</td>
<td>150 - 1,500</td>
<td>II, IP (MS), IS (MS), P(MS), I (PM)(MS), I(SM)(MS)</td>
<td>MS</td>
<td>0.50 4,000</td>
</tr>
<tr>
<td>Severe</td>
<td>0.2 - 2.0</td>
<td>1,500 - 10,000</td>
<td>V</td>
<td>HS</td>
<td>0.45 4,500</td>
</tr>
<tr>
<td>Very Severe</td>
<td>Over 2.0</td>
<td>Over 10,000</td>
<td>V Plus Pozzolan</td>
<td>HS Plus Pozzolan</td>
<td>0.45 4,500</td>
</tr>
</tbody>
</table>

### 4. EVALUATION

#### 4.1 General

All recommendations are based on knowledge of the area; however, the project design team should specify actual construction requirements. The final selection of foundation types and depths should be based on considerations of several factors, such as: 1) function of the structure, 2) soil strength properties, expansive properties, and settlement characteristics of subsurface materials; 3) the magnitude of applied structural loads; and 4) foundation construction costs.

The Strata identified as cemented Claystone is a “sedimentary rock” and is volumetrically stable. This material will most likely require rock excavation techniques when encountered during construction. Heavy machinery, properly equipped, will likely be required to excavate the sedimentary rock at this site. Equipment suppliers or manufacturers locally established and familiar with the local cemented sands, silts, and clay shale deposits should be able to assist with selecting appropriate excavation machinery.

The sedimentary rock formations are part of the Laredo Formation. Karst features such as vugs, voids, solution cavities or sinkholes are not common in this formation. While many areas exist with karst features, the areas drilled on this property having this cemented soil matrix formation appear to be non-existent or are relatively minor and consist of solution enlarged fractures or solution enlarged features following a bedding plane, some karst features can consist of caves or cavities that can significantly impact the proposed development. Voids or cavities were not encountered in the borings drilled at this site.
However, voids or cavities may be present in areas between the borings and not yet discovered.

When encountered during construction, minor karst features can typically be filled with select fill, flowable fill, lean concrete, clean gravel or a combination of these materials. Significant features typically require more stringent attention. The significance of any feature should be determined on a case by case basis, and the filling of any feature may require notification to, or approval by, the Texas Commission on Environmental Quality (TCEQ). Karst features, which will need to be addressed during the foundation design and construction phases of this project, are discussed further in the latter sections of this report. CET should be contacted immediately upon the discovery of any karst feature, so that the geotechnical engineer may evaluate the feature and make recommendations accordingly.

4.2 Potential Vertical Rise (PVR)

Potential vertical soil movements have been estimated using the Texas Department of Transportation method TEX-124-E, Potential Vertical Rise (PVR). This method utilizes the soils in-situ moisture conditions and plasticity characteristics within the active zone. It is estimated that depth of the active zone at this site is approximately 15 feet. Based on the borings drilled at the site, our laboratory analyses indicate that the PVR at this site are less than three (3) inches in its present condition. A sustained surcharge load of one (1) pound per square inch is assumed to be supplied by the floor and sustained live load in the PVR calculations. It is noted that the PVR estimates are provided as an indicator of the severity of potential soil movements at this site and are not intended as a prediction of actual soil foundation movements.

4.3 Settlement Analysis

The deep penetration of vertical pressure could cause excessive consolidation of soft soil layers at a considerable depth below the foundation even though a relatively low unit foundation load is used. Settlement of saturated cohesive soils is the summation of (a) immediate settlement, (b) consolidation settlement, and (c) secondary compression. Thus, as loads are applied, the immediate settlement occurs, when excess pore pressures generated by the loads are dissipated you have consolidation settlement, and secondary compression is basically controlled by the composition and structure of the soil skeleton and is usually small compared to the consolidation settlement.

Settlement calculations performed, indicate that in its present condition, the estimated settlement values will range from 0.50 inches to 0.75 inches. Under load conditions, the settlement values will remain at less than 0.75 inches, provided the soil matrix mixtures remain unchanged below the drilled depths. As with PVR calculations, these values are an indicator of the soil settlement severity.

5. RECOMMENDATIONS

5.1 Site Preparation

Final grade elevations proposed for this wastewater treatment facility have not been provided; however, final site grades may change prior to final construction drawings being
completed, therefore final finish grades must provide effective drainage away from proposed foundations during and after construction.

Site preparation should consist of the following:

1. Strip vegetation and loose topsoil, if any, containing significant organic material from all areas to receive proposed improvements and assigned right-of-ways prior to installation.

2. The exposed subgrade should then be prepared to the design elevation with specified bedding material as per the design engineer’s construction specifications, as necessary to achieve the desired final design elevation.

3. The primary backfill, for subsurface utilities, should follow immediately after the product pipe placement is at the specified design elevation, which in most cases is typically 12 inches above the product pipe. The trench secondary backfill material may consist of the excavated soils provided that all large aggregates, rocks, and boulders larger than the specified size per the construction documents have been removed and then be placed and compacted in layers not to exceed eight (8) inches and moisture conditioned between minus two (-2) to plus three (+3) percentage points of the optimum moisture and compacted to a minimum of 90 percent of the maximum dry density determined in accordance with ASTM D-698 (Standard Proctor) if located outside paved or improved areas subject to vehicular loads; otherwise it shall be placed and compacted in layers not to exceed eight (8) inches and moisture conditioned between minus two (-2) to plus three (+3) percentage points of the optimum moisture and compacted to a minimum of 98 percent of the maximum dry density determined in accordance with ASTM D-698 (Standard Proctor) for areas to receive pavement improvements or other improvements sensitive to differential movement.

Particular attention should be given to maintaining the proper moisture content during compaction and to preventing the fill from drying before subsequent lifts are placed.

For depths that will exceed drilled depths it will be necessary to field verify existing soil conditions by means of additional borings or by sampling pits prior to providing recommendations for those areas.

5.2 Engineering Analysis and Evaluation

General

Based on our discussion with LNV representatives, structural engineers of the project, the following foundation types are being considered for the project.

- Mat foundations
- Spread footings
- Continuous strip footings
- Slab-on-grade (Structural Fill).
The foundations being considered for the proposed structures must satisfy two independent engineering criteria with respect to the subsurface stratigraphy at this site. One criterion is the foundation system must be designed with an appropriate factor of safety to reduce the possibility of a bearing capacity failure of the soils and sedimentary rock underlying the foundations. The other criterion is differential movement beneath the foundation systems due to compression (consolidation) or expansion (swell) of the underlying soils and must be within tolerable limits for the structures.

5.3 Design Parameters

Estimated allowable skin friction and end bearing values for given depths are provided in the following table. These values include factors of safety of two (2) and three (3) for skin friction and end bearing, respectively.

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Effective Soil Unit Weight (pcf)</th>
<th>Allowable End Bearing Pressure¹ (ksf)</th>
<th>Allowable Side Friction² (psf)</th>
<th>Internal Friction Angle (deg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 5</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>5 – 10</td>
<td>97</td>
<td>4.6</td>
<td>380</td>
<td>---</td>
</tr>
<tr>
<td>10 – 20</td>
<td>102</td>
<td>9.0</td>
<td>850</td>
<td>---</td>
</tr>
<tr>
<td>20 – 45</td>
<td>90</td>
<td>13.5</td>
<td>1,200</td>
<td>---</td>
</tr>
</tbody>
</table>

¹The net allowable end bearing pressure refers to the pressure at the foundation bearing level in excess of the surrounding overburden pressure.

²The allowable passive pressure and side friction for non-cohesive (granular) soils are proportional to the effective over burden pressure and are based on a triangular pressure distribution.

The field and laboratory data acquired during this study indicate that the near surface Strata Fat Clay (CH), Clayey Sand (SC)/CLAY (CL) soils are mid to highly expansive. However, the data from our field borings indicate the Stratum Fat CLAY (CH) to be the dominating soil stratum that overlies the CLAYSTONE strata.

5.4 Building Pad Preparation

The following building pad preparation is based on preliminary information provided LNV; therefore, should any changes to the planned building location or FFE occur, CET should be notified in writing so that we may determine if modifications to the recommendations provided in this report are necessary.

Strip the building area of vegetation, topsoil, fill, loose debris and any fat CLAY (CH) or other CLAY (CL) soils. The building area is taken as the area that extends at least three (3) feet beyond the perimeter of the planned building limits, including any flatwork that abuts the structure such as sidewalks and patios. Excavation and stripping should be conducted to expose the existing CLAYSTONE as the subgrade across the building footprint and to
reach the desired subgrade elevation or per structural considerations, whichever results in a deeper excavation.

Proof roll the exposed ground surface within the building area with at least a 12-ton roller, or equivalent equipment, to detect any weak or soft areas or possible karst features. A qualified geotechnical engineer or his representative should be present to observe proof rolling operations. Weak or soft areas should be over excavated to expose competent rock in both horizontal and vertical limits. A qualified geotechnical engineer or his representative should be present to observe proof rolling operations.

Place and compact imported select fill in the building pad area as required to achieve the planned FFE. Select fill should meet the criteria discussed in the “Select Fill Materials” section of this report.

The appropriate select fill material should be placed in lifts not to exceed eight (8) inches in loose measure with a compacted thickness not to exceed six (6) inches. Select fill should be moisture conditioned to between minus three (-3) and plus three (+3) percentage points of optimum moisture content and then compacted to no less than 95 percent of the maximum dry density determined in accordance with ASTM D-698. To provide an “all-weather” working surface and to provide a more uniform slab support, consideration should be given to constructing the final six (6) inches, or “cap”, of the building pad using granular select fill.

5.5 Shallow Footing Foundations

Slab-on-structural fill foundation systems may be utilized, provided the building pad structural fill and supporting subgrade is properly prepared and moisture conditioned and the stiffened beams be founded a minimum of 36 inches below finish floor grade and the foundation system be on a minimum supporting subgrade of 30 inches of properly prepared, compacted, and moisture conditioned structural fill. The foundation may be designed for a bearing capacity of 3.0 kips per square foot (ksf) based on total loads.

These recommendations are for proper development of bearing capacity for the continuous beam sections of the foundation system and to reduce the potential for water to migrate beneath the slab foundation. These recommendations are not based on structural considerations. Grade beam depths for both the exterior and interior grade beams may need to be greater than recommended herein for structural considerations and should be properly evaluated and designed by the structural engineer. The grade beams or slab portions may be thickened and widened to serve as spread footings at concentrated load areas.

Continuous strip footings (grade beams) or spread footings may be considered in the design of the foundations for the building. Footings are typically used to support concentrated loads such as column or wall loads. Loads such as those imposed by walls may be supported by either spread footings or continuous strip footings (grade beams).

5.6 Construction Considerations

Excavation of the CLAYSTONE strata will likely require the use of jackhammers, rock saws, rock bits, rock teeth or other rock excavation techniques. Excavation for below grade
utilities will also likely require similar equipment and procedures. Very hard zones of the CLAYSTONE may require blasting for excavation.

For the footings or grade beams, if neat excavation is not possible then the foundations should be horizontally over excavated and formed. All loose materials should be removed from the over excavated areas and filled with lean concrete, compacted cement stabilized sand (two sacks cement to one cubic yard of sand) or flowable fill. Steel should be placed and the foundation poured the same day of excavation.

The bearing surface may become uneven or jagged as the result of both the excavation process and of removing clay zones, soft or moist material, and loose debris. Hand labor may be required to completely clean the base of the excavation as recommended herein. Where uneven differences in elevation occur greater than one (1) foot in the base of the footing excavation, the high side will need to be excavated lower to provide a more level base. Concrete with a compressive strength of at least 2,500 psi can be used to form a seal slab and level-up the base of the footing excavation to the planned bearing elevation.

The bearing surfaces for the footings should be excavated with a slight slope to create an internal sump for runoff water collection and removal. If surface runoff water accumulates at the bottom of the excavation, it should be pumped out prior to concrete placement. Under no circumstances should water be allowed to adversely affect the quality of the bearing surface.

5.7 Other Design Parameters

1) Vibration analysis in the Foundation system:

Poisson ratio
Typical values = 0.2 < x < 0.3

Dynamic Shear Modulus, G
Typical values = 1200 < x < 4000 (ksi)

2) Concrete seal slabs:

It is advisable to use concrete seal slabs at all excavation locations that will be utilized in the future for foundations, especially if the time factor will be long enough to go through several climatic cycles.

3) Excavated material for structural fill:

Excavated material (excluding the Fat Clay) may be utilized for fill material. It will require some laboratory testing such as gradation, hardness determination, adsorption/absorption, and the like all dependent on the intended use. If the intended used can be identified early on in the construction process the necessary testing can be carried out.

4) Temporary slopes on rock cuts:

Since we have not performed a detailed geologic investigation that would provide some information on such items as tension cracks, slip planes, or plane strain analysis on the
claystone strata; it is advisable to maintain as close as possible to a 2:1(V:H) slope where retaining structures are proposed.

Occupational Safety and Health Administration (OSHA) Safety and Health Standards (29 CFR Part 1926 Revised, 1989) require that all excavations/trenches in excess of five (5) feet deep be shored or appropriately sloped unless the excavation/trench sidewalls are comprised of “solid” rock. “Solid” unweathered rock was not encountered in the soil borings drilled at this site.

State of Texas legislation requires that - detailed plans and specifications for excavations/trench retention systems meet OSHA standards for a safe construction environment during utilities installation. Our recommendations are intended for use in conjunction with OSHA safety regulations and not as a replacement of those regulations. Based on the laboratory tests results, we recommend that the Strata I & III, CLAY (CH) & SANDY CLAY (CL) be considered as Type B soils and that the Stratum IV LIMESTONE be considered as Type A soils. If any of the soils become significantly wetter, saturated or submerged they should be considered as Type C soils.

As stated above, OSHA requires all soil excavations/trenches in excess of five (5) feet be shored or appropriately sloped. Currently available and practiced methods for achieving slope and/or trench wall stability includes sloping, benching, combinations of sloping and benching, and installation of shoring systems (hydraulic, timber, etc.). Trench shields may also be considered for use. However, these shields only provide protection to workers; they are not a means for providing slope or trench wall stability. OSHA addresses construction slopes in large excavations that are less than 20 feet deep. The following table is a reproduction of the OSHA Table B-1:

<table>
<thead>
<tr>
<th>Soil or Rock Type</th>
<th>Maximum Allowable Slopes (H:V)* for Excavations Less Than 20 Feet Deep***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stable Rock</td>
<td>Vertical</td>
</tr>
<tr>
<td>Type A**</td>
<td>¾: 1 (53°)</td>
</tr>
<tr>
<td>Type B</td>
<td>1: 1 (45°)</td>
</tr>
<tr>
<td>Type C</td>
<td>1½: 1 (34°)</td>
</tr>
</tbody>
</table>

Notes: Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.

* A short-term maximum allowable slope of ½H: 1V (63°) is allowed in excavations in Type A soil that are 12 feet or less in depth.

** Short-term maximum allowable slopes for excavations greater than 12 feet in depth shall be ¾H: 1V (53°).

*** A registered professional engineer shall design sloping or benching for excavations greater than 20 feet.
The OSHA regulations define short-term as a period of 24 hours or less.

Long-Term Slopes:

Natural Clay = 2H: 1V
Limestone = ¾H: 1V

Permanent Slopes:

Natural Clay = 3.5H: 1V
Limestone = 1H: 1V

5) High water table:

Ideally it is best to prevent or alleviate any potential for perched water in the excavated claystone layers by having proper drainage slopes, clay soil caps, or concrete slab/rip-rap. In areas where drainage systems can be installed or where de-watering systems can be installed it is advisable to implement those systems; where there is limited area or difficult to install such systems then other means of perched water should be considered. This is due to the potential for freeze/thaw cycles that can be detrimental to the claystone layer.

6) IBC 2000 has the following 0.2 second and 1.0 second spectral accelerations:

0.2, 007.9, MCE Value of Ss, Site Class B
1.0, 002.0, MCE Value of S1, Site Class B

7) Lateral Earth Pressures:

Presented below are at-rest, active, and passive earth pressure coefficients for various backfill types adjacent to any below-grade walls or site retaining walls. At-rest earth pressures are recommended in cases where little wall yield is expected (such as structural below-grade walls). Active earth pressures may be utilized in cases where the walls can exhibit a certain degree of horizontal movement (such as cantilevered retaining walls).

<table>
<thead>
<tr>
<th>Backfill Type</th>
<th>Estimated Total Unit Weight (pcf)</th>
<th>Lateral Earth Pressure Coefficients</th>
<th>At Rest (Ko)</th>
<th>Active (Ka)</th>
<th>Passive (Kp)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crushed Limestone</td>
<td>140</td>
<td></td>
<td>0.45</td>
<td>0.30</td>
<td>3.5</td>
</tr>
<tr>
<td>Clean Sand</td>
<td>120</td>
<td></td>
<td>0.50</td>
<td>0.35</td>
<td>3.0</td>
</tr>
<tr>
<td>Clean Gravel</td>
<td>120</td>
<td></td>
<td>0.45</td>
<td>0.30</td>
<td>3.5</td>
</tr>
</tbody>
</table>

*Passive earth pressure coefficients represent ultimate values. Appropriate safety factors (generally at least 2.0) should be applied when utilizing passive earth pressures.

The above values do not include a hydrostatic or ground level surcharge component. The effect of surcharge loads, where applicable, should be incorporated into wall pressure diagrams by adding a pressure component equal to the applicable lateral earth pressure coefficient times the surcharge load to the full height of the wall.

Adequate drainage should be provided behind site retaining walls through the use of granular backfill, wall drains, weep holes, etc. If proper drainage cannot be provided, an additional hydrostatic component should be considered in the design of the retaining walls.
The compactive effort should be controlled during backfill operations. Over compaction can produce lateral earth pressures in excess of at-rest magnitudes. Compaction levels adjacent to below-grade walls should be maintained between 95 and 100 percent of Standard Proctor (ASTM D-698) maximum dry density.

For site retaining wall or below-grade wall footings bearing on soil or properly compacted select fill, a coefficient of sliding resistance of 0.4 (allowable sliding resistance no greater than 500 psf) and a footing bearing capacity no greater than of 2,500 psf should be considered. For rock subgrade, a sliding coefficient of 0.7 (resistance no greater than 1,500 psf) and a footing bearing capacity of 4,500 psf may be utilized. All retaining walls should be checked against failure due to overturning, sliding, and overall slope stability. Such an analysis can only be performed once the dimensions of the wall are known.

A wall drain is recommended for collection and removal of surface water percolation and/or groundwater along the base of any below-grade walls or site retaining walls. Proper control of surface water percolation will help to prevent buildup of higher wall pressures. In unpaved areas, the final 12 inches of backfill for walls should preferably consist of cohesive soil. This will help to reduce percolation of surface water into the backfill.

5.8 Lateral Analysis

Presented below are the recommended soil parameters, which may be used for the lateral load analysis.

• At rest:

Cohesive soil backfill (on-site clay or processed claystone) ........................................ 75 psf/ft
Compacted granular backfill (on-site sand and gravel or imported soils) ..................... 55 psf/ft
On-site unprocessed sandstone, siltstone, or claystone materials ........................ not recommended

For soils above any free water surface, recommended equivalent fluid pressures for unrestrained foundation elements (free to move laterally) are:

• Active:

Cohesive soil backfill (on-site clay or processed claystone) ................................. 50 psf/ft
Compacted granular backfill (on-site sand and gravel or imported soils) ................... 35 psf/ft
On-site unprocessed sandstone, siltstone, or claystone materials ........................ not recommended

• Passive:

Cohesive soil backfill (on-site clay or processed claystone) .............................. 275 psf/ft
Cohesionless soil backfill (on-site sand and gravel or imported soils) ....................... 375 psf/ft
Undisturbed soils or bedrock ................................................................. 400 psf/ft

The lateral earth pressures herein do not include any factor of safety and are not applicable for submerged soils/hydrostatic loading. Additional recommendations may be necessary if submerged conditions are to be included in the design.
5.9 General Site Grading, Side Slopes and Berms

General site grading to achieve desired grades must consider stable construction side slopes that should not exceed one (1) vertical to three (3) horizontal for stability and maintenance. Control of surface waters can be managed by use of interceptor channels cut at the upstream areas of the site or by use of the detention pond excavations (below the two foot depth) as a berm around the higher ground elevations to divert rainfall and other type of ground surface waters from entering the working areas proposed for the building pad areas/structure. The berm (or channel) should be of sufficient height (or depth) to divert the surface waters and of side slopes that can be easily maintained by mechanical means (i.e., grass cutting by mowing), the side slope should be either one foot vertical to three, four, or five feet horizontal (V = 1’, H = 3, 4, or 5’) as necessary based on final elevations.

5.10 Additional Recommendations for re-use of Expansive Soils

- Subgrade Grading Operations. Swelling can be controlled by placing the more expansive soils in the lower parts of the embankments and by cross-hauling or importing less expansive soils to form the upper part of the subgrade.

- Compaction and Moisture Control. Soil volume changes can also be reduced by adequate moisture and density controls during subgrade compaction. Expansive soils compacted slightly wet of optimum expand less, have higher strengths after wetting, and absorb less water.

- Non Expansive Cover. In areas with prolonged periods of dry weather, highly expansive subgrades may require a cover layer of low volume change soil. A low volume change layer with low to moderate permeability is usually more effective and less costly than permeable, granular soil. Highly permeable, open graded sub-base materials are not recommended as cover for expansive soils because they allow more moisture to reach the subgrade.

5.11 Utility Trench Excavation and Backfill

It appears that excavation for utility trenches can be readily made with a conventional excavator in either native soil or compacted imported fill. If trenches are extended deeper than five (5) feet or are allowed to dry out, the excavations may become unstable and should be evaluated to verify their stability prior to occupation by construction personnel. Shoring or sloping of any deep trench walls may be necessary to protect personnel and provide temporary stability. All excavations should comply with current OSHA safety requirements for soils (Federal Register 29 CFR, Part 1926).

During wet weather, runoff water should be prevented from entering excavations. Water should be collected and disposed of outside the construction and the construction limits. Heavy construction equipment, excavated soil, and vehicular traffic should not be allowed within a distance of at least one-third (⅓) the slope height from the top of any excavation.

We recommend all backfill be placed in compacted lifts not to exceed six (6) inches in thickness, moisture conditioned between minus two (-2) to plus three (+3) percentage points of the optimum moisture and compacted to a minimum of 95 percent of the maximum dry density determined in accordance with ASTM D-698 (Standard Proctor). Jetting and
flooding should not be permitted. Poor compaction in utility trench backfill may cause excessive settlements resulting in damage to the pavement structural section or other overlying improvements. Compaction of trench backfill outside of improvement areas should be a minimum of 90 percent relative compaction.

Another fast and economical backfill alternative is the use of flowable Controlled Low Strength Material (CLSM) mixtures due to the saving of labor and time over placing and compacting soil or granular materials. If it is anticipated or specified that the flowable lean-mix backfill may be excavated at some point in the future the strength must be much lower than the 1,200 psi which the American Concrete Institute (ACI) uses as the upper limit for CLSM. The late-age strength of removable CLSM materials should be in the range of 30 to 150 psi as measured by compressive strength in cylinders. Controlled Low Strength Material (CLSM) is defined in ACI 229R and TxDOT Item 401.

6. GENERAL REMARKS

6.1 Construction Services

We recommend that Castle Engineering & Testing, LLC be retained to provide construction materials testing services during grading and foundation construction activities. This is to observe compliance with the plans, specifications, and geotechnical recommendations and to allow design changes if the subsurface conditions differ from those anticipated before construction.

6.2 Limitations

The evaluation and recommendations submitted in this report are based, in part, upon the information obtained from the soil borings drilled. The nature and extent of variations in the soil conditions between or beyond the borings and excavations may not become evident until actual construction.

The transition lines shown on the boring logs are approximate and the actual transitions may be gradual. If changes in nature or design of the project are planned, the conclusions and recommendations in this report should be reviewed by the soils engineer and if necessary, modified. Soil samples not altered by laboratory testing will be retained for a period of 30 days and then, unless we are directed otherwise, will be discarded.

This report has been prepared for the exclusive use of City of Laredo and their design team for specific application to the proposed UNITEC WWTP Improvements - 0.36 MGD Expansion Project in Laredo, Webb County, Texas, according to accepted foundation-engineering practices. No other warranty, expressed or implied, is made.
APPENDIX

Vicinity Map

Boring Location Plan

Boring Logs

The Symbol Key Sheet

Unified Soil Classification System and Terms Sheet

Field and Laboratory Testing Procedures
# LOG OF BORING No. B-1

**PROJECT NUMBER: 17M085**  
**DATE(S) DRILLED:** 5/10/18  
**SURFACE ELEVATION:** N/A

## FIELD DATA

<table>
<thead>
<tr>
<th>SOIL SYMBOL</th>
<th>DEPTH (FT)</th>
<th>SAMPLES</th>
<th>N: BLOWS/FTP</th>
<th>TONS/SQ FT</th>
<th>RQD %</th>
<th>MINUS NO. 200 SIEVE (%)</th>
<th>MOISTURE CONTENT (%)</th>
<th>LIQUID LIMIT</th>
<th>PLASTIC LIMIT</th>
<th>DRY DENSITY (POUNDS/CU.FT)</th>
<th>COMPRESSIVE STRENGTH (TONS/SQ FT)</th>
<th>FAILURE STRAIN (%)</th>
<th>CONFINING PRESSURE (POUNDS/IN^2)</th>
<th>ATTERBERG LIMITS</th>
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## DESCRIPTION OF STRATUM

- **85** - SANDY FAT CLAY WITH GRAVEL (CH) - Grayish Brown
- **89** - SANDY FAT CLAY (CH) - Grayish Brown
- **97** - SANDY FAT CLAY (CH) - Light Gray
- **96** - SANDY FAT CLAY (CH) - Grayish Brown
- **98** - SANDY FAT CLAY (CH) - Gray

**Boring Terminated at 25 Feet**

**REMARKS:**

The borehole was backfilled with cuttings upon completion of the drilling operations.

**GROUNDWATER INFORMATION:**

Subsurface water was not encountered during or after completion of drilling operations.

**DRILLING METHOD(S):**

Straight Flight

**GEOLOGICAL SYMBOL:**

- **CH**

**PROJECT:** Unitec WWTP 0.36 MGD Expansion  
**LOCATION:** Unitec Industrial Park  
**CLIENT:** City of Laredo - Utilities Department

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[Castle Engineering & Testing, LLC logo]
### LOG OF BORING No. B-2

**PROJECT:** Unitec WWTP 0.36 MGD Expansion  
**LOCATION:** Unitec Industrial Park  
**CLIENT:** City of Laredo - Utilities Department

**PROJECT NUMBER:** 17M085  
**DATE(S) DRILLED:** 5/10/18  
**SURFACE ELEVATION:** N/A

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**REMARKS:**  
The borehole was backfilled with cuttings upon completion of the drilling operations.
# LOG OF BORING No. B-3

**PROJECT:** Unitec WWTP 0.36 MGD Expansion  
**LOCATION:** Unitec Industrial Park  
**CLIENT:** City of Laredo - Utilities Department  

**PROJECT NUMBER:** 17M085  
**DATE(S) DRILLED:** 5/10/18  
**SURFACE ELEVATION:** N/A

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**DRILLING METHOD(S):**  
Straight Flight

**GROUNDWATER INFORMATION:**  
Subsurface water was not encountered during or after completion of drilling operations.

**DESCRIPTION OF STRATUM**

- CLAYEY SAND WITH GRAVEL (SC) - Brown
- SANDY LEAN CLAY (CL) - Grayish Brown
- SANDY FAT CLAY (CH) - Gray
- SANDY FAT CLAY (CH) - Grayish Brown
- SANDY FAT CLAY (CH) - Light Olive Gray
- SANDY FAT CLAY (CH) - Light Gray
- SANDY FAT CLAY (CH) - Light Olive Brown

**REMARKS:**  
The borehole was backfilled with cuttings upon completion of the drilling operations.

Boring Terminated at 45 Feet
**LOG OF BORING No. B-4**

**PROJECT:** Unitec WWTP 0.36 MGD Expansion  
**LOCATION:** Unitec Industrial Park  
**CLIENT:** City of Laredo - Utilities Department  
**PROJECT NUMBER:** 17M085  
**DATE(S) DRILLED:** 5/10/18  
**SURFACE ELEVATION:** N/A

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**GROUNDOVER INFORMATION:**

Subsurface water was not encountered during or after completion of drilling operations.

**REMARKS:**

The borehole was backfilled with cuttings upon completion of the drilling operations.
SYMBOL KEY SHEET

MATERIAL SYMBOLS

FILL
TOPSOIL
PEAT (PT)
ORGANIC CLAY (OH)
ORGANIC SILT (OL)
CLAY PLASTIC (Ch)
CLAY (CL)
SILTY CLAY (CL-ML)
SILT PLASTIC (MH)
SILT (ML)
SAND WELL GRADED (SW)
SAND POORLY GRADED (SP)
SAND CLAYEY (SC)
SAND SILTY (SM)
SAND (SW-SC)
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GRAVEL POORLY GRADED (GP)
GRAVEL CLAYEY (GC)
GRAVEL SILTY (GM)
GRAVEL (GW-GC)
GRAVEL (GW-GM)
GRAVEL (GP-GM)
LIME-STONE
SHALE
BASALT
SANDSTONE
BEDROCK
ASPHALT
CONCRETE
BASE
MARL
CLAYSTONE

STANDARD PENETRATION TEST (ASTM D 1586) DRIVING RECORD

Note: Driving is limited to 50 blows per interval, or 25 blows for 0.25 inch advancement, whichever controls. This is done to avoid damaging sampling tools.

Blows Per Foot | Description
--- | ---
25 | Sampler was seated 6 inches, then 25 blows were required to advance the sampler 12 inches.
50/4" | Sampler was seated 6 inches, then 50 blows were required to advance the sampler 4 inches.
ref/2" | Sampler could only be driven 2 inches of the 6 inch seating penetration before the 50 blow limit was reached.

SAMPLER SYMBOLS

FLIGHT AUGER
CORE BARREL
DISTURBED SAMPLE
NO RECOVERY
PISTON SAMPLER
SHELBY TUBE (3")
SPLIT BARREL (SPT)
GRAB SAMPLE

Project Name: 0.36 MGD Expansion - Unitec WWTP
Project Number: 17M085
Figure No. 1
## TERMS DESCRIBING CONSISTENCY OR CONDITION

**COARSE-GRAINED** soils (major portions retained on No. 200 sieve): includes (1) clean gravel and sands and (2) silty or clayey gravels and sands. Condition is rated according to relative density as determined by laboratory tests or standard penetration resistance tests.

### Descriptive Terms Relative Density SPT Blow Count

<table>
<thead>
<tr>
<th>Term</th>
<th>Relative Density</th>
<th>SPT Blow Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very loose</td>
<td>0 to 15 %</td>
<td>&lt; 4</td>
</tr>
<tr>
<td>Loose</td>
<td>15 to 35 %</td>
<td>4 to 10</td>
</tr>
<tr>
<td>Medium dense</td>
<td>35 to 65 %</td>
<td>10 to 30</td>
</tr>
<tr>
<td>Dense</td>
<td>65 to 85 %</td>
<td>30 to 50</td>
</tr>
<tr>
<td>Very dense</td>
<td>85 to 100 %</td>
<td>&gt; 50</td>
</tr>
</tbody>
</table>

**FINE-GRAINED** soils (major portions passing on No. 200 sieve): includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings, SPT blow count, or unconfined compression tests.

### Unconfined Compressive Strength kPa SPT Blow Count

<table>
<thead>
<tr>
<th>Term</th>
<th>Strength kPa</th>
<th>SPT Blow Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very soft</td>
<td>&lt; 25</td>
<td></td>
</tr>
<tr>
<td>Soft</td>
<td>25 to 50</td>
<td>2 to 4</td>
</tr>
<tr>
<td>Medium stiff</td>
<td>50 to 100</td>
<td>4 to 8</td>
</tr>
<tr>
<td>Stiff</td>
<td>100 to 200</td>
<td>8 to 15</td>
</tr>
<tr>
<td>Very stiff</td>
<td>200 to 400</td>
<td>15 to 30</td>
</tr>
<tr>
<td>Hard</td>
<td>&gt; 400</td>
<td>&gt; 30</td>
</tr>
</tbody>
</table>

### Laboratory Classification Criteria

- **For GW, GP, SW, SP:**
  - **Above "A" line:**
    - C = \( \frac{D_{15}}{D_{60}} \)  greater than 6; between 1 and 3
    - \( \frac{D_{15}}{D_{60}} \) greater than 4; between 1 and 3
    - Not meeting all gradation requirements for GW

- **For SM:**
  - **Above "A" line:**
    - C = \( \frac{D_{15}}{D_{60}} \) greater than 6; between 1 and 3
    - Not meeting all gradation requirements for SM

### Plasticity Chart

- **CL** Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
- **OL** Organic silts and organic silt clay of low plasticity
- **MH** Inorganic silts, micaceous or distomaceous fine sandy or silty clays, organic silts
- **CH** Inorganic clays of high plasticity, fat clays
- **OH** Organic clays of medium to high plasticity, organic silts
- **Pt** Peat and other highly organic soils

### Notes
1. Classifications are based on the Unified Soil Classification System and include consistency, moisture, and color. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate.
2. Surface elevations are based on topographic maps and estimated locations.
3. Descriptions on these boring logs apply only at the specific boring locations and at the time the borings were made. They are not guaranteed to be representative of subsurface conditions at other locations or times.

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FIELD AND LABORATORY TESTING PROCEDURES

FIELD TESTING

A. Boring Procedure Between Samples
The borehole is extended downward, between samples by continuous flight, hollow or stem augers or by rotary drilling techniques using bentonite drilling fluid or water.

B. Penetration Test and Split-Barrel Sampling of Soils (ASTM D-1586)
This sampling method consists of driving a 2-inch outside diameter split barrel sampler using a 140 pound hammer freely falling through a distance of 30 inches. The sampler is first seated 6 inches into the material to be sampled and then driven an additional 12 inches. The number of blows required to drive the sampler the final 12 inches is known as the Standard Penetration Resistance. Recovered samples are first classified as to color and texture by the field logger. Later, in the laboratory, the field logger's classification is reviewed by the soils engineer who examines each sample.

C. Thin-Walled Tube Geotechnical Sampling of Soils (ASTM D-1587)
This method consists of pushing thin walled steel tubes, usually 3 inches in diameter, into the soils to be sampled using hydraulic or other means. Cohesive soils are usually to be sampled in this manner and relatively undisturbed samples are recovered.

D. Soil Investigation and Sampling by Auger Borings (ASTM D-1452)
This method consists of augering a hole and removing representative soil samples from the auger flight or bit at 5 foot intervals or with each change in the substrata. Disturbed samples are obtained and this method is, therefore, limited to situations where it is satisfactory to determine the approximate subsurface profile.

E. Diamond Core Drilling for Site Investigation (ASTM D-2113)
This method consists of advancing a hole into hard strata by rotating a single or double tube core barrel equipped with a cutting bit. Diamond, tungsten carbide, or other cutting agents may be used for the bit. Wash water is used to remove the cuttings and to cool the bit. Normally, a 2 inch outside diameter by ½ inch inside diameter (NX) coring bit is used unless otherwise noted. The rock or hard material recovered within the core barrel is examined in the field and in the laboratory and the cores are stored in partitioned boxes. The core recovery is the length of the material recovered and is expressed as a percentage of the total distance penetrated.

F. Visual – Manual Soil Classification Procedure (ASTM D-2488)
This procedure is a visual – manual soil classification methodology for the description of soil for engineering purposes when precise soil classification is not required.

LABORATORY TESTING

A. Atterberg Limits: Liquid Limit (LL), Plastic Limit (PL) and Plasticity Index (PI) of Soils (ASTM D-4318 or TEX 104-E, 105-E and 106-E)
Atterberg Limits determine the soil’s plasticity characteristics. The soil’s Plasticity Index (PI) is representative of this characteristic and is the difference between the Liquid Limit (LL) and the Plastic Limit (PL). The LL is the moisture content at which the soil will flow as a heavy viscous fluid. The PL is the moisture content at which the soil begins to lose its plasticity. The test results are presented on the boring logs adjacent to the appropriate sampling information.

B. Particle Size Analysis of Soils (ASTM D-422 or TEX 110-E)
Grain size analysis tests are performed to determine the particle size and distribution of the samples tested. The grain size distribution of the soils coarser than the Standard No. 200 sieve was determined by passing the sample through a standard set of nested sieves.

C. Laboratory Determination of Water (Moisture) Content of Soil and Rock (ASTM D-2216 or TEX 103-E)
The moisture content of soil is defined as the ratio, expressed as a percentage, of the weight of water in a given soil mass to the weight of solid particles. It is determined by measuring the wet and oven dry weights of a soil sample. The test results are presented on the boring logs.

D. Unconfined Compressive Strength of Cohesive Soil (ASTM D-2166)
The unconfined compressive strength of soil is determined by placing a section of an undisturbed sample into a loading frame and applying an axial load until the sample fails in shear. The test results are presented on the boring logs adjacent to the appropriate sampling information.

E. California Bearing Ratio (CBR) of Lab Compacted Soils (ASTM D-1883)
The CBR test is performed by compacting soil in a six inch diameter mold at the desired density, soaking the sample for four days under a surcharge load approximating the pavement weight and then testing the soils in punching shear. A two inch diameter piston is forced into the soil to determine the resistance to penetration. The CBR is the ratio if the actual load required to produce 0.1 inches of penetration to that producing the same penetration in a standard crushed stone.

F. Swell Test (ASTM D-4546)
The swell test is performed by confining a one inch thick specimen in a 2½ diameter stainless steel ring and loading the specimen to the approximate overburden pressure. The test specimen is then inundated with distilled water and allowed to swell for 48 hours. The volumetric swell is measured as a percentage of the total volume and is converted mathematically to linear swell.

G. Compaction Tests (ASTM D-698, D-1557, TEX 113-E and TEX 114-E)
The compaction test is performed by compacting soil in a steel mold at varying moisture contents. Layers are compacted using a hammer weight and number of blows per layer which vary with the different test procedures, ASTM D-698, D-1557, TEX 113-E and TEX 114-E. The data is plotted and the maximum unit weight and moisture content determined. The test results are given in the appendix with a notation of the test method used.

H. Classification of Soils for Engineering Purposes (Unified Soil Classification System, ASTM D-2487)
This standard describes a system for classifying mineral and organic-mineral soils for engineering purposes based on laboratory determination of particle size characteristics, liquid limit, and plasticity index shall be used when precise classification is required.

I. Amount of Material in Soils Finer Than the No. 200 (75µm) Sieve (ASTM D-1140)
There are two tests methods to cover determination of the amount of material finer than the No. 200 (75 µm) sieve by washing. Method A – Test specimen is not dispursed prior to wash sieving. Method B – Test specimen is dispursed by soaking in water containing a deflocculating agent prior to wash sieving.