LAKE HAVASU CITY

Booster Pump Station Site 4 Improvements

ITB NO. B24-PW-108029-5000433

TECHNICAL SPECIFICATIONS
VOLUME 2

LAKE HAVASU CITY

BOOSTER PUMP STATION PROJECT

TABLE OF CONTENTS

TECHNICAL SPECIFICATIONS

-

DIVISION I – GENERAL REQIREMENTS

SECTION 01050 SUMMARY OF WORK
SECTION 01040 ORDER OF CONSTRUCTION
SECTION 01060 SPECIAL CONDITIONS
SECTION 01072 PROJECT RECORD DOCUMENTS
SECTION 01200 MOBILIZATION DEMOBILIZATION
SECTION 01300 FORCE ACCOUNT
SECTION 01320 PROJECT MEETINGS-SCHEDULES AND REPORTS
SECTION 01325 CONSTRUCTION PHOTOGRPHS
SECTION 01330 SUBMITTALS
SECTION 01350 SPECIAL PROCEDURES
SECTION 01420 DEFINITIONS AND STANDARDS
SECTION 01423 REFERENCE STANDARDS
SECTION 01520 FIELD OFFICES AND SHEDS
SECTION 01530 TEMPERORARY UTILITIES AND FACILITIES
SECTION 01560 ENVIRONMENTAL PROTECTION AND SPECIAL CONTROLS
SECTION 01580 PROJECT IDENTIFICATION AND SIGNS
SECTION 01600 EQUIPMENT AND MATERIALS
SECTION 01610 REGULATORY REQUIREMENTS
SECTION 01612 SEISMIC DESIGN CRITERIA
SECTION 01631 SUBSTITUTIONS
SECTION 01650 DEMONSTRATIONS OF SYSTEMS COMMISSIONING
SECTION 01780 CONTRACT CLOSEOUT

DIVISION 2 - SITEWORK

SECTION 02100 CLEARING AND GRUBBING
SECTION 02110 REMOVAL OF EXISTING EQUIPMENT
SECTION 0220 EARTHWORK
SECTION 02300 TRENCH EXCAVATION AND BACKFILL
SECTION 02321 EXCAVATION, FILING AND BACK
SECTION 02515 UTILITY, VALVES AND ACCESSORIES
SECTION 02532 UTILITY STRUCTURES
SECTON 02535 PIPE INSTALLATION
SECTION 02550 WATER PIPING SYSTEMS
SECTION 02600 SUBGRADE PREPARATION
SECTION 02610 AGGREGATE BASE COURSE
SECTION 02810 TEMPORARY CONSTRUCTION FENCING

DIVISION 3 – CONCRETE

SECTION 03100 CONCRETE FORMWORK
SECTION 03200 CONRETE REINFORCEMENT
SECTION 03300 CAST IN PLACE
SECTION 03301 EXPOXIES
SECTION 03356 TOOLED CONCRETE FINISHES
SECTION 03600 GROUT
SECTION 03605 EPOXY BONDING REINFORCING BARS

DIVISION 5 - ANCHORS, BOLTS, AND CONCRETE INSERTS

SECTION 05052 ANCHOR BOLTS, TOGGLE BOLTS AND CONCRETE INSERTS
SECTION 05120 MISCELLANEOUS STEEL

DIVISION 7 - THERMAL MOISTURE PROTECTION

SECTION 07900 JOINT SEALERS

DIVISION 9 – PROTECTIVE COATINGS

SECTION 09900 PROTECTIVE COATINGS

DIVISION 11 – EQUIPMENT

SECTION 11005 EQUIPMENT GENERAL REQUIREMENTS
SECTION 11210 PUMPING EQUIPMENT – GENERAL STATEMENT
SECTION 11219 VERTICAL MULTI-STAGE CENTRIFUGAL PUMP
SECTION 11339 PRESSURE RELIEF VALUES
SECTION 11405 SURGE HYDROPNEUMATIC TANK

DIVISION 15 MECHANICAL

SECTION 15050 BASIC PROCESS PIPING MATERIALS AND METHODS
SECTION 15062 DUCTILE IRON PIPING
SECTION 15063 COPPER PIPING
SECTION 15075 PLASTIC PIPING AND TUBING
SECTION 15110 VALVES
SECTION 15111 BALL VALVES
SECTION 15112 BUTTERFLY VALVES, OPERATORS AND APPURTENANCES
SECTION 15514 CHECK VALVES
SECTION 15141 MECHICAL – PROCESS PIPE SUPPORTS
SECTION 15495 DISINFECTION OF PORTABLE WATER PIPING

DIVISON 16 GENERAL ELECTRICAL REQUIREMENTS

SECTION	16000	GENERAL ELECTRICAL REQUIREMENTS
SECTION	16010	GENERAL REQUIREMENTS
SECTION	16111	CONDUIT, FITTINGS AND ACCESSORIES
SECTION	16120	WIRE, CABLE AND ACCESSORIES
SECTION	16180	STARTERS, RELAYS, SWITCHES, CIRCUIT BREAKERS TVSS
SECTION	16420	SERVICE ENTRANCE SECTION
SECTION	16450	GROUNDING
SECTION	16462	PANELBOARDS
SECTION	16482	SOLID STATE MOTOR CONTROLLERS
SECTION	16500	LIGHTING
SECTION	16900	GENERAL REQUIREMENTS –INSTRUMENTS AND CONTROLS
SECTION	16901	CONTROL PANELS-INSTRUMENTS AND CONTROLS
SECTON	16902	MEASURING AND CONTROLLING INSTRUMENTS AND LOOPS
SECTION	16903	SCADA (EXTENSION OF EXISTING SYSTEM)
SECTION	16950	FIELD TESTING

DIVISION I

GENERAL REQUIREMENTS

SECTION 00020

NOTICE INVITING BIDS

Lake Havasu City

PROJECT NO.: **B24-PW-108029-500433**

PROJECT NAME: **BOOSTER STATION 4 IMPROVEMENTS**

PRE-BID MEETING: **N/A**

BID DUE DATE: **November 29, 2023**

BID DUE TIME: **3:00 p.m., ARIZONA TIME**

PROJECT DESCRIPTION:

This project consists of upgrading the existing booster pump station at Site 4 by expanding it by one pump with appurtenances, instrumentation, controls and individual soft starters on each booster pump, etc. Constructing shade canopy over extended area, all on site. Project also involves installing a PRV Station on Cherry Tree Blvd immediately adjacent to existing PRV station and connecting a water main on Cherry Tree Place.

QUESTIONS: All questions that arise relating to this solicitation shall be directed in writing to purchasing@lhcaz.gov . To be considered, written inquiries shall be received at the above-referenced email address by **November 17, 2023 at 3:00 p.m.**, Arizona Time. Inquiries received will then be answered in an Addendum.

Sealed bids for the project specified will be received by the **City Clerk's Office, 2330 N. McCulloch Boulevard, Lake Havasu City, Arizona, 86403** until the time and date stated. **Bids received by the correct time and date will be opened and read aloud immediately thereafter in Room 109 of Lake Havasu City Hall.** Public openings may be attended virtually by accessing the following video conferencing system:

To join the meeting on a computer or mobile phone:
https://bluejeans.com/2330864044?src=calendarLink
Meeting ID: 233 086 4044
Phone Dial-in
+1.408.740.7256 (US (San Jose))

+1.888.240.2560 (US Toll Free)

Bids must be clearly addressed to the City Clerk's Office, 2330 McCulloch Blvd. N, Lake Havasu City, Arizona, 86403, and received no later than the exact time and date indicated above. Late bids will not be considered under any circumstances.

Bids must be submitted in a sealed envelope with the Project Number and the bidder's name and address clearly indicated on the envelope. All bids must be completed in ink or typewritten on a form to be obtained from the specifications and a complete Invitation for Bid returned along with the offer no later than the time and date cited above.

Bid documents and specifications are available on Lake Havasu City's website at www.lhcaz.gov or on DemandStar at www.demandstar.com. For documents obtained outside of DemandStar please contact purchasing@lhcaz.gov to be added to the planholders' list.

BONDS:

Bid Bond:	10%
Labor and Material Bond:	100%
Faithful Performance Bond:	100%

Project Completion Date: _300 Calendar Days after Notice to Proceed.

Lake Havasu City reserves the right to accept or reject any or all bids or any part thereof and waive informalities deemed in the best interest of the City.

Pursuant to the Americans with Disabilities Act (ADA), Lake Havasu City endeavors to ensure the accessibility of all of its programs, facilities and services to all persons with disabilities. If you need an accommodation for this meeting, please contact the City Clerk's office at (928) 453-4142 at least 24 hours prior to the meeting so that an accommodation may be arranged.

Publication Dates: Today's News Herald October 24, 2023 & October 31, 2023
Arizona Business Gazzette October 26, 2023 & November 2, 2023

** END OF SECTION **

INTENT TO BID NOTIFICATION

ITB NO. B24-PW-108029-500433

ITB TITLE: Booster Pump Station 4 Improvements,
Project No. B24-PW-108029-500433

CLOSING DATE & TIME: November 29, 2023, at 3:00 p.m. Arizona Time

LETTER OF INTENT TO BID SUBMITTAL

This is notification that it is our present intent to submit a bid in response to the above referenced ITB. Please add our company to your planholders list.

The individual to whom all information regarding this ITB should be transmitted is:

Company Name: _____

Contact Name: _____

Street Address: _____

City, State, & Zip: _____

Phone Number: Fax Number: _____

E-Mail Address: _____

Submit this Letter of Intent by the deadline for requests for clarification and protests which must be physically received by **November 20, 2023, at 3:00 p.m., Arizona Time.**

Clarification/Protest/Question/Letter of Intent to Bid
ITB No.: **B24-PW-108029-500433**
Booster Pump Station 4 Improvements, Project No. 108029
Lake Havasu City
Administrative Services Department, Procurement Division
Email to: purchasing@lhcaz.gov

SECTION 00100
INFORMATION FOR BIDDERS

1. RECEIPT AND OPENING OF BIDS

The City of Lake Havasu City, Arizona, (hereinafter called the "Owner") invites Bids on the form attached hereto. All blanks must be appropriately filled in. The Bidder shall also complete and submit a form listing proposed subcontractor enclosed herein. Any subcontractors proposed to be used on the project not listed on this form shall not be considered when evaluating the Contractor's qualifications and ability to perform the work. Bids for **Booster Pump Station 4 Improvements, Project No. B24-PW-108029-500433** will be received by the City Clerk's office, 2330 N. McCulloch Boulevard, Lake Havasu City, Arizona 86403 no later than **November 29, 2023, at 3:00 pm Arizona Time**, where said Bids will be publicly opened and virtually read aloud immediately thereafter in Room 109 of Lake Havasu City Hall.

The Owner may consider informal any Bid not prepared and submitted in accordance with the provisions hereof and may waive any informalities or reject any and all Bids. Any Bid may be withdrawn prior to the above scheduled time for the opening of Bids or authorized postponement thereof. Any Bid received after the time and date specified shall not be considered. No Bidder may withdraw a Bid within ninety (90) days after the actual date of the opening thereof.

2. PREPARATION OF BID

Each Bid must be submitted on the prescribed Form. Each Document must be submitted with an original signature of the Bidder, as well as all witnesses indicated therein. All blank spaces for Bid prices must be filled in, in ink or typewritten, in both words and figures.

Each Bid must be submitted in a sealed envelope bearing on the outside the name of the Bidder, the Bidder's address, and the name and number of the project for which the Bid is submitted. If forwarded by mail, the sealed envelope containing the Bid must be enclosed in another envelope addressed as specified in the Bid form.

3. FACSIMILE BIDS OR MODIFICATIONS

No facsimile ("FAX") Bids or bid modifications will be accepted. Any modifications to the Bid shall be made by an authorized representative of the bidding company in person.

4. QUALIFICATIONS OF BIDDER

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

The Owner may request that the Bidder provide a list of key people for the project with their related work experience.

The Owner reserves the right to reject any Bid if the evidence submitted by or investigation of such Bidder fails to satisfy the Owner that such Bidder is properly qualified to carry out the obligations of the Contract and to complete the work contemplated therein in a timely manner. Conditional Bids will not be accepted.

All Bidders and listed subcontractors must be valid Arizona Licensed Contractors at the time of Bidding, approved by the Arizona State Registrar of Contractors to do the type and amount of work specified in these documents. In accordance with the Arizona State Registrar of Contractors, the Bidder must possess a minimum of a Class A Arizona Contractor's License to perform the type and amount of work specified in these documents. Failure of any bidder to possess all contractors' licenses as listed in the bid packet, at the time of bidding, shall result in the bid being considered non-responsive and not in substantial compliance, and any such bid shall not be considered, Refer to Section 00420, page 3, item 13.

5. ARITHMETIC DISCREPANCIES IN THE BID

A. For the purpose of the evaluation of Bids, the following will be utilized in resolving arithmetic discrepancies found on the face of the Bid Schedule as submitted by Bidders:

1. Obviously misplaced decimal points will be corrected;
2. In case of discrepancy between unit price and extended price, the unit price will govern;
3. Apparent error in extension of unit prices will be corrected;
4. Apparent errors in addition of lump sums will be corrected; and
5. In case of discrepancy between words and figures in unit prices, the amount shown in words shall govern;

B. For the purpose of Bid evaluation, the Owner will evaluate the bids on the basis of the unit prices, extensions, and totals arrived at by resolution of arithmetic discrepancies as provided above.

6. INCOMPLETE BIDS

Failure to submit a Bid on all items in the Schedule will result in an incomplete Bid and the Bid may be rejected. UNIT OR LUMP SUM PRICES MUST BE SHOWN FOR EACH BID ITEM WITHIN THE SCHEDULE.

NOTE: FAILURE TO INDICATE UNIT OR LUMP SUM PRICES IN THE APPROPRIATE COLUMN, WITH THE EXTENSION OF THE PRICES IN THE
FAR RIGHT COLUMN, WILL CAUSE THE BID TO BE "NON-RESPONSIVE".

All forms indicated in the Bid Proposal, Section 00300, must be completely filled out, executed, and submitted with the Bid. Failure to do so will render the bid "non-responsive" and the bid will not be accepted.

7. BID SECURITY

Each Bid must be accompanied by certified check, cashier's check, or a Bid Bond prepared on the form attached hereto or on a similar form acceptable to the Owner, duly executed by the Bidder as principal and having as surety thereon a surety company approved by the Owner, in the amount of ten percent (10%) of the Bid. Bid Bonds shall be valid for at least ninety (90) days after the date of the receipt of Bids. Such cash, check or Bid Bond will be returned to all except the three (3) lowest Bidders within fifteen (15) business days after the opening of Bids. The remaining checks or Bid Bonds will be returned promptly after the Owner and the accepted Bidder have executed the Contract, or if no award has been made within ninety (90) days after the date of the opening of Bids, upon demand of the Bidder at any time thereafter, so long as he has not been notified of the acceptance of his Bid.

8. LIQUIDATED DAMAGES FOR FAILURE TO ENTER INTO CONTRACT

The successful Bidder, upon his failure or refusal to execute and deliver the Contract, Bonds, and certificates required within ten (10) calendar days from the date of the Notice of Award, shall forfeit to the Owner, as liquidated damages for such failure or refusal, the difference between his bid and the amount of the contract actually entered into with another party should he not enter into a contract at the bid price and provide the required payment and performance bonds and certificates of insurance. Liquidated damages for failure to enter the contract shall not exceed the amount of the Bid Bond.

9. SECURITY FOR FAITHFUL PERFORMANCE AND PAYMENT

Simultaneously with his delivery of the executed Contract, the Bidder shall furnish on the forms provided herein, in 100% of the amount of this Contract, 1) a surety bond as security for faithful performance of this Contract, and 2) a surety bond as security for the payment of all persons performing labor on the project under this Contract and persons furnishing materials in connection with this Contract, and 3) a listing of all subcontractors who will be performing or providing more than one-half
percent (0.50%) of the contract work, as specified in the General Conditions included herein. The surety on such bond or bonds shall be a duly authorized surety company satisfactory to the Owner, listed on the Treasury Department's most current list (Circular 570 as amended), and authorized to transact business in the State of Arizona.

10. POWER OF ATTORNEY

Attorneys-in-fact who sign Bid Bonds or Contract bonds must file with each bond a certified and effectively dated copy of their power-of-attorney.

11. LAWS AND REGULATIONS

The Bidder's attention is directed to the fact that all applicable Federal Laws, State Laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the Contract throughout, and they will be deemed to be included in the Contract the same as though herein written out in full.

12. METHOD OF AWARD

A. The City will award the Contract on the basis of the Bid or Bids most advantageous to the City. In determining whether a Bid is most advantageous, in addition to price, the City may consider the following:

1. The ability, capacity, and skill of the Bidder to perform the Contract or provide the service indicated.
2. Whether the Bidder can perform the Contract or provide the service promptly, and within the time specified without delay or interference.
3. The character, integrity, reputation, judgment, experience, and efficiency of the Bidder.
4. The quality of performance on previous contracts;
5. The previous compliance with laws and ordinances by the Bidder;
6. The financial responsibility of the Bidder to perform under the Contract or provide the service;
7. The limitations of any license the Bidder may be required to possess;
8. The quality, availability,and adaptability of the product or service;
9. The ability of the Bidder to provide future maintenance and/or service;
10. The number and scope of any conditions attached to the Bid; and;
11. The life cycle, maintenance, and performance of the equipment or product being offered.

13. OBLIGATION OF THE BIDDER

At the time of the opening of Bids, each Bidder will be presumed to have inspected the site and to have read and to be thoroughly familiar with the Plans and Contract documents (including all Addenda, if applicable). The failure or omission of the Bidder to examine any form, instrument or document, or site changes due to natural causes, shall in no way relieve any Bidder from any obligation in respect to his Bid. Site changes due to natural causes prior to Bid opening shall not be cause for Bid alteration or withdrawal.

14. TIME OF COMPLETION AND LIQUIDATED DAMAGES

The Bidder must agree to commence work on or before a date to be specified in a written "Notice to Proceed" from the Owner, and to complete the work within 240 calendar days of the date of the Notice to Proceed.

The Bidder further agrees to pay as liquidated damages, the sum indicated in the following Schedule of Liquidated Damages for each consecutive calendar day thereafter, plus any additional costs incurred by the Engineer as provided in Section 17 of the General Conditions, that the Contract remains incomplete. For the purposes of determining the Liquidated Damages for the project, the Original Contract Amount shall be that which is included in the Contract between the Owner and the Contractor for the project.

SCHEDULE OF LIQUIDATED DAMAGES		
Original Contract Amount		Daily Charges
From More Than	To and Including	Calendar Day or Fixed Rate
0	25,000	210
25,000	50,000	250
50,000	100,000	280
100,000	500,000	430
500,000	1,000,000	570
1,000,000	2,000,000	710
From More Than	To and Including	Calendar Day or Fixed Rate
2,000,000	5,000,000	1,070
5,000,000	10,000,000	1,420
10,000,000	---0---	1,780

15. CONDITIONS OF WORK

Each Bidder must inform himself fully of the conditions relating to the construction of the project and the employment of labor thereon. Failure to do so will not relieve a successful Bidder of his obligation to furnish all material and labor necessary to carry out the provisions of his Contract. Insofar as possible, the Contractor, in carrying out his work, must employ such methods or means as will not cause any interruption of or interference with the work of any other Contractor.

16. ADDENDA AND INTERPRETATIONS

All questions that arise relating to this solicitation shall be directed in writing to:

[PROCUREMENT CONTACT Shannon Blakey, Management Specialist]
purchasing@lhcaz.gov
Administrative Services Department, Procurement Division
Lake Havasu City
2330 McCulloch Blvd. North
Lake Havasu City, AZ 86403

To be considered, written inquiries shall be received by the above-referenced contact by November 17, 2023 at 3:00 p.m. Arizona Time. Inquiries received will then be answered in an Addendum. Any and all such interpretations and any supplemental instructions will be in the form of written Addenda to the Specifications which, if issued, will be available to all prospective Bidders, not later than five (5) calendar days prior to the date fixed for the opening of Bids. Failure of any Bidder to incorporate any such Addendum or interpretation shall not relieve such Bidder from any obligation under his/her Bid as submitted. All Addenda so issued shall become part of the Contract documents.

No informal contact initiated by offerors on this solicitation will be allowed with members of City staff from the date of distribution of this solicitation until after the closing date and time for the submissions of quotations. All questions or issues related to this solicitation shall be submitted in writing.

17. CONFLICT OF INTEREST

Pursuant to A.R.S. Section 38-511, this Contract is subject to cancellation by Buyer if any person significantly involved initiating, negotiating, securing, drafting or creating the Contract on behalf of Lake Havasu City is, at any time while the Contract is in effect, an employee of any other party to the Contract in any capacity or a consultant to any other party of the Contract with respect to the subject matter of the Contract.

18. NO COLLUSION

The bidder will be required to complete, notarize and submit as part of this bid package the "No Collusion Affidavit" form, as attached herein. Failure of the bidder to submit a properly executed affidavit may be grounds for rejection of the bid.

19. EMPLOYMENT ELIGIBILITY VERIFICATION

The bidder will be required to complete, notarize, and submit as part of this bid package the "Employer Verification of Employment Eligibility" form, as attached herein. Failure of the bidder to submit a properly executed verification of eligibility form may be grounds for rejection of the bid.

20. EXAMINATION OF THE PLANS AND SPECIFICATIONS

Each Bid shall be made in accordance with the Plans and Specifications which may be examined at the following locations:

A. Lake Havasu City, 2330 N. McCulloch Boulevard, Lake Havasu City, AZ 86403, 928.855.2116

B. Dodge Data & Analytics, 3315 Central Avenue, Hot Springs, AR, 71913, 871.375.2946, FAX 501.625.3544, www.construction.com, dodge.bidding@construction.com

C. Colorado River Building Industry Association, 2182 McCulloch Blvd, Suite 3, Lake Havasu City, AZ 86403, 928.453.7755, FAX 928.453.3175, www.crbia.org, frontdesk@criba.org

D. Northern AZ Home Builders, 1500 E. Cedar Avenue, Suite 86, Flagstaff AZ 86004, 928.779.3071, FAX 928.779.4211, www.nazba.org, info@nazba.org

E. Performance Graphics Blueprinting, 4140 Lynn Drive, Suite 107, Fort Mohave, AZ, 86426, 928.763.6860, FAX 928.763.6835, prints@pgblueprinting.net

F. Construction Market Data, 30 Technology Parkway South, Suite 500, Norcross, GA 30092-2912, 800.876.4045, FAX 800.303.8629, www.cmdgroup.com, projects@cmdgroup.com

G. ISqFt, 3301 N 24th Street, Phoenix, AZ, 85016, 800.364.2059, FAX 800.792.7508, www.isqft.com, arizonaRianroom@isqft.com

H. Integrated Digital Technologies, LLC, 4633 E Broadway Blvd., Tucson, AZ 85711, PO Box 13086, Tucson AZ, 85732, 520.319.0988, FAX, 520.319.1430; content@idtRians.com

I. Yuma/Southwest Contractors Association, 350 W. 16th Street, Suite 207, Yuma, AZ 85364, Phone:928-539-9035, Fax:928-539-9036, www.yswca.com, Rlans@yswca.com

J. Arizona Builders Exchange, 1700 N. McClintock Drive, Tempe, AZ, 85281, (480) 227-2620, www.azbex.com, rkettenhofen@azbex.com

K. Construction Reports.com, 4110 N Scottsdale Road, Suite 335, Scottsdale, AZ, 85251, 480.994.0020, FAX 480.994.0030,

www.constructionreRorts.com, jess@constructionreRorts.com

L. Construction Reporter, 1609 2nd Street NW, Albuquerque, NM, 87102, 505.243.9793, FAX 505.242.4758, www.constructionreRorter.com, jane@constructionreRorter.com

M. PlanRoom Central at A&E Reprographics, 1030 Sandretto Drive, Suite F, Prescott, AZ, 86305, 928.442.9116, www.a-erero.com, planroom1@a-erero.com

N. Shirley's Plan Service, 425 S. Plumer Ave, Tucson, AZ, 85719, 520.791.7436, FAX 520.882.9208, www.shirleysRianservice.com, bids@shirleysRianservice.com

O. Construction Notebook Nevada, 3131 Meade Ave, Suite B, Las Vegas, NV, 89102-7885, 702.876.8660, FAX 702.876.5683, www.constructionnotebook.com

P. The Blue Book Building & Construction Network, Jefferson Valley, NY 10535, 800.431.2584, www.thebluebook.com info@thebluebook.com, tdizon@mail.thebluebook.com

Q. Integrated Marketing Systems (IMS), 945 Hornblend Street, Suite G, San Diego, CA 92109, 888.467.3151, FAX 858.490.8811, www.imsinfo.com, ims@imsinfo.com

** END OF SECTION **

SECTION 00300
BID PROPOSAL

Lake Havasu City, Arizona

The undersigned, as bidder, declares that we have received and examined the documents entitled **Booster Pump Station 4 Improvements, Project No. B24-PW-108029 -500433** and will contract with the Owner, on the form of Contract provided herewith, to do everything required for the fulfillment of the contract for the construction of the **Booster Pump Station 4 Improvements, Project No. B24-PW-108029-500433,** the prices and on the terms and conditions herein contained.

We agree that the Contract Documents include Volumes I and II of the Contract Documents as well as the referenced documents.

We agree that the following shall form a part of this proposal and are included herein as our submittal:

Section	Title	Enclosed (Mark X)
00300	**Bid Proposal**	
00310	**Bid Schedule**	
00400	**Arizona Statutory Bid Bond**	
00420	**Bidder's Statement of Qualifications**	
00430	**Affidavit of Contractor Certifying That There Was No Collusion In Bidding for Contract**	
00450	**Hazard Communication Program**	
00460	**Employment Eligibility Verification**	

We acknowledge that addenda numbers _____ through _____ have been received and have been examined as part of the Contract Documents.

We certify that our proposal is genuine, and not sham or collusive, nor made in the interest or behalf of any undisclosed person, organization, or corporation, and that we have not directly or indirectly induced or solicited any other bidder to put in a sham bid, or directly or indirectly inducted or solicited any other potential bidder to refrain from bidding, and that we have not in any manner sought by collusion to secure an advantage over any other bidder.

The bidder agrees that this Bid shall be good and may not be withdrawn for a period of ninety (90) calendar days after the scheduled closing time for receiving Bids.

Upon receipt of written notice of the acceptance of this bid, Bidder shall execute the formal Contract attached within 10 days and deliver a Performance Bond, Payment Bond, and Certificates of Insurance as required by Paragraph 25 of the General Conditions and the Special Provisions.

We hereby declare that we have visited the site and have carefully examined the Contract Documents relating to the work covered by the above bid or bids.

Enclosed herewith is a certified or cashier's check or bid bond, payable to Lake Havasu City, Arizona, in the amount of ten percent (10%) of the total bid. This check or bond is submitted as a guarantee that we will enter into a Contract and furnish the required bonds in the event a contract is awarded us. The bid security attached, without endorsement, is to become the property of Lake Havasu City, Arizona, in the event the Contract and Bonds are not executed within the time set forth, as liquidated damages for delay and additional work caused thereby.

Cooperative Use of Contract

This solicitation is being prepared by the City of Lake Havasu, Arizona ("City") for the use of the City. While this solicitation is for the use of the City, other eligible public agencies may have an interest in utilizing the resulting contract. After an award, and with the approval of the bidder, this solicitation may be utilized by eligible public agencies. Any such usage by other entities must be in accordance with the ordinance, charter and/or procurement rules and regulations of the respective political entity.

Please indicate below your acceptance or rejection regarding such participation of other governmental entities. Your response will not be considered a bid response requirement in awarding a contract. If you do not wish to grant such access to other eligible public agencies, please so state in your bid response below. In the absence of a statement to the contrary, the City will assume that you do wish to grant access to any contract that may result from this solicitation.

Bidder hereby grants _____, or does not grant_____, cooperative purchase access to other eligible public agencies.

We understand that Lake Havasu City, Arizona reserves the right to reject any and/or all bids, or to waive any informalities in any bid, deemed by them to be for the best interests of Lake Havasu City, Arizona.

Dated in _____ this _____ day of _____.

Respectfully Submitted By:

By: _____

Title: _____

Name of Firm:_____

Address: _____

Phone: _____ FAX: _____

Email Address: _____

Seal - If bid by a Corporation:

Arizona Contractor's License No.: _____Type: _____

Federal Tax ID No.:_____

** END OF SECTION **

BID SCHEDULE
LAKE HAVASU CITY

Booster Pump Station 4 Improvements
Project No. B24-PW-108029-500433

Lake Havasu City Council
Lake Havasu City
2330 N. McCulloch Boulevard
Lake Havasu City, AZ 86403

The City Council:

Pursuant to request for bids to be opened November 29, 2023, at 3:00 P.M., Arizona Time, at Room 109 of Lake Havasu City Hall, for the above project, the Contractor proposes to complete work, including furnishing all labor and materials, per the Specifications and Plans at the Following prices.

This Schedule of Items and Prices shall be completed in ink or typed by the Bidding Contractor. In case of discrepancy between the word and figure amount description, the word description shall control extensions.

Prices must be entered for each item and the appropriate subtotal and total blank shall be filled out. Bid prices shall include sales tax and all other applicable taxes and fees.

Bidder agrees to perform all the necessary work to complete the **Booster Pump Station 4 Improvements, Project No. B24-PW-108029-500433**

SECTION 0310

BID SCHEDULE - BOOSTER STATION 4 IMPROVEMENTS, B24-PW-108029-500433

ITEM NO.	DESCRIPTION	EST QTY	UNIT OF MEASURE	UNIT PRICE (*1) (WORD)	UNIT PRICE (FIGURE)	ITEM TOTAL (*2) COSTS
BASE BID						
1	Mobilization/Demobilization, Bonds, Permitting and Insurance	1	L.S.		$	$
2	All demolition work including piping, mechanical, electrical and civil work at BPS 4	1	L.S.		$	$
3	All mechanical work including piping, pumps, valves, meters, tanks, and appurtenances at BPS 4	1	L.S.		$	$
4	All civil/site, fencing, grading and concrete works at BPS 4	1	L.S.		$	$
5	All work associated with Cherry Tree Blvd PRV & Cherry Tree Lane Connection	1	L.S.		$	$
6	Metal Shade Canopy	1	L.S.		$	$
7	Painting and Coating	1	L.S.		$	$
8	All electrical and instrumentation work	1	L.S.		$	$
9	Force Account	1	L.S.	Fifty Thousand Dollars	$50,000.00	$50,000.00
	TOTAL BID(*3) + FORCE ACCOUNT				$	$

Above line items and totals shall include all work shown on the plans and specified herein, including taxes, insurance and bonding.

*1 The "Unit Price" column shall indicate unit or lump sum prices for each bid item and shall be indicated in written and numerical form.

*2 The "Item Total Costs" column shall indicate the extension of the unit prices, which is obtained by multiplying the "Estimated Quantity" column by the "Unit Price" column.

*3 The "Bid Total" amount shall be the sum of all costs listed in the "Item Total Costs" column.

The total lump sum prices for **Booster Pump Station 4 Improvements. Project No. B24-PW-108029-500433,** shall include all labor, materials, shoring, removal, disposal, overhead, profit, insurance, taxes, and all other related costs and work to cover the finished work of the several kinds called for. Changes in the Contract shall be processed in accordance with Paragraph 16 of the General Conditions.

Bidder understands that the Owner reserves the right to reject any or all Bids, or portions thereof, and to waive any informalities in the bidding.

The Bidder agrees that this Bid shall be good and may not be withdrawn for a period of ninety (90) calendar days after the scheduled closing time for receiving Bids.

Upon receipt of written notice of the acceptance of this Bid, Bidder shall execute the formal Contract attached within 10 days and deliver a Performance Bond, Payment Bond, and Certificates of Insurance as required by Paragraph 25 of the General Conditions and the Special Provisions.

The Bid security attached in the sum of $ is to become the property of the Owner in the event the Contract and Bond(s) are not executed and provided within the time above set forth, as liquidated damages for the delay and additional expense to the Owner caused thereby.

Bidder hereby acknowledges receipt of the following Addenda: ___, ___, ___.

RESPECTFULLY SUBMITTED BY:

BY: _____

TITLE: _____

FIRM: _____

ADDRESS: _____

_____

PHONE: _____FAX_____

EMAIL: _____

Seal - if Bid by a corporation

AZ Contractor's License No: _____ Type_____

** END OF SECTION **

SECTION 00400
ARIZONA STATUTORY BID BOND

PURSUANT TO TITLES 28, 34 AND 41, ARIZONA REVISED STATUTES
(Penalty of this bond must not be less than 10% of the bid amount)

KNOW ALL MEN BY THESE PRESENTS:

That, _____(hereinafter "Principal"), as Principal, and _____, (hereinafter "Surety"), a corporation organized and existing under the laws of the State of _____, with its principal offices in the City of _____, holding a certificate of authority to transact surety business in Arizona issued by the Director of the Department of Insurance pursuant to Title 20, Chapter 2, Article 1, as Surety, are held and firmly bound unto Lake Havasu City, Arizona, (hereinafter "Obligee"), as Obligee, in the amount of Ten Percent (10%) of the amount of the bid of Principal, submitted by Principal to the Obligee for the work described below, for the payment of which sum, the Principal and Surety bind themselves, and their heirs, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid for:

Booster Pump Station 4 Improvements, Project No. B24-PW-108029-500433

NOW, THEREFORE, if the Obligee shall accept the proposal of the Principal and the Principal shall enter into a contract with the Obligee in accordance with the terms of the proposal and give the bonds and certificates of insurance as specified in the standard specifications with good and sufficient surety for the faithful performance of the contract and for the prompt payment of labor and materials furnished in the prosecution of the contract, or in the event of the failure of the Principal to enter into the contract and give the bonds and certificates of insurance, if the Principal pays to the Obligee the difference not to exceed the penalty of the bond between the amount specified in the proposal and such larger amount for which the Obligee may in good faith contract with another party to perform the work covered by the proposal then this obligation is void. Otherwise, it remains in full force and effect provided, however, that this bond is executed pursuant to the provisions of Section 34-201, Arizona Revised Statutes, and all liabilities on this bond shall be determined in accordance with the provisions of that section to the extent as if it were copied at length herein.

Witness our hands this ___day of_____, _____.

PRINCIPAL	SEAL	SURETY	SEAL

By: _____ By: _____
Principal Attorney-in-Fact

Its: _____ _____
Principal's Title Agency of Record

_____
Agency Address

** END OF SECTION **

SECTION 00420
BIDDER'S STATEMENT OF QUALIFICATIONS

The Undersigned certifies the truth and correctness of all statements and of all answers to questions made hereinafter.

SUBMITTED TO: Lake Havasu City, Arizona
2330 N. McCulloch Boulevard
Lake Havasu City, AZ 86403

SUBMITTED BY: NAME:_____

ADDRESS:_____

PRINCIPAL OFFICE: _____

[ ] Corporation
[ ] Partnership
[ ] Individual
[ ] Joint Venture
[ ] Other

(NOTE: Attach separate sheets as required)

1. How many years has your organization been in business as a Contractor?

2. How many years has your organization been in business under its present business name?

3. If a Corporation, answer the following:
   Date of Incorporation: _____
   State of Incorporation:_____
   President: _____
   Vice President(s): _____
   _____
   Secretary: _____
   Treasurer: _____

4. If a Partnership, answer the following:
   Date of organization: _____
   Type of Partnership: _____
   (General/Limited/Assoc.)
   Name and Address of all partners.
   _____
   _____

5. If other than a Corporation or Partnership, describe Organization and name Principals:
   _____

6. What percent of the work do you normally perform with your own forces?

List trades:

7. Have you ever failed to complete any work awarded to you? If so, indicate when, where and why:

_____

_____

_____

8. Has any Officer or Partner of your Organization ever been an Officer or Partner of another Organization that failed to complete a construction contract? _____If so, state circumstances:

_____

_____

9. List major construction projects your Organization has under contract on this date:

Project Name	Name, Email Address & Telephone Number of Owner	Project Location	Contract Amount	Contract Date	Percent Complete	Scheduled Completion

10. List similar construction projects your Organization has completed in the past five years:

Project Name	Name, Email Address & Telephone Number of Owner	Project Location	Contract Amount	Date Awarded	Date Completed	Percent with Own Forces

11. List the construction experience of the principal individuals in your Organization:

Individual's Name	Construction Experience - Years	Within Your Organization		
		Present Position & Years Experience	Dollar Volume Responsibility	Previous Position & Years Experience

12. List states and categories in which your Organization is legally qualified to do business:

_____
_____
_____

13. List all Arizona Contractor licenses currently held by your Organization; the status of each license; and provide a photocopy of each license with your bid proposal.

	License Class / #	Status
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____

Please attach a list of additional Arizona Contractor licenses, if any.

14. Bank References:

_____
_____
_____

15. Trade References:

_____
_____
_____

16. Name of Bonding and Insurance Companies and Name and Address of Agents: Maximum Bonding Capacity _____

_____
_____

17. The Undersigned agrees to furnish, upon request by the Owner, within seven days after the Bid Opening, a current Statement of Financial Conditions, including Contractor's latest regular dated financial statement or balance sheet which must contain the following items:

Current Assets: (Cash, joint venture accounts, accounts receivable, notes receivable, accrued interest on notes, deposits, and materials and prepaid expenses), net fixed assets and other assets.

Current Liabilities: (Accounts payable, notes payable, accrued interest on notes, provision for income taxes, advances received from owners, accrued salaries, accrued payroll taxes), other liabilities, and capital (capital stock, authorized and outstanding shares par values, earned surplus).

Date of statement or balance sheet: _____

Name of firm preparing statement: _____

By: _____
(Agent and Capacity)

18. List of Subcontractors. In accordance with paragraph 1.0 of Instructions to Bidders, the following is a breakdown of all subcontractors anticipated to be used for completing this project and their approximate percentage of work to be performed.

The Bidder certifies that all Subcontractors listed are eligible to perform Work on public works projects pursuant to ARS 34-241.

Subcontractor	Description of Work	% of Total Project
	Total % of all Subcontractor's work on project	
	Total % for Prime Contractor	

19. Dated at _____ this _ day of _____, _____

Name of Organization: _____

By: _____

Title: _____

** END OF SECTION **

SECTION 00430
AFFIDAVIT OF CONTRACTOR CERTIFYING THAT THERE WAS NO COLLUSION IN BIDDING FOR CONTRACT

STATE OF)
) ss
CITY OF)

(NAME OF INDIVIDUAL)

BEING DULY SWORN, DEPOSES AND SAYS:

THAT HE IS_____
(TITLE)

OF _____
(NAME OF BUSINESS)

THAT PURSUANT TO SECTION 34-253 OF THE ARIZONA REVISED STATUTES, HE CERTIFIES AS FOLLOWS:

THAT NEITHER HE NOR ANYONE ASSOCIATED WITH SAID

_____
(NAME OF BUSINESS)

HAS DIRECTLY, OR INDIRECTLY, ENTERED INTO ANY CONTRACT, PARTICIPATED IN ANY COLLUSION OR OTHERWISE TAKEN ANY ACTION IN RESTRAINT OF FREE COMPETITIVE BIDDING IN CONNECTION WITH THIS PROJECT.

_____
NAME

_____
TITLE

_____
NAME OF BUSINESS

SUBSCRIBED AND SWORN TO BEFORE ME THIS __ DAY OF _____, _____

MY COMMISSION EXPIRES: _____

NOTARY PUBLIC: _____

** END OF SECTION **

SECTION 00450
HAZARD COMMUNICATION PROGRAM
Lake Havasu City

HAZARD COMMUNICATION PROGRAM FOR_____
(*Name of Company*)

The purpose of this program is to ensure that potential hazards and hazard control measures for chemicals used by this company are understood by company employees.

The written program is available for employee review at any time. It is located _____. A copy of the program will be provided to any employee or employee representative, upon request.

CONTAINER LABELING:

_____ will verify that all containers received for use by this company will:
(name/title of individual)

* be clearly labeled as to the contents, matching identification on MSDS;
* note the appropriate hazard warnings;
* List the name and address of the manufacturer.

No containers will be released for use until the above data is verified.

MATERIAL SAFETY DATA SHEETS:

Copies of MSDS's for all hazardous chemicals to which employees may be exposed will be kept _____.
_____ will be responsible for ensuring that:
(Name/title of individual)

* MSDS's for the new chemicals are available;
* MSDS's will be available for review to all employees during each work shift;
* Copies will be available on request.

EMPLOYEE TRAINING AND INFORMATION:

Each employee will be provided the following information and training before working in areas where hazardous chemicals exist. In addition, if a new hazardous material is introduced into the workplace, affected employees will be given new information and training concerning that material.

A. Minimum Information Provided:

(1) All operations and locations in the work area where hazardous chemicals are present.

GENERAL INDUSTRY

A. Minimum Information Provided:

(1) The location and availability of the written hazard communication program, including list(s) of hazardous chemicals used and related material safety data sheets;

(2) The method the company will use to inform employees of potential hazards of non-routine tasks (jobs that are not routine for an individual because of infrequency, location or type.)

B. Minimum Training Provided:

(1) Methods and observations used to detect the presence or release of a hazardous chemical in the work area (such as company monitoring programs, continuous monitoring device, visual appearance, and odor or to other characteristics of hazardous chemicals;

(2) The physical and health hazards of chemicals in the assigned work area;

(3) The measures to take to protect against such hazards, including specific company procedures concerning work practices, emergencies and care and use of protective equipment.

(4) Details of the company hazard communication program, including explanation of the labeling system, the material safety data sheets, and how to obtain and use the appropriate hazard information.

(OPTIONAL) Upon completion of the training, each employee will sign a form acknowledging receipt of the written hazard communication program and related training.

HAZARDOUS NON-ROUTINE TASKS: (If applicable.)

If company employees are required to do hazardous non-routine tasks, such as welding in confined spaces, or cleaning of tanks, the employer must address how the employees doing the work will be informed about the specific hazards to which they will be exposed, what personal protective equipment will be provided and who will be responsible to oversee the operation or operations. If the company does not have any hazardous non-routine tasks, line through this section and state "NO HAZARDOUS NON-ROUTINE TASKS".

CHEMICALS IN UNLABELED PIPES: (If applicable.)

If the company has chemicals in unlabeled pipes, the company must inform the employees of the hazards associated with those chemicals. If the company does not have any chemicals in unlabeled pipes, line through this section and state "NO CHEMICALS IN UNLABELED PIPES".

INFORMING CONTRACTORS:

Providing contractors and their employees with the following information is the responsibility of _____.
(Name/title of individual)

(1) Hazardous chemicals to which they may be exposed while on the job site;
(2) Measures the employees may take to lessen the possibility of exposure;
(3) Steps the company has taken to lessen the risks;
(4) Where the MSDS's are for chemicals to which they may be exposed;
(5) Procedures to follow if they are exposed.

CONTRACTORS INFORMING EMPLOYERS:

Contractors entering this workplace with hazardous materials will supply this employer with MSDS's covering those particular products the contractor may expose this company's employees to while working at this site.

LIST OF HAZARDOUS CHEMICALS IN THIS WORKPLACE

_____

_____

_____

_____

CONTRACTOR:

By: _____

Name: _____

Title: _____

Address: _____

** END OF SECTION **

LAKE HAVASU CITY
EMPLOYMENT ELIGIBILITY VERFICATION & FORM

INSTRUCTIONS FOR COMPLETION OF EMPLOYMENT ELIGIBILITY VERIFICATION FORM

WHO MUST COMPLETE THIS FORM?

In accordance with Lake Havasu City Code Chapter 3.30, Employment of Unauthorized Aliens, all contractors, and subcontractors furnishing labor, time, or effort for construction or maintenance of any structure, building, transportation facility, or improvements of real property must complete this form.

Contractors or subcontractors, as described above, must certify that they have complied, in good faith, with the applicable requirements of the Federal Immigration Control and Reform Act with respect to the hiring of covered employees. This certification must be executed by an authorized representative.

WHEN THIS FORM MUST BE COMPLETED?

This form must be completed by all contractors and subcontractors and submitted to the City department awarding the contract, license agreement, or lease no later than notification of successful direct selection, bid, request for proposals, request for qualification, or any similar competitive or noncompetitive procurement or bidding process.

LIST OF ACCEPTABLE DOCUMENTS:

LIST A		LIST B		LIST C
Documents that Establish Both	**OR**	**Documents that Establish**	**AND**	**Documents that Establish**
U.S. Passport (unexpired or expired)		Driver's license or ID Card issued by a state or outlying possession of the United States provided it contains a photograph or information such as name date of birth		U.S. social security card issued by the Social Security Administration
Certificate of U.S. Citizenship		ID card issued by a federal, state or local government agencies or entities, provided it contains a photograph or information		Certification of Birth Abroad issued by the Department of State
Certificate of Naturalization		School ID card with photograph		Original or certified copy of a birth certificate issued by a state, county, municipal authority or outlying
Unexpired foreign passport with I-551 stamp or attached federal Form I-94		Voter's registration card		Native American tribal document
Permanent Resident Card or Alien		U.S. Military card or draft record		U.S. Citizen ID Card
Unexpired Temporary		Military dependent's ID card		ID Card for the use of Resident Citizen in the
Unexpired Employment		U.S. Coast Guard Merchant Mariner Card		Unexpired employment authorization document issued by DHS
Unexpired Reentry		Native American tribal		
Unexpired Refugee Travel Document		Driver's license issued by a		
Unexpired Employment Authorization Document issued by DHS that contains a		For persons under age 18 who are unable to present a document listed above: School record or report card; Clinic.		

LAKE HAVASU CITY
EMPLOYMENT ELIGIBILITY VERFICATION & FORM

The undersigned attests under penalty of perjury, that they have reviewed the documents presented to them by their employees, and that the documents provided to the undersigned by their employees, as more particularly identified in the attached exhibit entitled "list of acceptable documents" appear to be genuine and appear to relate to the employee name, and to the best of the undersigned's knowledge, the employee is eligible to work in the United States based upon the undersigned's review of the documents presented.

Signature of Authorized Representative of Covered Employer/Contractor/ Subcontractor	Print Name	Title
Business or Organization Name	Business Phone Number	Date (month/date/year)
Address (Street Name and Number)		
City, State, Zip Code		

SECTION 00500
CONTRACT

THIS CONTRACT is entered into by and between LAKE HAVASU CITY, ARIZONA, a municipal corporation ("OWNER"), and _____a(n) ARIZONA corporation,
Federal I.D. _____"CONTRACTOR").

WHEREAS, OWNER has developed plans for and desires to commence the **Booster Pump Station 4 Improvements, Project No. B24-PW-108029-500433** ("PROJECT"); and

WHEREAS, CONTRACTOR represents that it possesses the experience, competence, equipment and financing to properly complete the PROJECT, and has formally proposed to do so, and to furnish all necessary labor, materials, and equipment and services therefore in accordance with said plans, and subject to the terms and conditions hereof.

NOW, THEREFORE, in consideration of these promises and the mutual covenants herein, it is hereby agreed as follows:

1. CONTRACTOR shall commence and complete the construction of the PROJECT;

2. CONTRACTOR shall furnish all of the material, supplies, tools, equipment, labor and other services necessary for the construction and completion of the PROJECT.

3. CONTRACTOR shall commence the PROJECT in accordance with the CONTRACT DOCUMENTS within TEN (10) calendar days after the date of the Notice to Proceed. Final completion of the PROJECT shall occur within **300 calendar days** of the date of the Notice to Proceed. The period for completion may be extended through the authorized and approved change order process.

4. Liquidated Damages: OWNER and CONTRACTOR recognize that time is of the essence of this CONTRACT and that OWNER will suffer financial loss if the PROJECT is not completed within the time specified in paragraph 3 above, plus any extensions thereof allowed in accordance with the General Conditions. They also recognize the delays, expense and difficulties involved in proving in a legal or arbitration proceeding the actual losses or damages (including special, indirect, consequential, incidental and any other losses or damages) suffered by OWNER if a complete acceptable PROJECT is not delivered on time.

   Accordingly, and instead of requiring proof of such losses or damages, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) CONTRACTOR shall pay the OWNER **$XXX** for each calendar day that expires after the time specified in paragraph 3 for delivery of acceptable Bid Items, plus any costs incurred by the Engineer as provided in Section 17 of the General Conditions.

5. CONTRACTOR agrees to complete the PROJECT in accordance with all of the terms and conditions of the CONTRACT DOCUMENTS for the sum of **$XXXXX** as shown in the Bid Schedule.

6. CONTRACTOR shall submit a completed Section 00450 entitled Hazard Communication Program with the executed copy of this CONTRACT.

7. The term "CONTRACT DOCUMENTS" means and includes the following:

00020 Notice Inviting Bids
00100 Information for Bidders
00300 Bid Proposal
00310 Bid Price Schedule
00400 Bid Bond
00420 Bidder's Statement of Qualifications
00430 Bidder's Affidavit of No Collusion
00450 Hazard Communication Program
00460 Employment Eligibility Verification
00500 CONTRACT
00500A Indemnification and Insurance Requirements
00500B Contractor Claim Handling Procedure
00510 Arizona Statutory Performance Bond
00520 Arizona Statutory Payment Bond
00670 Notice of Award
00680 Notice to Proceed
00685 Certificate of Substantial Completion
00690 Certificate of Final Completion
00700 General Conditions
00800 Special Provisions
Technical Specifications and Details
Construction Contract Drawings
Change Orders
Lien Releases (Conditional and Final)
Addenda

8. OWNER shall pay CONTRACTOR in the manner and at such times as set forth in the General Conditions and in such amounts as required by the CONTRACT DOCUMENTS.

9. In the event CONTRACTOR fails to perform any portion of the PROJECT or satisfy any term or condition of the CONTRACT DOCUMENTS, OWNER may at its sole discretion file notice and/or claim of such failure with CONTRACTOR'S surety.

10. Israel. If applicable, Contractor certifies that it is not currently engaged in, and agrees for the duration of this Contract that it will not engage in, a boycott of goods and services from Israel, as defined in A.R.S. § 35-393.

11. Conflict of Interest. The Contract may be cancelled in accordance with Arizona Revised Statutes Section 38-511.

12. Forced Labor of Ethnic Uyghurs Certification. If applicable, Contractor certifies that it does not currently, and agrees for the duration of the Contract that it will not, use: (1) the forced labor of ethnic Uyghurs in the People's Republic of China; (2) any goods or services produced by the forced labor of ethnic Uyghurs in the People's Republic of China;

or (3) any contractors, subcontractors, or suppliers that use the forced labor or any goods or services produced by the forced labor of ethnic Uyghurs in the People's Republic of China. If Contractor becomes aware it is not in compliance with this certification, it shall notify the City within five business days after becoming aware. This Contract will terminate upon failure to remedy the noncompliance within 180 days of the notification. (A.R.S. § 35-394)

13. Export Administration Act. The CONTRACTOR warrants compliance with the Export Administration Act.

14. Recyclable Products. The CONTRACTOR shall use recyclable products and products which contain recycled content to the maximum extent economically feasible in the performance of the work set forth in the CONTRACT.

15. Asbestos License. The CONTRACTOR shall possess an asbestos abatement license if required under A.R.S. Title 32 or 49.

16. Assignment. No right or interest in this CONTRACT shall be assigned by CONTRACTOR without prior, written permission of the OWNER signed by the City Manager; and no delegation of any duty of CONTRACTOR shall be made without prior written permission of the OWNER signed by the City Manager. Any attempted assignment or delegation by CONTRACTOR in violation of this provision shall be a breach of this CONTRACT by CONTRACTOR.

[SIGNATURES ON FOLLOWING PAGE]

IN WITNESS WHEREOF, the parties hereto have executed, or caused to be executed by their duly authorized officials, this CONTRACT in two (2) copies, each of which shall be deemed an original. The last date of signature shall be the effective date of this CONTRACT.

OWNER:
Lake Havasu City, Arizona

By: _____ Date: _____

Name: _____
Title: _____

APPROVED AS TO FORM:
Lake Havasu City Attorney's Office

By: _____ Date: _____

CONTRACTOR:

By: _____ Date: _____

Name/Title: _____

Address: _____

ATTEST:

BY: _____

Name/Title: _____

** END OF SECTION **

LAKE HAVASU CITY CONSTRUCTION CONTRACT
INDEMNIFICATION AND INSURANCE REQUIREMENTS
(long form)

I. INDEMNIFICATION

Contractor shall indemnify and hold harmless City, its officers, volunteers and employees from and against any and all liabilities, damages, losses, and costs, including reasonable attorney's fees, but only to the extent caused by the negligence, recklessness, or intentional wrongful conduct of Contractor or other persons employed or used by the Contractor in the performance of this Contract. It is agreed that Contractor will be responsible for primary loss investigation, defense, and judgment costs where this indemnification is applicable.

II. INSURANCE REQUIREMENTS

A. CONTRACTOR and its subcontractors shall procure and maintain until all of their obligations have been discharged, including any warranty periods under this CONTRACT, are satisfied, insurance against claims for injury to persons or damage to property which may arise from or in connection with the performance of the work hereunder by the CONTRACTOR, its agents, representatives, employees or subcontractors.

B. The insurance requirements herein are minimum requirements for this CONTRACT and in no way limit the indemnity covenants contained in this CONTRACT. City in no way warrants that the minimum limits contained herein are sufficient to protect the CONTRACTOR from liabilities that might arise out of the performance of the work under this CONTRACT by the CONTRACTOR, its agents, representatives, employees or subcontractors, and CONTRACTOR is free to purchase additional insurance.

C. MINIMUM SCOPE AND LIMITS OF INSURANCE: CONTRACTOR shall provide coverage with limits of liability not less than those stated below.

1. **Commercial General Liability – Occurrence Form**

Policy shall include bodily injury, property damage, personal injury and broad form contractual liability coverage.

a.	General Aggregate	$2,000,000
b.	Products – Completed Operations Aggregate	$1,000,000
c.	Personal and Advertising Injury	$1,000,000
d.	Blanket Contractual Liability – Written and Oral	$1,000,000
e.	Fire Legal Liability	$ 50,000
f.	Each Occurrence	$1,000,000

i. The policy shall be endorsed to include the following additional insured language: ***"Lake Havasu City, its departments, agencies, boards, commissions, and its***

officers, officials, agents, volunteers and employees shall be named as additional insureds with respect to liability arising out of the activities performed by or on behalf of the CONTRACTOR".

ii. Policy shall contain a waiver of subrogation against Lake Havasu City, its departments, agencies, boards, commissions, and its officers, officials, agents, volunteers and employees for losses arising from work performed by or on behalf of the CONTRACTOR.

iii. Completed operations coverage shall remain effective for at least two years following expiration of CONTRACT.

2. **Business Automobile Liability**

a. Bodily Injury and Property Damage for any owned, hired, and/or non-owned vehicles used in the performance of this contract.

Combined Single Limit (CSL)	$1,000,000

iv. The policy shall be endorsed to include the following

v. additional insured language: "Lake Havasu City, its departments, agencies, boards, commissions, and its officers, officials, agents, volunteers and employees shall be named as additional insureds with respect to liability arising out of the activities performed by or on behalf of the CONTRACTOR, involving automobiles owned, leased, hired or borrowed by the CONTRACTOR."

vi. Policy shall contain a waiver of subrogation against Lake Havasu City, its departments, agencies, boards, commissions, and its officers, officials, agents, volunteers and employees for losses arising from work performed by or on behalf of the CONTRACTOR.

3. **Workers' Compensation and Employers' Liability**

a. Workers' Compensation	Statutory
b. Employers' Liability Each Accident	$ 500,000
Disease – Each Employee	$ 500,000
Disease – Policy Limit	$1,000,000

vii.

i. Policy shall contain a waiver of subrogation against Lake Havasu City, its departments, agencies, boards, commissions, and its officers, officials, agents, volunteers and employees for losses arising from work performed by or on behalf of the CONTRACTOR.

ii. This requirement shall not apply if exempt under A.R.S. Section 23-901.

4. **Professional Liability (Errors and Omissions Liability)***
***(Not Applicable)**

a. Each Claim	$1,000,000
b. Annual Aggregate	$2,000,000

i. In the event that the professional liability insurance required by this CONTRACT is written on a claims-made basis, CONTRACTOR warrants that any retroactive

date under the policy shall precede the effective date of this CONTRACT; and that either continuous coverage will be maintained or an extended discovery period will be exercised for a period of two (2) years beginning at the time work under this CONTRACT is completed.

ii. The policy shall cover professional misconduct or lack of ordinary skill for those positions defined in the Scope of Work of this CONTRACT.

5. **Builders' Risk (Property) Insurance (Vertical Construction Only)**

a. CONTRACTOR shall purchase and maintain, on a replacement cost basis Builders' Risk insurance in the amount of the initial CONTRACT amount as well as subsequent modifications thereto, including modifications through Change Order, for the entire work at the site. Such Builders' Risk insurance shall be maintained until final payment has been made or until no person or entity other than CITY has an insurable interest in the property required to be covered, whichever is earlier. This insurance shall include interests of CITY, CONTRACTOR and any tier of CONTRACTOR's subcontractors in the work during the life of the CONTRACT and course of construction and shall continue until the work is completed and accepted by CITY. For new construction projects, CONTRACTOR agrees to assume full responsibility for loss or damage to the work being performed and to the buildings or structures under construction. For renovation construction projects, CONTRACTOR agrees to assume responsibility for loss or damage to the work being performed at least up to the full CONTRACT amount, unless otherwise required by the Contract documents or amendments thereto.

b. Builders' Risk insurance shall be on an all-risk policy form and shall also cover false work and temporary buildings or structures and shall insure against risk of direct physical loss or damage from external causes including debris removal, demolition occasioned by enforcement of any applicable legal requirements and shall cover reasonable compensation for architects' and engineers' services and expenses, and other "soft costs," required as a result of such insured loss.

c. Builders' Risk insurance must provide coverage from the time any covered property falls within CONTRACTOR's control and/or responsibility and continue without interruption during construction or renovation or installation, including any time during which covered property is being transported to the construction or installation site, and while on the construction or installation site awaiting installation. The policy will provide coverage while the covered premises or any part thereof is occupied. Builders' Risk insurance shall be primary and not contributory.

d. If the CONTRACT requires testing of equipment or materials or other similar operations, at the option of city, CONTRACTOR will be responsible for providing property insurance for these exposures under a Boiler Machinery insurance policy.

6. **Contractor's Personal Property**

CONTRACTOR and each of its subcontractors and suppliers shall be solely responsible for any loss or damage to its or their personal property and that of their employees and workers, including, without limitation, property or materials created or provided pursuant to this CONTRACT, any subcontract or otherwise, its or their tools, equipment, clothing, fencing, forms, mobile construction equipment, scaffolding, automobiles, trucks, trailers or semi-trailers including any machinery or apparatus attached thereto, temporary structures and uninstalled materials, whether owned, used, leased, hired or rented by CONTRACTOR or any subcontractor, consultant or supplier or employee or worker (collectively, "Personal Property"). CONTRACTOR and its subcontractors, consultants and suppliers, at its or their option and own expense, may purchase and maintain insurance for such Personal Property and any deductible or self-insured retention in relation thereto shall be its or their sole responsibility. Any such insurance shall be CONTRACTOR's and the subcontractors', suppliers' volunteers and employees' and workers' sole source of recovery in the event of loss or damage to its or their Personal Property. Any such insurance purchased and maintained by CONTRACTOR and any subcontractor, consultant or supplier shall include a waiver of subrogation as to Owner. CONTRACTOR waives all rights of recovery, whether under subrogation or otherwise, against all such parties for loss or damage covered by CONTRACTOR's property insurance. CONTRACTOR shall require the same waivers from all subcontractors and suppliers and from the insurers issuing property insurance policies relating to the Work or the Project purchased and maintained by all subcontractors and suppliers. The waivers of subrogation referred to in this subparagraph shall be effective as to any individual or entity even if such individual or entity (a) would otherwise have a duty of indemnification, contractual or otherwise, (b) did not pay the insurance premium, directly or indirectly, and (c) whether or not such individual or entity has an insurable interest in the property which is the subject of the loss or damage.

7. **Theft, Damage, or Destruction of Work**

In the event of theft, damage or destruction of the Work, CONTRACTOR will re-supply or rebuild its Work without additional compensation and will look to its own resources or insurance coverages to pay for such re-supply or rebuilding. CONTRACTOR will promptly perform, re-supply or rebuild, regardless of the pendency of any claim by CONTRACTOR against any other party, including Owner, that such party is liable for damages, theft, or destruction of CONTRACTOR's Work. This subparagraph shall apply except to the extent that the cost of re-supply or rebuilding is paid by Owner's builder's risk insurance; in such event, Owner waives (to the fullest extent permitted by the builder's risk policy) all rights of subrogation against CONTRACTOR and each of its subcontractors to the extent of such payment by Owner's builder's risk insurer.

D. ADDITIONAL INSURANCE REQUIREMENTS: The policies shall include, or be endorsed to include the following provisions:

1. Lake Havasu City, its departments, agencies, boards, commissions and its officers, officials, agents, volunteers and employees wherever additional insured status is required. Such additional insured shall be covered to the full limits of liability purchased by the CONTRACTOR, even if those limits of liability are in excess of those required by this CONTRACT.
2. The Contractor's insurance coverage shall be primary insurance with respect to all other available sources.
3. Coverage provided by the Contractor shall not be limited to the liability assumed under the indemnification provisions of this CONTRACT.

E. NOTICE OF CANCELLATION: Each insurance policy required by the insurance provisions of this CONTRACT shall not be suspended, voided, cancelled, reduced in coverage or in limits without ten (10) business days written notice to City. Such notice shall be mailed directly to Lake Havasu City, Community Investment Department, Procurement Division, 2330 McCulloch Blvd. North, Lake Havasu City, AZ, 86403 and shall be sent by certified mail, return receipt requested.

F. ACCEPTABILITY OF INSURERS**:** Insurance is to be placed with duly licensed or approved non-admitted insurers in the state of Arizona with an "A.M. Best" rating of not less than A- VII. CITY in no way warrants that the above-required minimum insurer rating is sufficient to protect the CONTRACTOR from potential insurer insolvency.

G. VERIFICATION OF COVERAGE**:**

1. CONTRACTOR shall furnish CITY with certificates of insurance as required by this CONTRACT. The certificates for each insurance policy are to be signed by a person authorized by that insurer to bind coverage on its behalf and the Project/contract number and project description shall be noted on the certificate of insurance.

2. All certificates and endorsements are to be received and approved by CITY at least ten (10) days before work commences. Each insurance policy required by this CONTRACT must be in effect at or prior to commencement of work under this CONTRACT and remain in effect for the duration of the Project. Failure to maintain the insurance policies as required by this CONTRACT, or to provide evidence of renewal, is a material breach of contract.

3. All renewal certificates required by this CONTRACT shall be sent directly to Lake Havasu City, Community Investment Department, Procurement Division, 2330 McCulloch Blvd. North, Lake Havasu City, AZ, 86403. The Project/contract number and project description shall be noted on the certificate of insurance. CITY reserves the right to require complete, certified copies of all insurance policies required by this CONTRACT at any time**.**

H. SUBCONTRACTORS**:** CONTRACTOR's certificate(s) shall include all subcontractors as insureds under its policies **or** CONTRACTOR shall furnish to CITY separate certificates and endorsements for each subcontractor. All coverages for subcontractors shall be subject to the minimum requirements identified above.

I. APPROVAL**:** Any modification or variation from the insurance requirements in this CONTRACT must have prior approval from the CITY's Human Resources/Risk Management Division, whose decision shall be final. Such action will not require a formal CONTRACT amendment but may be made by administrative action.

J. EXCEPTIONS**:** In the event the CONTRACTOR or sub-contractor(s) is/are a public entity, then the Insurance Requirements shall not apply. Such public entity shall provide a Certificate of Self-Insurance.

SECTION 00500B
CONTRACTOR Claim Handling Procedure

1. Claimant is to submit in writing to the OWNER or their REPRESENTATIVE the details of the claim to include the where, when, and how of the claim, and an estimate of damage, if applicable.

2. OWNER or their REPRESENTATIVE will forward the claim directly to the CONTRACTOR for handling. The CONTRACTOR is to respond to the claimant, in writing, within 30 calendar days of receipt with copies to:

   Lake Havasu City Human Resources/Risk Management Division
   Lake Havasu City Community Investment Department
   OWNER'S REPRESENTATIVE, if applicable

   If the CONTRACTOR denies the claim, the reasons for such denial must be included in the response to the claimant.

SECTION 00510
ARIZONA STATUTORY PERFORMANCE BOND

PURSUANT TO TITLES 28, 34, AND 41, ARIZONA REVISED STATUTES
(Penalty of this bond must be 100% of the Contract amount)

KNOW ALL MEN BY THESE PRESENTS THAT:

_____
(hereinafter "Principal"), as Principal, and

_____
(hereinafter "Surety"), a corporation organized and existing under the laws of the State of _____with its principal office in the City of _____, holding a certificate of authority to transact surety business in Arizona issued by the Director of Insurance pursuant to Title 20, Chapter 2, Article 1, as Surety, are held and firmly bound unto Lake Havasu City, Arizona (hereinafter "Obligee") in the amount of **WRITTEN AMOUNT AND 00/100** (Dollars) ($_____), for the payment whereof, Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the ___ day of _____, _____, to furnish all of the material, supplies, tools, equipment, labor and other services necessary for the construction and completion of

Booster Pump Station Improvements, Project No. B24-PW-108029-500433

Which, contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THE OBLIGATION IS SUCH, that if the Principal faithfully performs and fulfills all of the undertakings, covenants, terms, conditions and agreements of the contract during the original term of the contract and any extension of the contract, with or without notice of the Surety, and during the life of any guarantee required under the contract, and also performs and fulfills all of the undertakings, covenants, terms, conditions and agreements of all duly authorized modifications of the contract that may hereafter be made, notice of which modifications to the Surety being hereby waived, the above obligation is void. Otherwise, it remains in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, and all liabilities on this bond shall be determined in accordance with the provisions of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, to the same extent as if it were copied at length in this agreement.

The prevailing party in a suit on this bond shall recover as part of the judgment reasonable attorney fees that may be fixed by a judge of the court.

Witness our hands this ___ day of _____ , _____.

_____

PRINCIPAL SEAL

BY: _____

AGENCY OF RECORD

_____

BY: _____

_____

AGENCY ADDRESS SURETY SEAL

** END OF SECTION **

SECTION 00520
ARIZONA STATUTORY PAYMENT BOND
PURSUANT TO TITLES 28, 34, AND 41, ARIZONA REVISED STATUTES
(Penalty of this bond must be 100% of the Contract amount)

KNOW ALL MEN BY THESE PRESENTS THAT:
_____(hereinafter "Principal"), as Principal, and

_____
(hereinafter Surety), a corporation organized and existing under the laws of the State of with its principal office in the City of _____, holding a certificate of authority to transact surety business in Arizona issued by the Director of the Department of Insurance pursuant to Title 20, Chapter 2, Article 1, as Surety, are held and firmly bound unto Lake Havasu City, Arizona (hereinafter "Obligee") in the **amount of _____(Written Amount)_____ 00/100 (Dollars) ($ amount)** for the payment whereof, Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the _____ of _____, _____, to furnish all of the material, supplies, tools, equipment, labor and other services necessary for the construction and completion of

Booster Pump Station 4 Improvements, Project No. B24-PW-108029-500433

which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFOR, THE CONDITION OF THE OBLIGATION IS SUCH, that if the Principal promptly pays all monies due to all persons supplying labor or materials to the Principal or the Principal's subcontractors in the prosecution of the work provided for in the contract, this obligation is void. Otherwise, it remains in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Title 34, Chapter 2, Article 2, Arizona Revised Statues, and all liabilities on this bond shall be determined in accordance with the provisions, conditions and limitations of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, to the same extent as if it were copied at length in this agreement.

The prevailing party in a suit on this bond shall recover as part of the judgment reasonable attorney fees that may be fixed by a judge of the court.

Witness our hands this ___ day of _____, _____.

_____

PRINCIPAL SEAL

_____ BY:_____

AGENCY OF RECORD

_____BY:_____

AGENCY ADDRESS SURETY SEAL

** END OF SECTION **

SECTION 00670
NOTICE OF AWARD

TO: **DATE:**

PROJECT Description: Booster Pump Station 4 Improvements, Project No. B24-PW-10829-500433

The Booster Pump Station Improvements project includes: partial demolition of existing booster pump and appurtenances, electrical service panels and related components, and installation of a new booster pump, valves and piping, replacing existing hydropneumatic tank with new hydropneumatic tank and appurtenances, electrical panels and wiring, shade canopy, and construction of a new PRV station on Cherry Tree Lane.

Project No. B24-PW-10829-500433

The OWNER has considered the BID submitted by you for the above-described WORK in response to its Advertisement for BIDS dated November 29, 2023, and Information for Bidders.

You are hereby notified that your BID has been accepted for items in the amount of $ XXX, to include: all labor and materials needed to complete the project in its entirety as identified in the contract documents.

You are required by the Information for Bidders to execute the Contract and furnish the required CONTRACTOR'S Performance Bond, Payment Bond, and Certificates of Liability, Vehicular, and Workmen's Compensation Insurance within ten (10) calendar days from the postmark date when this notice was sent by U.S. Mail.

If you fail to execute said Contract and to furnish said BONDS within ten (10) days from the date of this Notice, said OWNER will be entitled to consider all your rights arising out of the OWNER'S acceptance of your BID as abandoned and as a forfeiture of your BID BOND. The OWNER will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of this NOTICE OF AWARD to the OWNER.

Dated day of , 20##.

Lake Havasu City, Arizona

BY: _____

NAME: Lynette Singleton

TITLE: Procurement Official

Acceptance of Notice

(NOTE: The contractor shall return a signed copy of this notice to the owner.)

Receipt of this NOTICE OF AWARD is hereby acknowledged by:

Contractor _____

This the ____ day of _____, 20##.

BY: _____ TITLE: _____

** END OF SECTION **

SECTION 00680
NOTICE TO PROCEED FOR MATERIALS

TO: **Date:**

RE: **Booster Pump Station 4 Improvements, Project No. B24-PW-10829-500433**

You are hereby notified to commence ordering of materials in accordance with the Contract dated _____within ten (10) calendar days of the date of this Notice to Proceed. The period for completion may be extended through the authorized and approved change order process.

OWNER: Lake Havasu City, Arizona

By: _____

Name: _____

Title: _____

ACCEPTANCE OF NOTICE

(NOTE: The Contractor shall return a signed copy of this Notice to the Owner)

Receipt of the above NOTICE TO PROCEED is hereby acknowledged

this the __ day of_____, ____.

By: _____

Name: _____

Title: _____

** END OF SECTION **

SECTION 00680
NOTICE TO PROCEED

TO: Date:

RE: **Booster Pump Station 4 Improvements, Project No. B24-PW-10829-500433**

You are hereby notified to commence WORK in accordance with the Contract dated _____within ten (10) calendar days of the date of this Notice to Proceed, and you are to complete the WORK within **300** days with a completion date of (_____). The period for completion may be extended through the authorized and approved change order process.

OWNER: Lake Havasu City, Arizona

By: _____

Name: _____

Title: _____

ACCEPTANCE OF NOTICE

(NOTE: The Contractor shall return a signed copy of this Notice to the Owner)

Receipt of the above NOTICE TO PROCEED is hereby acknowledged

this the __ day of_____, ____.

By: _____

Name: _____

Title: _____

** END OF SECTION **

SECTION 00685
CERTIFICATE OF SUBSTATIONAL COMPLETION

I hereby state that the degree of completion of:

Booster Pump Station 4 Improvements, Project No. B24-PW-10829-500433

Provides the full-time use of the project, or defined portion of the project, for the purposes for which it was intended and is the commencement of the Guarantee Period.

"Substantial Completion" shall not be considered as final acceptance.

Lake Havasu City, Arizona

By: _____

Name:_____

Title: _____

ACCEPTANCE OF NOTICE

(NOTE: The Contractor shall return a signed copy of this Notice to the Owner)

Receipt of the above **CERTIFICATE OF SUBSTANTIAL COMPLETION** is hereby acknowledged this the _____ day of _____, _____.

By: _____

Name: _____

Title: _____

E-original: [CONTRACTOR]
E-copy: Procurement (Purchasing@lhcaz.gov)
Lake Havasu City, City Clerk (CityClerk@lhcaz.gov)

CERTIFICATE OF COMPLETION

I hereby state that all goods and services required by:

Booster Pump Station 4 Improvements, Project No. B24-PW-108029-500433

have been delivered in conformance with the Contract, and all activities required by the Contractor under the Contract were completed as of _____.
(Date)

Lake Havasu City, Arizona

By: _____

Name:_____

Title: _____

E-original: [CONTRACTOR]

E-copy: Procurement (Purchasing@lhcaz.gov)
City Clerk (CityClerk@lhcaz.gov)

SECTION 00700
GENERAL CONDITIONS

This section of the Contract Documents is pre-printed. Any modifications to the following Articles, as may be required for this Project, are made in the Special Provisions.

1.0 DEFINITIONS

Wherever in the Contract Document the following terms are used, the intent and meaning shall be interpreted as follows:

1.1 Addenda

Written or graphic instruments issued prior to the opening of Bids which modify or interpret the Contract Documents, Drawings and Specifications, by additions, deletions, clarifications or corrections.

1.2 As Approved

The words "as approved," unless otherwise qualified, shall be understood to be followed by the words "by the Owner."

1.3 As Shown, and as Indicated

The words "as shown" and "as indicated" shall be understood to be followed by the words "on the Drawings" or "in the Specifications."

1.4 Award

The acceptance, by the Owner, of the successful Bidder’s proposal.

1.5 Bid

The offer or proposal of the Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

1.6 Bidder

Any individual, firm partnership or corporation, or combination thereof submitting a proposal for the Work contemplated, acting directly or through a duly authorized representative.

1.7 Bonds

Bid, Performance, and Payment Bonds and other instruments of security, furnished by the Contractor and its surety in accordance with the Contract Documents.

1.8 Calendar Day

Every day shown on the calendar, measured from midnight to the next midnight.

1.9 Change Order

A written order to the Contractor, signed by the Owner, covering changes in the Plans, Specifications, or proposal quantities and establishing the basis of payment and contract time adjustment, if any, for the Work affected by such changes.

If the Change Order increases the existing Contract Amount, the Builder's Risk Insurance limit must be increased to the adjusted Contract Amount.

1.10 Contract

The "Contract" is the written Contract covering the performance of the Work and the furnishing of labor, materials, incidental services, tools, and equipment in the construction of the Work. It includes Supplemental Contracts amending or extending the Work contemplated in the manner hereinafter described and which may be required to complete the Work in a substantial and acceptable manner to the Owner. The Contract may include Contract Change Orders.

1.11 Contract Documents

The "Contract Documents" consist of the Bidding Requirements, Contract Forms, Conditions of the Contract including General and/or Supplemental General Conditions, Special Provisions, the Technical Specifications, and the Drawings, including all Addenda and modifications thereafter incorporated into the Documents before execution and including all other requirements incorporated by specific reference thereto.

1.12 Contract Price

The total monies payable by Owner to the Contractor under the terms and conditions of the Contract Documents.

1.13 Contract Time

The number of calendar days stated in the Contract Documents for the completion of the Work.

1.14 Contractor

The individual, partnership, firm, or corporation primarily liable for the acceptable performance of the Work contracted for and the payment of all legal debts pertaining to the Work who acts directly or through lawful agents or employees to complete the Contract Work.

1.15 Days

Unless otherwise specifically stated, the term "days" will be understood to mean calendar days.

1.16 Drawings

The term "Drawings," also described as "Plans," refers to the official drawings, profiles, cross sections, elevations, details, and other working drawings, and supplementary drawings, or reproductions thereof, which show the locations, character, dimensions, and details of the Work to be performed. Drawings may either be bound in the same book as the balance of the Contract Documents or bound in separate sets, and are a part of the Contract Documents, regardless of the method of binding.

1.17 Engineer

The individual, partnership, firm, or corporation duly authorized by the Owner (sponsor) to be responsible for the Engineering of the contract Work and acting directly or through an authorized representative.

1.18 Field Order

A written order effecting a change in the Work not involving an adjustment in the Contract Price or an extension of the Contract Time, issued by the Engineer to the Contractor during construction.

1.19 Final Acceptance

Upon due notice from the Contractor of presumptive completion of the entire project, the Owner will make an inspection. If all construction provided for and contemplated by the contract is found completed to the Owner's satisfaction and all requirements of the contract have been met, that inspection shall constitute the final inspection and the Owner will make the final acceptance and issue the Certificate of Completion.

If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory or that all requirements of the contract have not been met, the Owner will give the Contractor the necessary instructions for correction or completion, and the Contractor shall immediately comply with and execute the instructions. Upon correction of the work, completion of contract requirements, and notification to Owner, another inspection will be made which shall constitute the final inspection provided the work has been satisfactorily completed and all requirements of the contract met. In such event, the Owner will make the final acceptance and issue the Certificate of Completion.

1.20 Inspector

An authorized representative of the Owner assigned to make all necessary inspections and/or tests of the Work performed or being performed, or of the materials furnished or being furnished by the Contractor.

1.21 Methodology and Quality of Workmanship

The manner and sequence of construction which considered to be the acceptable standard in which to perform the Work.

1.22 Notice

The term "notice" or the requirement to notify, as used in the Contract Documents or applicable State or Federal statutes, shall signify a written communication delivered in person or by certified or registered mail to the individual, or to a member of the firm, or to an officer of the corporation for whom it is intended. Certified or registered mail shall be addressed to the last business address known to him who gives the notice.

1.23 Notice of Award

The written notice of the acceptance of the Bid from the Owner to the successful Bidder.

1.24 Notice to Proceed

Written communication issued by the Owner to the Contractor authorizing him to proceed with the Work and establishing the date of commencement of the Work.

1.25 Or Equal

The phrase "or equal" shall be understood to indicate that the "equal" product is the same or better than the product names in function, performance, reliability, quality, and general configuration. Determination of equality in reference to the project design requirements will be made by the Owner.

1.26 Owner

The term “Owner” shall be understood to be Lake Havasu City, Arizona.

1.27 Payment Bond

The approved form of security furnished by the Contractor and its surety as a guaranty that it will pay in full all bills and accounts for materials and labor used in the construction of Work.

1.28 Performance Bond

The approved form of security furnished by the Contractor and its surety as a guarantee that the Contractor will complete the Work in accordance with the terms of the Contract and guarantee the Work for a period of one (1) year after the date of Certificate of Substantial Completion.

1.29 Plans

Plans shall have the same meaning as "Drawings," see Section 1.16.

1.30 Project

The undertaking to be performed as provided in the Contract Documents, see Section 1.11.

1.31 Proposal

The offer of the Bidder for the Work when made out and submitted on the prescribed proposal form, properly signed and guaranteed.

1.32 Proposal Guarantee

The cash, or cashier's check or certified check, or bidder's bond accompanying the Proposal submitted by the Bidder, as a guarantee that the Bidder will enter into a contract with the Owner for the construction or doing of the Work, if it is awarded to it, and will provide the contract bonds and insurance required.

1.33 Shop Drawings

All drawings, diagrams, illustrations, brochures, schedules and other data which are prepared by the Contractor, a Subcontractor, manufacturer, supplier or distributor, which illustrate how specific portions of the Work shall be fabricated or installed.

1.34 Specifications

The directions, provisions and requirements pertaining to the method and manner of performing the Work or to the quantities and qualities of the materials to be furnished under the Contract, together with all other directions, provisions and requirements, plus such amendments, deletions from or additions which may be provided for by Supplemental Contract or Change Orders.

1.35 Subcontractor

A Subcontractor is a person or entity who has a direct or indirect contract with a Contractor to perform any of the Work at the site. For convenience, the term Subcontractor is referred to throughout the Contract Documents as if singular in number and masculine in gender but includes the plural and feminine gender and includes a Sub-Subcontractor or an authorized representative thereof. The term Subcontractor does not include any separate Contractor or its Subcontractors.

1.36 Substantial Completion

"Substantial Completion" shall be that degree of completion of the project or a defined portion of the project, sufficient to provide the Owner, at its discretion, the full-time use of the project or defined portion of the project for the purposes for which it was intended. "Substantial Completion" shall not be considered as final acceptance.

1.37 Supplemental General Conditions

Modifications to General Conditions required by a Federal Agency for participation in the Project and approved by the agency for participation in the Project and approved by the agency in writing prior to inclusion in the Contract Documents and such requirements that may be imposed by applicable state laws. The term also includes modifications or additions to the General Conditions required by the Owner or Engineer.

1.38 Supplier

Any person or organization who supplies materials or equipment for the Work, including that fabricated to a special design, but who does not perform labor at the site.

1.39 Surety

The corporation, partnership, or individual, other than the Contractor, executing Payment, or Performance Bonds which are furnished to the Owner by the Contractor.

1.40 Work

The word "Work" within these Contract Documents shall include all material, labor, tools, utilities, and all appliances, machinery, transportation, and appurtenances necessary to perform and complete the Contract, and such additional items not specifically indicated or described which can be reasonably inferred as belonging to the item described or indicated and as required by good practice to provide a complete and satisfactory system or structure.

1.41 Working Day

A working day shall be any day, other than a legal holiday, Saturday or Sunday, on which the normal working forces of the Contractor may proceed with regular work.

2.0 NOTICE TO PROCEED

2.1 After the Owner has issued the Notice Of Award, the Contractor shall provide the Performance Bond, the Payment Bond, the Certificate Of Insurance, the Work Schedule, the monthly cash flow, and a signed Contract within ten (10) calendar days. The Owner's attorney will review each document and, if they are found to be acceptable, the Owner will sign and execute the Contract. Within a period of sixty (60) calendar days after executing the Contract, the Owner will issue the Notice To Proceed. Within ten (10) calendar days of the postmark date of the Notice To Proceed, the Work shall commence. The Contractor shall not commence any Work until such time that the Notice To Proceed has been issued.

3.0 ADDITIONAL INSTRUCTIONS AND DETAIL DRAWINGS

3.1 The Engineer may furnish additional instructions to the Contractor by means of Drawings or otherwise, during the progress of the Work as necessary to make clear or to define in greater detail the intent of the Specifications and Contract Drawings.

The additional drawings and instruction thus supplied will become a part of the Contract Documents. The Contractor shall carry out the Work in accordance with the additional detail drawings and instructions.

4.0 SCHEDULES, REPORTS AND RECORDS

4.1 The Contractor shall submit to the Owner payrolls, reports, estimates, records and other data where applicable as are required by the Contract Documents for the Work to be performed.

4.2 The Contractor, after the Contract award and prior to the Pre-Construction Conference, shall prepare for submittal to the Engineer for review, a detailed progress schedule. The progress schedule shall be brought up to date and submitted to the Engineer prior to each progress payment request, and at such other time intervals as the Engineer may request.

A. Progress Schedule

The schedule shall be a time-scaled critical path progress schedule showing in detail the proposed sequence of activity. The critical path analysis shall consist of a graphic network diagram and shall clearly show start and completion dates and percentage of work completed.

4.3 The Contractor shall also forward to the Engineer, prior to each progress payment request, an itemized report of the delivery status of major and critical items of purchased equipment and material, including Shop Drawings and the status of shop and field fabricated work. These progress reports shall indicate the date of the purchase order, the current percentage of completion, estimated delivery, and cause of delay, if any.

4.4 If the completion of any part of the Work or the delivery of materials is behind the approved schedule, the Contractor shall submit in writing a plan acceptable to the Engineer for bringing the Work up to schedule.

4.5 The Owner shall have the right to withhold progress payments for the Work if the Contractor fails to update and submit the progress schedule and reports as specified, and such withholding shall not constitute grounds for additional claims by the Contractor against the Owner.

4.6 The Contractor shall submit an estimated monthly cash flow, based upon the progress schedule with the bonds, schedules, and Certificate Of Insurance.

5.0 DRAWINGS AND SPECIFICATONS

5.1 The intent of the Drawings and Specifications is that the Contractor shall furnish all labor, materials, tools, equipment, utilities, and transportation necessary for the proper execution of the Work in accordance with the Contract Documents and all incidental work necessary to complete the Project in an acceptable quality and manner, ready for use, occupancy or operation by the Owner.

5.2 In case of conflict between the Drawings and Specifications, the Specifications shall govern. Figure dimensions on Drawings shall govern over scale dimensions, and detailed Drawings shall govern over general Drawings.

5.3 Any discrepancies found between the Drawings and Specifications and site conditions or any inconsistencies or ambiguities in the Drawings or Specifications shall be immediately reported verbally and within 24 hours of such a discovery, in writing to the Engineer, who shall promptly correct such inconsistencies or ambiguities in writing. Work done by the Contractor after his discovery of such discrepancies, inconsistencies or ambiguities shall be done at the Contractor's risk, and the Contractor shall assume full responsibility therefor and shall bear all costs attributable thereto, if not acceptable to the Owner.

6.0 SHOP DRAWINGS

6.1 The Contractor shall provide seven (7) copies of the Shop Drawings as specified or as may be necessary for the prosecution of the Work as required by the Contract Documents. All drawings and schedules shall be submitted sufficiently in advance to allow the Engineer not less than 20 regular working days for checking the submittal. The Engineer's approval of any Shop Drawings shall not release the Contractor from responsibility for deviations from the Contract Documents.

6.2 When submitted for the Engineer's review, Shop Drawings shall bear the Contractor's certification by means of a signed Stamp, that he has reviewed, checked and approved the Shop Drawings and that they are in conformance with the requirements of the Contract Documents. Shop Drawings, which in the opinion of the Engineer are incomplete or unchecked by the Contractor, will be returned to the Contractor for resubmission in the proper form.

If Shop Drawings or submittals are rejected by the Engineer, all costs incurred by the Engineer Or The Owner for reviewing the resubmittals shall be charged to the Contractor, and the Owner has the right to deduct such costs from any monies owed the Contractor by the Owner.

6.3 When Shop Drawings have been reviewed by the Engineer, two sets of submittals will be returned to the Contractor appropriately stamped. If major changes or corrections are necessary, the Shop Drawing may be rejected and one set will be returned to the Contractor with such changes or corrections indicated, and the Contractor shall correct and resubmit the Shop Drawings. No changes shall be made by the Contractor to resubmit Shop Drawings other than those changes indicated by the Engineer, unless such changes are clearly described in a letter accompanying the resubmitted Shop Drawings.

6.4 The review of such Shop Drawings and catalog cuts by the Engineer shall not relieve the Contractor from responsibility for corrections of dimensions, fabrication details, and space requirements, or for deviations from the Contract Drawings or Specifications, unless the Contractor has called attention to such deviations in writing by a letter accompanying the Shop Drawings and the Engineer approves the change or deviation in writing at the time of submission; nor shall review by the Engineer relieve the Contractor from the responsibility for errors in the Shop Drawings. When the Contractor does call such deviations to the attention of the Engineer, the Contractor shall state in his letter whether or not such deviations involve any deduction or extra cost adjustment.

6.5 Portions of the Work requiring a Shop Drawing or sample submission shall not begin until the Shop Drawing or submission has been approved by the Engineer. A copy of each approved Shop Drawing and each approved sample shall be kept in good order by the Contractor at the site and shall be available to the Engineer.

7.0 RECORD DRAWINGS

7.1 During construction, the Contractor shall keep an accurate record of the following:

A. Deviations between the Work as shown on the Plans and the Work as actually installed.

B. The specific locations of piping, valves, electric conduits, duct work, equipment, and other such work which was not located on the Plans. The Record Drawings shall show distances to these locations from known points on the Plans.

C. Equipment schedules indicating manufacturer's names and model numbers. When all revisions showing work as installed are made, the corrected set of plans shall be delivered to the Engineer before the final pay request is processed. These plans shall be clearly marked "Record Drawings."

7.2 Nothing contained in this section shall be construed as authorizing any deviation in the Work as shown on the Contract Drawings without a written Change Order or written authority to the Contractor from the Engineer.

8.0 MATERIALS, SERVICES, AND FACILITIES

8.1 It is understood that, except as otherwise specifically stated in the Contract Documents, the Contractor shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, supervision, temporary construction of any nature, and all other services and facilities of any nature whatsoever necessary to execute, complete, and deliver the Work within the specified time.

8.2 The Contractor shall furnish the Owner a list of materials and the source of supply of each of the materials on the list. The source of supply of each of the materials shall be approved by the Owner before the delivery of said materials is started. Only materials conforming to these

Specifications and approved by the Owner shall be used in the Work. All materials proposed for use may be inspected or tested at any time during their preparation and use. After trial, if it is found that sources of supply which have been approved do not furnish a uniform product, or if the product from any source proves unacceptable at any time, the Contractor shall furnish approved material from other approved sources. No material which, after approval, has in any way become unfit for use shall be used in the Work.

8.3 The Contractor warrants to the Owner and Engineer that the materials and equipment furnished under the Contract will be new and of a quality equal to that specified or approved and, that all Work will be of good quality, free from faults and defects and in conformance with the Contract Documents. Mechanical and electrical equipment shall be the products of manufacturers of established good reputations and regularly engaged in the fabrication of such equipment. Unless otherwise noted, any equipment offered shall be current models which have been in successful regular operation under comparable conditions for a period of at least two years. This time requirement, however, does not apply to minor details nor to thoroughly demonstrated improvements in design or in material of construction. Work shall be done and completed in a thorough and workmanlike manner and if required by Engineer, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment used.

8.4 All materials which the Engineer or its authorized Inspector has determined do not conform to the requirements of the Plans and Specifications will be rejected. They shall be removed immediately from the vicinity of the Work by the Contractor at his own expense, unless otherwise permitted by the Engineer. No rejected material, the defects of which have been subsequently corrected, shall be used in the Work, unless approval in writing has been given by the Engineer. Upon failure of the Contractor to comply promptly with any order of the Engineer made under the provisions in this section, the Engineer shall have authority to cause the removal and replacement of rejected material and to deduct the cost thereof from any monies due or to become due the Contractor.

8.5 If any part or portions of the Work done or material furnished under this Contract shall prove defective or non-conforming with the Drawings and Specifications, and if the imperfection in the same shall not be of sufficient magnitude or importance as to make the Work dangerous or unsuitable, or if the removal of such Work will create conditions which are dangerous or undesirable, the Engineer shall have the right and authority to retain such Work but shall make such deductions in the final payment therefor as may be just and reasonable. Such adjustment shall be effected whether or not final payment has been made.

8.6 Materials and equipment shall be so stored as to insure the preservation of their quality and fitness for the Work. Stored materials and equipment to be incorporated in the Work shall be located so as to facilitate prompt inspection.

8.7 Manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer.

8.8 Materials, supplies or equipment to be incorporated into the Work shall not be purchased by the Contractor or the Subcontractor subject to a chattel mortgage or under a conditional sale contract or other Contract by which an interest is retained by the seller.

9.0 INSPECTION AND TESTING

9.1 All material and equipment used in the construction of the Project shall be subject to adequate inspection and testing in accordance with generally accepted standards, as required and defined in the Contract Documents.

9.2 The Owner shall provide all inspection and testing services not required by the Contract Documents.

9.3 The Contractor shall provide at its expense the testing and inspection services required by the Contract Documents.

9.4 If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any Work to specifically be inspected, tested, or approved by someone other than the Contractor, the Contractor will give the Engineer timely notice of readiness, the minimum of which shall be forty-eight (48) hours. The Contractor will then furnish the Engineer the required certificates of inspection, testing or approval.

9.5 Inspections, tests or approvals by the Engineer or others shall not relieve the Contractor from its obligations to perform the Work in accordance with the requirements of the Contract Documents.

9.6 The Engineer and its representatives will at all times have access to the Work. In addition, authorized representatives, and agents of any participating Federal or State agency shall be permitted to inspect all Work, materials, payrolls, records of personnel, invoices of materials, and other relevant data and records. The Contractor will provide proper facilities for such access and observation of the Work and also for any inspection or testing thereof.

9.7 If any Work is covered contrary to the written instructions of the Engineer or prior to inspection, if must, if requested by the Engineer, be uncovered for his observation and replaced at the Contractor's expense.

9.8 If the Engineer considers it necessary or advisable that Work that has already been approved be inspected or tested by the Engineer or others, the Contractor, at the Engineer's request, will uncover, expose or otherwise make available for observation, inspection or testing as the Engineer may require, that portion of the Work in question, furnishing all necessary labor, materials, tools, and equipment. If it is found that such Work is defective, the Contractor will bear all the expenses of such uncovering, exposure, observation, inspection, and testing and of satisfactory reconstruction. If, however, such Work is not found to be defective, the Contractor will be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction and an appropriate Change Order shall be issued.

10.0 SUBSTITUTIONS

10.1 Whenever a material, article or piece of equipment is identified on the Drawings or Specifications by reference to brand name or catalogue number, it shall be understood that this is referenced for the purpose of defining the performance or other salient requirements and that other products of equal capacities, quality and function shall be considered. The Contractor may recommend the substitution of a material, article, or piece of equipment of equal substance and function for those referred to in the Contract Documents by reference to brand name or catalogue number, and if, in the opinion of the Engineer, such material, article, or piece of equipment is of equal substance and function to that specified, the Engineer may approve its substitution and use by the Contractor. Any cost differential shall be deductible from the Contract Price and the Contract Documents shall be appropriately modified by Change Order. The Contractor warrants that if substitutes are approved, no major changes in the function or general design of the Project will result. Incidental changes or extra component parts required to accommodate the substitute will be made by the Contractor without a change in the Contract Price or Contract Time. Any substitutions not properly approved and authorized by the Engineer may be considered defective and the Engineer may require the Contractor to remove the substituted material, article or piece of equipment and the Contractor shall bear any and all costs associated with the removal of the substituted item, including all engineering, inspection, testing or surveying costs incurred by the Owner or the Engineer.

10.2 Determination of equality in reference to the project design requirements will be made by the Owner. "Equal" products shall not be purchased or installed by the Contractor without the Owner's written approval. Contractor shall have fourteen (14) days after issuance of Notice to Proceed for submission of data substantiating a request for substitution of an "or equal" item.

11.0 PATENTS

11.1 The Contractor shall pay all applicable royalties and license fees. The Contractor shall defend all suits or claims for infringement of any patent rights and indemnify and hold the Owner and Engineer harmless from loss on account thereof, except that the Owner shall be responsible for any such loss when a particular process, design, or the product of a particular manufacturer or manufacturers is specified, however if the Contractor has reason to believe that the design, process or product specified is an infringement of a patent, it shall be responsible for such loss unless it promptly gives such information to the Engineer.

12.0 SURVEYS, PERMITS, REGULATIONS

12.1 The Owner shall furnish all boundary surveys and establish all base lines for locating the principal component parts of the Work together with a suitable number of bench marks adjacent to the Work as shown in the Contract Documents. The Contractor shall satisfy itself as to the accuracy of all measurements before constructing any permanent structure and shall not take advantage of any errors which may have been made in laying out the Work. From the information provided by the Owner, unless otherwise specified in the Contract Documents, the Contractor shall

develop and make all detail surveys needed for construction such as slope stakes, batter boards, stakes for pile locations and other working points, lines, elevations and cut sheets.

12.2 Such stakes and markings as the Engineer may set for either its own or the Contractor's guidance shall be scrupulously preserved by the Contractor. In the event the Contractor, or its employees, destroy or otherwise remove or obliterate such stakes or markings, an amount equal to the cost of replacing the same may be deducted from subsequent estimates due the Contractor at the discretion of the Owner.

12.3 Permits and licenses of a temporary nature necessary for the prosecution of the Work shall be secured and paid for by the Contractor unless otherwise stated in the Supplemental General Conditions. Permits, licenses and easements for permanent structures or permanent changes in existing facilities shall be secured and paid for by the Owner, unless otherwise specified. The Contractor shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the Work as drawn and specified. If the Contractor perceives that the Contract Documents are at variance therewith, he shall promptly notify the Engineer in writing, and any necessary changes shall be adjusted as provided in Section 16. Changes In The Work. If the Contractor performs and works knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice to the Engineer, he shall assume full responsibility therefore and shall bear all costs attributable thereto.

13.0 PROTECTION OF WORK, PROPERTY AND PERSONS

13.1 The Contractor shall have sole responsibility for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. The Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to, all employees on the Work and other persons who may be affected thereby, all the Work and all materials or equipment to be incorporated therein, whether in storage on or off the site, and other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and other items not designated for removal, relocation or replacement in the course of construction.

13.2 The Contractor shall comply with all applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction. The Contractor shall erect and maintain, as required by the conditions and progress of the Work, all necessary safeguards for safety and protection. The Contractor shall notify Owners of adjacent utilities when prosecution of the Work may affect them. The Contractor shall remedy all damage, injury or loss to any property caused, directly or indirectly, in whole or in part, by the Contractor, any Subcontractor or anyone directly or indirectly employed by any of them or anyone for whose acts any of them be liable, except damage or loss attributable to the fault of the Contract Documents or to the acts or omissions of the Owner or the Engineer or anyone employed by either of them or anyone for whose acts either of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of the Contractor.

13.3 In emergencies affecting the safety of persons or the Work or property at the site or adjacent thereto, the Contractor, without special instruction or authorization from the Engineer or Owner, shall act to prevent threatened damage, injury or loss. He shall give the Engineer prompt Written Notice of any significant changes in the Work or deviations from the Contract Documents caused thereby, and a Change Order shall thereupon be negotiated and issued covering the changes and deviations involved, as provided in Section 16.0, Changes in the Work.

13.4 The Contractor shall designate a responsible member of its organization at the site whose duty shall be the prevention of accidents and the safety of all those at the site. The person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and the Engineer. The Engineer will not be responsible for safety precautions and programs in connection with the Work or for the Contractor's failure to properly perform its responsibilities with respect to initiating, maintaining and supervising all safety precautions and programs.

14.0 PUBLIC SAFETY

14.1 Whenever the Contractor's operations create a condition hazardous to traffic or to the public, it shall furnish at its own expense, and without cost to the Owner, such flagmen and guards as are necessary to give adequate warning to the public of any dangerous conditions to be encountered and he shall furnish, erect, and maintain such fences, barricades, lights, signs, and other devices as are necessary to prevent accidents and avoid damage or injury to the public.

14.2 Should the Contractor appear to be neglectful or negligent in furnishing warning and protective measures as above provided, the Engineer may direct attention to the existence of a hazard and the necessary warning and protective measures shall be furnished and installed by the Contractor at its own expense without cost to the Owner. Should the Engineer point out the inadequacy of warning and protective measures, such action on the part of the Engineer shall not relieve the Contractor from responsibility for public safety or abrogate his obligation to furnish and pay for these devices.

14.3 Should the Contractor fail to, be neglectful, or be negligent in furnishing or maintaining warning and protective facilities as required herein, the Owner may furnish or maintain such facilities and charge Contractor therefor by deducting the cost thereof from periodic progress payments due the Contractor as such costs are incurred by Owner.

14.4 No material or equipment shall be stored where it will interfere with the free and safe passage of public traffic, and at the end of each day's Work and at other times when construction operations are suspended for any reason, the Contractor shall remove all equipment and other obstructions from that portion of the right-of-way open for use by public traffic.

15.0 SUPERVISION BY CONTRACTOR

15.1 The Contractor shall supervise and direct the Work, using its best skill and attention. The Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. The Contractor shall employ and maintain on the Work a qualified

supervisor or superintendent who shall have been designated in writing by the Contractor as the Contractor's representative at the site, and who shall have been approved by the Engineer, which approval shall not be unreasonably withheld. The supervisor shall have full authority to act on behalf of the Contractor and all communications given to and by the supervisor shall be as binding as if given to and by the Contractor. The supervisor shall be present on the site at all times. The Contractor shall be responsible to the Owner for the acts and omissions of the employees, subcontractors, and the agents and employees, and other persons performing any other Work under the Contract with the Contractor.

16.0 CHANGES IN THE WORK

16.1 The Owner may at any time, as the need arises, order changes within the scope of the Work without invalidating the Contract. If such changes increase or decrease the amount due under the Contract Documents, or in the time required for performance of the Work, an equitable adjustment shall be authorized by Change Order.

16.2 The Engineer, also, may at any time, by issuing a Field Order, make changes in the details of the Work. The Contractor shall proceed with the performance of any changes in the Work so ordered by the Engineer unless the Contractor believes that such Field Order entitles him to a change in Contract Price or Time, or both, in which event he shall give the Engineer Written Notice thereof within seven (7) days after the receipt of the ordered change. Thereafter the Contractor shall document the basis for the change in Contract Price or Time within fourteen (14) days. The Contractor shall not execute such changes pending the receipt of an executed Change Order or further instruction from the Owner.

16.3 If the Contractor wishes to make a claim for an increase in the Contract sum, it shall give the Engineer written notice thereof within fourteen (14) days after the occurrence of the event giving rise to such claim. This notice shall be given by the Contractor before proceeding to execute the Work, except in an emergency endangering life or property, in which case Contractor shall proceed in accordance with the provisions of the Contract. No such claim shall be valid unless so made. If the Owner and Contractor cannot agree on the amount of adjustment in the Contract sum, it shall be determined by the Engineer. Any change in the Contract sum resulting from such claim shall be authorized in a Change Order.

16.4 The value of any Work covered by a Change Order shall be determined by one or more of the following methods in the order of precedence listed below:

A. Unit prices previously approved.
B. An agreed lump sum.
C. Cost plus percentage.

17.0 TIME FOR COMPLETION AND LIQUIDATED DAMAGES

17.1 The date of beginning and the time for completion of the Work are essential conditions of the Contract Documents and the Work embraced shall be commenced on a date specified in the Notice to Proceed.

17.2 The Contractor shall proceed with the Work at such rate of progress to insure full completion within the Contract Time. It is expressly understood and agreed, by and between the Contractor and the Owner, that the Contract Time for the completion of the Work described herein is a reasonable time, taking into consideration the average climatic and economic conditions and other factors prevailing in the locality of the Work.

17.3 The Contractor shall only work an eight (8) hour day consisting of Monday through Friday, between 6:00 a.m. to 6:00 p.m., and do not include local municipal holidays. If the Contractor desires to carry on Work more than eight (8) hours each day, or work at night or outside the regular hours, it shall give timely notice (72 hours) to the Engineer and receive the Owner's written approval to allow satisfactory arrangements to be made for inspecting the Work in progress. Should the prosecution of the Work be discontinued for any reason, the Contractor shall notify the Engineer at least 24 hours in advance of resuming operations. The Contractor shall be responsible for any extra compensation due or costs incurred as a result of Contractor's desire to carry out Work beyond an eight (8) hour day, or at night or outside regular hours, including but not limited to, any additional costs or compensation due the Engineer And Owner or its employees or agents as a result of having to be present at the site. The costs or extra compensation necessitated by the Contractor's Work beyond an eight (8) hour day, or at night or outside regular business hours may be deducted or withheld from progress payment or any other payments due to Contractor.

17.4 If for any reason a suspension of the work should occur; the Contractor, at its own expense, shall do all the Work necessary to provide a safe, smooth and unobstructed passageway through construction for use by public traffic or to provide for the proper and efficient operation of sewer, drainage and other facilities within the site of the Work, during the period of such suspension. In the event that the Contractor fails to perform the Work specified in this Subsection, the Owner will perform such Work and the cost thereof will be deducted from periodic progress payments due the Contractor.

17.5 During inclement weather and other conditions, the Contractor shall pursue only such portions of the Work as shall not be damaged thereby. No portions of the Work which satisfactory quality or efficiency will be affected by an unfavorable condition shall be constructed while these conditions remain, unless by special means or precautions, approved by the Engineer, the Contractor is able to overcome them.

17.6 Delays in delivery of equipment or material purchased by the Contractor or its Subcontractor, including Engineer-selected equipment, shall not be considered as a just cause for delay as this is not beyond the control of the Contractor. The Contractor shall be fully responsible for the timely ordering, scheduling, expediting, delivery, and installation of all equipment and materials.

17.7 In case of failure on the part of the Contractor to complete the Work within the time affixed in the Contract, or such extension thereof as may be allowed by Engineer or Owner, the Contract shall by that fact be terminated by written notice. The Owner shall not thereafter pay or allow the Contractor any further compensation for any Work done by it under said Contract, and the Contractor and its sureties shall be liable to the Owner for all loss or damage which it may suffer by reason of his failure to complete the Contract within such time. Failure to prosecute the Work diligently shall be grounds for termination by the Owner pursuant to this paragraph.

In the event the Contract should be terminated, the Owner shall have the right to take over the Work and to proceed with the same until it is completed, either by performing said Work itself directly or by contracting it out to some other person or persons, and in such event the Owner may take possession of and utilize, in completing the Work, such materials, appliances and plant as may be on the site of the Work and necessary for its completion. Nothing herein contained shall be deemed to limit the right of the Owner in the event of any breach of Contract by the Contractor; but all rights herein given to the Owner are and shall be deemed to be additional to any other rights or remedies which the Owner shall have under any provision of law.

17.8 Should the Contractor fail to complete the Work, or any part thereof, in the time agreed upon in the Contract or within such extra time as may have been allowed for delays by extensions granted as provided in the Contract, the Contractor shall reimburse the Owner for the additional expense and damage for each calendar day that the Contract remains uncompleted after the Contract completion date. It is agreed that the amount of such additional expense and damage incurred by reason of failure to complete the Work is the per diem rate, as stipulated in Section 15, Information For Bidders, plus any costs incurred by the Engineer including, but not limited to: the Engineer's costs for additional inspection, testing or surveying as a result of the Contractor's failure to complete the Work in the time agreed upon. The said amounts are agreed upon as liquidated damages for the loss to the Owner on account of expense due to the employment of Engineers, inspectors, and other employees after the expiration of the time of completion, and on account of the value of the operation of the Works dependent thereon. It is expressly understood and agreed that this amount is not to be considered in the nature of a penalty, but as liquidated damages which have accrued against the Contractor. The Owner shall have the right to deduct such damages from any amount due, or that may become due the Contractor, or the amount of such damages shall be due and collectible from the Contractor or its Surety.

17.9 The Contractor shall not be charged with liquidated damages or any excess costs when the delay in completion of the Work is due to any of the reasons set forth below provided the Contractor has given Written Notice of the delay within three (3) days of the occurrence of the cause of the delay to the Owner or Engineer. In the event notice is not given as provided, liquidated damages may be assessed.

A. To unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not restricted to: acts of God, or of the public enemy, acts of the Owner, acts of another Contractor in the performance of a separate contract with the Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and abnormal and unforeseeable weather.

18.0 CORRECTION OF WORK

18.1 The Contractor shall promptly correct all work rejected by the engineer as defective or as failing to conform to the contract documents, whether observed before or after substantial completion and whether or not fabricated, installed or completed. Contractor shall bear all costs of correcting such rejected work, including compensation for the engineer's additional services made necessary thereby. Contractor shall also bear the costs of making good all work of the Owner or separate Contractor destroyed or damaged by such correction or removal.

18.2 All removal and replacement work shall be done at the Contractor's expense. If the Contractor does not take action to remove such rejected work within ten (10) days after receipt of Written Notice, the Owner may remove such work and store the materials at the expense of the Contractor, including compensation for the engineer's additional services made necessary thereby.

19.0 SUBSURFACE CONDITIONS

19.1 The Contractor shall promptly, and before such conditions are disturbed, except in the event of an emergency, notify the Owner by Written Notice of:

A. Subsurface or latent physical conditions at the site differing materially from those indicated in the Contract Documents; or

B. Unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in Work of the character provided for in the Contract Documents.

19.2 The Owner shall promptly investigate the conditions, and if it finds that such conditions do so materially differ and cause an increase or decrease in the cost of, or in the time required for, performance of the Work, an equitable adjustment shall be made, and the Contract Documents shall be modified by a Change Order. Any claim of the Contractor for adjustment hereunder shall not be allowed unless he has given the required Written Notice; provided that the Owner may, if he determines the facts so justify, consider, and adjust any such claims asserted before the date of final payment.

20.0 SUSPENSION OF WORK, TERMINATION AND DELAY

20.1 The Owner may suspend the Work or any portion thereof for a period of not more than ninety (90) days or such further time as agreed upon by the Contractor, by Written Notice to the Contractor and the Engineer which notice shall fix the date on which Work shall be resumed. The Contractor shall resume that Work on the date so fixed. The Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to any suspension.

20.2 In addition to any other reasons for termination provided in the Contract, the Contractor shall be considered in default of the Contract and such default will be considered as cause for the

Owner to terminate the Contract for any of the following reasons if the Contractor:

A. Fails to begin the Work under the Contract within the time specified in the "Notice to Proceed," or
B. Fails to perform the Work or fails to provide sufficient workers, equipment or materials to assure completion of Work in accordance with the terms of the Contract, or
C. Performs the Work unsuitably or neglects or refuses to remove materials or to perform such new Work as may be rejected as unacceptable and unsuitable, or
D. Discontinues the prosecution of the Work, or
E. Fails to resume Work which has been discontinued within a reasonable time after notice to do so, or
F. Becomes insolvent or is declared bankrupt, or commits any act of bankruptcy or insolvency, or
G. Allows any final judgment to stand against him unsatisfied for a period of 10 days, or
H. Makes an assignment for the benefit of creditors, or acceptable manner, or
I. Is otherwise in breach of the Contract and has failed to remedy the breach within ten (10) days of written notice of the existence of such breach, or
J. Fails to provide safe conditions for its workers and/or the general public.

Should the Owner consider the Contractor in default of the Contract for any reason above, he shall immediately give Written Notice to the Contractor and the Contractor's surety as to the reasons for considering the Contractor in default and the Owner's intentions to terminate the Contract.

If the Contractor or Surety, within a period of 10 days after Written Notice, does not proceed in accordance therewith, then the Owner shall have, upon written notification of the facts of such delay or neglect, the power and authority without violating the Contract, to take the prosecution of the Work out of the hands of the Contractor. The Owner may appropriate or use any or all materials and equipment that have been mobilized for use in the Work and are acceptable and may enter into an Contract for the completion of said Contract according to the terms and provisions thereof, or use such other methods as in the opinion of the Owner will be required for the completion of said Contract in an acceptable manner.

All costs and charges incurred by the Owner, together with the cost of completing the Work under Contract, will be deducted from any monies due or which may come due the Contractor. If such expense exceeds the sum which would have been payable under the Contract, then the Contractor and the Surety shall pay to the Owner the amount of such excess.

20.3 Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of monies due Contractor by Owner will not release Contractor from liability.

20.4 Upon seven days Written Notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, elect to terminate the Contract. In such case, Contractor shall be paid (without duplication of any items):

20.4.1 for completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such work;

20.4.2 for expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead on such expenses;

20.4.3 for reasonable costs incurred in settlement of terminated contracts with Subcontractors, Suppliers and others; and

20.4.4 for reasonable expenses directly attributable to termination.

Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

20.5 If the Work should be stopped under an order of any court or other public authority for a period of more than ninety (90) days, through no act or fault of the Contractor or of anyone employed by him, or if the Owner should fail to pay the Contractor within 45 days after the time specified in the Payments To Contractor, Section 22.0, then the Contractor may, upon 15 days Written Notice to the Owner, stop Work until payment of the amount owing has been received.

20.6 The Owner may terminate the Contract or a portion thereof if conditions encountered during the progress of the Work make it impossible or impracticable to proceed with the Work or a local or national emergency exists.

When Contracts, or any portion thereof, are terminated before completion of all Work in the Contract, adjustments in the amount bid for the pay items will be made on the actual quantity of Work performed and accepted, or as mutually agreed for pay items of Work partially completed or not started. No claim for loss of anticipated profits will be considered.

Termination of the Contract or any portion thereof shall not relieve the Contractor of its responsibilities for the completed work nor the surety of its obligation for and concerning any just claims arising out of the Work performed.

21.0 ISSUANCE OF NOTICE OF COMPLETION AND FINAL ACCEPTANCE BY OWNER

21.1 Upon completion of the Project, a Final Inspection shall be requested by the Contractor in writing and the Owner will make an inspection within seven (7) days. If all construction provided for and contemplated by the contract is found completed to his satisfaction, that inspection shall constitute the final inspection and the Owner will make the final acceptance and issue a Certificate Of Completion to the Contractor.

If, however, the inspection discloses any Work, in whole or in part, as being unsatisfactory, the Owner will give the Contractor the necessary instructions for correction of same, and the Contractor shall immediately comply with and execute such instructions. Upon correction of the Work, another inspection will be made which shall constitute the final inspection provided the Work has been satisfactorily completed. In such event, the Owner will make the final acceptance and issue a Certificate Of Completion to the Contractor.

22.0 PAYMENTS TO CONTRACTOR

22.1 In addition to any documents required by the Engineer to be submitted to Engineer at the time a partial pay estimate is submitted, including partial lien released as specified in Section 22.9 of the General Conditions**,** the Contractor shall, at least ten (10) days before each progress payment falls due (but not more often than once a month), submit to the Engineer a partial payment estimate filled out and signed by the Contractor covering the Work performed during the period covered by the partial payment estimate and supported by such data as the Engineer may reasonably require. If payment is requested on the basis of materials and equipment not incorporated in the Work, title to such materials and equipment shall vest in the Owner, and Contractor shall supply, at the time of submission of payment estimate, supporting documents satisfactory to the Owner, to establish and protect Owner's interest in the materials and equipment, and Contractor shall maintain appropriate insurance on same until such time as actual possession by the Owner of the materials and equipment shall occur. The Engineer will, within seven (7) days after receipt of each partial payment estimate, either indicate in writing his approval of payment and present the partial payment estimate to the Owner or return the partial payment estimate to the Contractor indicating in writing his reasons for refusing to approve payment. In the latter case, the Contractor may make the necessary corrections and resubmit the partial payment estimate. The Owner will, within fourteen (14) days of presentation to him of an approved partial payment estimate, pay the Contractor a progress payment on the basis of the approved partial payment estimate. The Owner shall retain ten (10) percent of the amount of each payment until final completion and acceptance of all Work covered by the Contract Documents. When the Contract is fifty percent completed, one-half of the amount retained shall be paid to the Contractor provided the Contractor makes a written request for the payment and the Contractor is making satisfactory progress on the Contract and there is no specific cause or claim requiring a greater amount to be retained. After the Contract is fifty per cent completed, no more than five per cent of the amount of any subsequent progress payments made under the Contract may be retained providing the Contractor is making satisfactory progress on the project, except that if at any time the Owner determines satisfactory progress is not being made, ten per cent retention shall be reinstated for all progress payments made under the Contract subsequent to the determination.

22.2 In lieu of ten percent (10%) retention provided for in paragraph 22.1, of this Article, the Owner shall, at the Contractor's option, accept as a substitute an assignment of any of the following:

A. Time certificates of deposit of banks licensed by the State of Arizona; or
B. Securities of or guaranteed by the United States of America; or

C. Securities of the State of Arizona, or any county, municipality or school district thereof; or

D. Shares of savings and loan institutions authorized to transact business in the State of Arizona.

Such assigned instruments shall have a face value in an amount equal to ten percent (10%) of the progress payment for which such instruments are tendered and shall be retained by the Owner as a guarantee for complete performance of the Contract.

In the event the Owner accepts substitute security as provided herein for the ten percent (10%) retention, the Contractor shall be entitled to all interest or income earned by such security, and all such security in lieu of retention shall be returned to the Contractor within sixty (60) days after final completion and acceptance of all material, equipment and work covered by the contract if the Contractor has furnished the Owner satisfactory receipts for all labor and material billed and waivers of liens from any and all persons holding claims against the work.

In no event shall the Owner accept a time certificate of deposit of a bank or shares of a savings and loan institution in lieu of the retention specified in paragraph 22.1 of this Article unless accompanied by a signed and acknowledged waiver of the bank or savings and loan institution of any right or power to set off against either the Owner or the Contractor in relationship to the certificates or shares assigned.

22.3 The Contractor shall promptly pay each Subcontractor, upon receipt of payment from the Owner out of the amount paid to the Contractor on account of such Subcontractors' Work, the amount to which said Subcontractor is entitled, reflecting the percentage actually retained, if any, from payments to the Contractor on account of such Subcontractors' Work. The Contractor shall, by an appropriate Contract with each Subcontractor, require each Subcontractor to make payments to his Sub-subcontractors in similar manner.

22.4 Prior to Substantial Completion, the Owner, with the approval of the Engineer and with the concurrence of the Contractor, may use any completed or substantially completed portions of the Work. Such use shall not constitute an acceptance of such portions of the Work.

22.5 The Owner shall have the right to enter the premises for the purpose of doing Work not covered by the Contract Documents. This provision shall not be construed as relieving the Contractor of the sole responsibility for the care and protection of the Work, or the restoration of any damaged Work except such as may be caused by agents or employees of the Owner.

22.6 Upon final completion and acceptance of the Work, the Engineer shall issue a certificate attached to the final payment request that the Work has been accepted under the conditions of the Contract Documents. No retention of payments may be delayed or retained without a specific written finding by the Engineer or Owner of the reasons justifying the delay in payment. The entire balance found to be due the Contractor, including the retained percentages, except the amount necessary to pay the expenses the Owner reasonably expected to incur in order to pay or discharge the expenses determined by the Engineer or Owner in the finding justifying the retention

or delay, shall be paid to the Contractor, within sixty (60) days of completion or proper filing of the Notice of Completion.

22.7 The Contractor shall indemnify and save the Owner or the Owner's agents harmless from all claims growing out of the lawful demands of Subcontractors, laborers, workmen, mechanics, materialmen, and furnishers of machinery and parts thereof, equipment, tools, and all supplies, incurred in the furtherance of the performance of the Work. The Contractor shall, at the Owner's request, furnish satisfactory evidence, in the form of lien releases or other documents deemed appropriate by the Owner**,** that all obligations of the nature designated above have been paid, discharged, or waived. If the Contractor fails to do so the Owner may, after having notified the Contractor, either pay unpaid bills or withhold from the Contractor's unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged whereupon payment to the Contractor shall be resumed, in accordance with the terms of the Contract Documents, but in no event shall the provisions of this sentence be construed to impose any obligations upon the Owner to either the Contractor, his Surety, or any third party. In paying any unpaid bills of the Contractor, any payment so made by the Owner shall be considered as a payment made under the Contract Documents by the Owner to the Contractor and the Owner shall not be liable to the Contractor for any such payments made in good faith.

22.8 If any payment to Contractor is delayed after the date due, interest shall be paid at the rate of one percent per month or fraction of a month on such unpaid balance as may be due. If the Owner fails to make payment sixty (60) days after final completion and acceptance, in addition to other remedies available to the Contractor, interest shall be paid at the rate of one per cent per month or fraction of the month on such unpaid balance as may be due, except for that amount necessary to pay the expenses the Owner reasonably expects to incur in order to pay or discharge the expense determined by the Engineer or Owner in the finding justifying the retention or delay.

22.9 The Owner may require the Contractor to furnish partial releases or liens executed by all persons, firms and corporations who have furnished labor services or materials incorporated into the Work during the period of time for which the progress payment is due, releasing such lien rights as these persons, firms or corporations may have for that period.

23.0 ACCEPTANCE OF FINAL PAYMENT AS RELEASE

23.1 Following the Owner's acceptance of the Work, the Owner will issue a Notice of Completion to the Contractor. Sixty days after the issuing of the Notice of Completion, and upon receipt of the necessary Unconditional lien releases executed by all persons, firms and corporations who have furnished labor services or materials incorporated into the work evidencing that all liabilities have been fully discharged, the Owner will pay to the Contractor the entire sum so found to be due after deducting therefrom all previous payments and all amounts to be kept and all amounts to be retained under the provisions of the Contract. All previous prior partial estimates and payments shall be subject to correction in the final estimate and payment.

23.2 The acceptance by the Contractor of final payment shall be and shall operate as a release to the Owner of all claims and all liability to the Contractor other than claims in stated amounts as may be specifically excepted by the Contractor for all things done or furnished in connection with this Work and for every act and neglect of the Owner and others relating to or arising out of this Work. Any payment, however, final or otherwise, shall not release the Contractor or his sureties from any obligations under the Contract Documents or the Performance Bond and Payment Bonds.

24.0 INSURANCE

24.1 The Contractor shall give special attention to Section 00500-A of the Bid Documents when preparing a bid, which outline the insurance requirements of Owner and the Contractor shall consider these insurance requirements part of the Bid/Contract documents.

The Contractor shall purchase and maintain such insurance as will protect him from claims set forth below which may arise out of or result from the Contractor's execution of the Work, whether such execution be by itself or by any Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

A. Claims under worker's compensation, disability benefit and other similar employee benefit acts;

B. Claims for damages because of bodily injury, occupational sickness or disease, or death of his employees;

C. Claims for damages because of bodily injury, sickness or disease, or death of any person other than his employees;

D. Claims for damages insured by usual personal injury liability coverage which are sustained (1) by any person as a result of an offense directly or indirectly related to the employment of such person by the Contractor, or (2) by any other person; and

E. Claims for damages because of injury to or destruction of tangible property, including loss of use resulting therefrom.

The Contractor is responsible to respond to claims arising as a result of its work. See Section 500-B for specific procedures.

24.2 Certificates of Insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work. These Certificates shall contain a provision that coverages afforded under the policies will not be canceled unless at least ten (10) days prior Written Notice has been given to the Owner, “Attention: Contract Administrator, 2330 McCulloch Boulevard North, Lake Havasu City, AZ, 86403”.

24.3 The Contractor shall procure and maintain, at its own expense, during the Contract Time, liability insurance as specified in Section 500-A, incorporated herein.

25.0 CONTRACT SECURITY

25.1 The Contractor shall within ten (10) days after the receipt of the Notice Of Award furnish the Owner with a Performance Bond and a Payment Bond in sums equal to the amount of the Contract PRICE, conditioned upon the performance by the Contractor of all undertakings, covenants, terms, conditions and Contracts of the Contract Documents, and upon the prompt payment by the Contractor to all persons supplying labor and materials in the prosecution of the Work provided by the Contract Documents. Such Bonds shall be executed by the Contractor and a corporate bonding company licensed to transact such business in the state in which the Work is to be performed and named on the current list of "Surety Companies Acceptable on Federal Bonds" as published in the Treasury Department Circular Number 570. The expense of these Bonds shall be borne by the Contractor. If at any time a surety on any such Bond is declared a bankrupt or loses its right to do business in the state in which the Work is to be performed or is removed from the list of Surety Companies accepted on Federal Bonds, Contractor shall within ten (10) days after notice from the Owner to do so, substitute an acceptable Bond (or Bonds) in such form and sum and signed by such other surety or sureties as may be satisfactory to the Owner. The premiums on such Bond shall be paid by the Contractor. No further payments shall be deemed due nor shall be made until the new surety or sureties shall have furnished an acceptable Bond to the Owner.

26.0 ASSIGNMENTS

26.1 Neither the Contractor nor the Owner shall sell, transfer, assign or otherwise dispose of the Contract or any portion thereof, or of his right, title or interest therein, or his obligations thereunder, without written consent of the other party. Nor shall the Contractor assign any monies due or to become due to him hereunder without the previous written consent of the Owner.

26.2 The Owner and Contractor each bind itself, its partners, successors and assigns and legal representatives to the other party hereto and to the partners, successors, assigns and legal representatives of such other party in respect to all covenants, Contracts and obligations contained in the Contract Documents.

27.0 INDEMNIFICATION

27.1 Contractor shall indemnify and hold harmless City, its officers and employees from and against any and all liabilities, damages, losses, and costs, including reasonable attorney's fees, but only to the extent caused by the negligence, recklessness, or intentional wrongful conduct of Contractor or other persons employed or used by the Contractor in the performance of this Contract. It is agreed that Contractor will be responsible for primary loss investigation, defense, and judgment costs where this indemnification is applicable.

27.2 In any and all claims against the Owner or the Engineer, or any of their agents or employees, by any employee of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, the indemnification obligation shall not be limited in any way by any limitation on the amount or type of damages, compensation of benefits payable by or for the Contractor or any Subcontractor under worker's compensation acts, disability benefit acts or other employee benefits acts.

27.3 The obligation of the Contractor under this paragraph shall not extend to the liability of the Engineer, his agents or employees arising out of the preparation or approval of maps, DRAWINGS, opinions, reports, surveys, Change Orders, designs or Specifications.

28.0 SEPARATE CONTRACTS

28.1 The Owner reserves the right to let other contracts in connection with this Project. The Contractor shall afford other Contractors reasonable opportunity for the introduction and storage of their materials and the execution of their Work and shall properly connect and coordinate its Work with theirs. If the proper execution or results of any part of the Contractor's Work depends upon the Work of any other Contractor, the Contractor shall inspect and promptly report to the Engineer any defects in such Work that render it unsuitable for such proper execution and results.

28.2 The Owner may perform additional Work related to the Project by itself, or it may let other contracts containing provisions similar to these. The Contractor shall afford the other Contractors who are parties to such Contracts (or the Owner, if he is performing the additional Work himself), reasonable opportunity for the introduction and storage of materials and equipment and the execution of Work and shall properly connect and coordinate his Work with theirs.

28.3 If the performance of additional Work by other Contractors or the Owner is not noted in the Contract Documents prior to the execution of the Contract, written notice thereof shall be given to the Contractor prior to starting any such additional Work. If the Contractor believes that the performance of such additional Work by the Owner or others involves it in additional expense or entitles him to an extension of the Contract Time, it may make a claim therefore as provided in Sections 16 and 17.

29.0 SUBCONTRACTING

29.1 The Contractor may utilize the services of specialty Subcontractors on those parts of the Work which come under normal contracting practices or are typically performed by specialty Subcontractors, provided the Contractor, simultaneously with the delivery of the executed Contract, shall furnish to the Owner and the Engineer in writing the names of the persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each of the principal portions of the Work. The engineer will promptly reply to the Contractor in writing stating whether or not the Owner or the Engineer, after due investigation, has reasonable objection to any such proposed person or entity. Failure of the Owner or Engineer to promptly reply shall constitute notice of no reasonable objection. The Contractor shall not contract with any such proposed person or entity to whom the Owner or Engineer has made reasonable objection and the Contractor shall not be required to contract with anyone to whom he has a reasonable objection. If the Owner or Engineer has a reasonable objection to any proposed person or entity, the Contractor shall submit a substitute to whom the Owner or the Engineer has no reasonable objection. The Contractor shall make no substitution for any Subcontractor, person or entity previously selected if the Owner or Engineer makes reasonable objection to such substitution.

29.2 The Contractor shall not award Work to Subcontractor(s), in excess of forty-nine (49%) percent of the Contract Price, without prior written approval of the Owner.

29.3 The Contractor shall be fully responsible to the Owner for the acts and omissions of its Subcontractors, and of persons either directly or indirectly employed by them, as it is for the acts and omissions of persons directly employed by it.

29.4 The Contractor shall not employ any Subcontractors that are not properly licensed with Lake Havasu City and the State of Arizona. Changes of Subcontractors listed with the Proposal shall be made only with the approval of the Owner.

29.5 Nothing contained in these Contract Documents shall be construed as creating any contractual relationship between any Subcontractor and the Owner; the Contractor shall be as fully responsible to the Owner for the acts and omissions of Subcontractors, and of persons employed by them, as he is for the acts and omissions of persons directly employed by him.

29.6 The Contractor shall, without additional expense to the Owner, utilize the services of specialty Subcontractors on those parts of the Work which are specified or required by State or local laws to be performed by specialty Subcontractors.

29.7 The Contractor shall be responsible for the coordination of all trades, Subcontractors, material and people engaged upon this Work. The Owner will not undertake to settle any differences between the Contractor and his Subcontractors or between Subcontractors.

29.8 The Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the Work to bind Subcontractors to the Contractor by the terms of the Contract Documents insofar as applicable to the Work of Subcontractors and to give the Contractor the same power as regards terminating any subcontract that the Owner may exercise over the Contractor under any provision of the Contract Documents.

29.9 Nothing contained in this Contract shall create any contractual relation between any Subcontractor and the Owner.

30.0 ENGINEER'S AUTHORITY

30.1 The Engineer shall act as the Owner's representative during the construction period. The Engineer shall decide questions which may arise as to quality and acceptability of materials furnished and Work performed and shall interpret the intent of the Contract Documents in a fair and unbiased manner. The Engineer will make periodic visits to the site and determine if the Work is proceeding in accordance with the Contract Documents.

30.2 The Contractor will be held strictly to the intent of the Contract Documents in regard to the quality of materials, workmanship and execution of the Work. Inspections may be made at the factory or fabrication plant of the source of material supply.

30.3 The Engineer shall not be responsible for the construction means, controls, techniques, sequences, procedures, or construction safety precautions and programs in connection with the Work and will not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents. The Engineer shall not be responsible or have control or charge over the acts or omissions of the Subcontractors, or any of their agents or employees, or any other person performing any of the Work.

30.4 The Engineer shall promptly make decisions relative to interpretation of the Contract Documents.

30.5 The Engineer will have the authority to reject Work which does not conform to the Contract Documents. Whenever, in its opinion, it is considered necessary or advisable for the implementation of the intent of the Contract Documents, the Engineer will have authority to require special inspection or testing of the Work in accordance with the other terms of this Contract whether or not such Work be then fabricated, installed or completed.

31.0 LAND AND RIGHTS-OF-WAY

31.1 Prior to issuance of Notice To Proceed, the Owner shall obtain all land and rights-of-way necessary for carrying out and for the completion of the Work to be performed pursuant to the Contract Documents, unless otherwise mutually agreed.

31.2 The Owner shall provide to the Contractor information which delineates and describes the lands owned and rights-of-way acquired.

31.3 The Contractor shall provide at its own expense and without liability to the Owner any additional land and access thereto that the Contractor may desire for temporary construction facilities, or for storage of materials.

32.0 GUARANTEE

32.1 Except as otherwise specified, all Work shall be guaranteed by the Contractor against defects resulting from the use of inferior materials, equipment, or workmanship for a period of one (1) year from the date the Certificate of Substantial Completion is issued by the Owner, or within such longer period of time as may be prescribed by law or by the terms of any applicable special guarantee required by the Contract Documents.

32.2 If, within any guarantee period, repairs or changes are required in connection with guaranteed Work, which, in the opinion of the Owner, is rendered necessary as the result of the use of materials, equipment, or workmanship which are inferior, defective, or not in accordance with the terms of the Contract, the Contractor shall, promptly upon receipt of notice from the Owner, and without expense, (1) place in satisfactory condition in every particular all of such guaranteed Work, correcting all defects therein; (2) make good all damage to the building, site or Work, or equipment or contents thereof, which in the opinion of the Owner, is the result of the use of materials, equipment, or workmanship which are inferior, defective, or not in accordance with the terms of the contract; and (3) make good any Work or material, or the equipment and contents of said building, site or Work disturbed in fulfilling any such guarantee. If the Contractor, after notice, fails to proceed promptly to comply with the terms of the guarantee, the Owner may have the defects corrected and the Contractor and his surety shall be liable for all expense incurred. The Performance Bond shall remain in full force and effect through the guarantee period.

GUARANTEE

32.3 The Contractor agrees to execute, and to cause each Subcontractor to execute, a written guarantee to the Owner, in substantially the following form:

GUARANTEE FOR:

We hereby guarantee, both jointly and severally, that the improvement which we have installed for the Owner of Project, specifically described as:

Booster Pump Station 4 Improvements, Project No. 108029

has been done in accordance with the Contract Drawings and Specifications.

We agree, both jointly and severally, to repair and replace any or all Work included in said improvement, together with any other adjacent work which may be displaced or damaged by so doing, that may prove to be defective in its workmanship or material within a period of one year from date of the Certificate of Substantial Completion, ordinary wear and tear and unusual abuse or neglect accepted.

In the event of our failure to comply with the above mentioned conditions within a reasonable period of time (as determined by the Owner) after being notified in writing by the Owner, we both jointly and severally, do hereby authorize the Owner to proceed to have said defects repaired and made good at our expense, and we will honor and pay the costs and charges therefore upon demand.

Signed _____

Countersigned _____

Local Representative to be contacted for service:

Name _____

Address _____

Phone No. _____

FAX _____

The guarantee form(s) shall be completed and returned with the acknowledgement of the Certificate of Completion.

The failure of the Contractor or any Subcontractor to execute, such guarantee shall not affect the right of the Owner to rely on and enforce the guarantee and the obligations respectively assumed by the Contractor and each Subcontractor under Subparagraph 32.1 and 32.2 hereof.

33.0 ARBITRATION

33.1 Provided both parties mutually agree, all claims, disputes and other matters in question arising out of, or relating to, the Contract Documents or the breach thereof, except for claims which have been waived by the making and acceptance of final payment as provided by Section 23, may be decided by arbitration in accordance with the American Arbitration Association or any other similar body. The foregoing Contract to arbitrate shall be specifically enforceable under the prevailing arbitration law (Arizona Revised Statutes Sections 12-1501, *et seq*.) of the State of Arizona. The award rendered by the arbitrators shall be final, and judgment may be entered upon it in any court having jurisdiction thereof.

33.2 Notice of the demand for arbitration shall be filed in writing with the other party to the Contract Documents and with the American Arbitration Association and a copy shall be filed with the Engineer. The party filing for arbitration may select which arbitration service to use. Demand for arbitration shall in no event by made on any claim, dispute or other matter in question which would be barred by the applicable statute of limitations.

33.3 The Contractor shall carry on the Work and maintain the progress schedule during any arbitration proceedings, unless otherwise mutually agreed in writing.

33.4 The provisions of the Contract pertaining to arbitration are not binding upon Engineer and Engineer cannot be compelled to participate against his will in an arbitration arising out of a dispute over the Contract or Contract Documents unless Engineer so consents in writing to be a party to the arbitration.

34.0 TAXES AND CHARGES

34.1 The Contractor shall pay all State and local sales and use taxes on items, and in a manner as required by the laws and statutes of the State of Arizona and its political subdivisions. The Contractor shall withhold and pay any and all withholding taxes, whether State or Federal, and pay all Social Security charges, State Unemployment Compensation charges, industrial insurance, workers' compensation charges, and pay or cause to be withheld, as the case may be, any and all taxes, charges, or fees, or sums whatsoever, which are now or may hereafter be required to be paid or withheld under any laws.

35.0 MISCELLANEOUS CONDITIONS

35.1 In the event that either party to the Contract is required to institute arbitration or litigation to enforce its rights under the terms of the Contract, then the prevailing party in the arbitration or litigation shall be entitled to recover all costs and attorney's fees incurred.

35.2 In the event that any provision contained in the Contract is found to be contrary to the applicable law, then it shall be severed, and the remaining provisions of the Contract shall remain in full force and effect.

35.3 The Contract shall be governed by the laws of the State of Arizona.

36.0 CONFLICTS WITHIN THE PLANS OR SPECIFICATIONS

36.1 In the event that a conflict is discovered between sections of the Specifications or between the Plans and the Specifications, the following list of priority shall be used to resolve the conflict:

A. Executed Change Orders
B. Addenda
C. Contract
D. Special Provisions
E. General Conditions
F. Instructions to Bidders
G. Technical Specifications
H. Plans
I. Referenced Standard Specifications or Other Documents

37.0 NONDISCRIMINATION

37.1 The Contractor, with regard to the work performed pursuant to this contract, shall not discriminate on the grounds of race, color, sex, religion, creed, age, physical or mental disability, or national origin or ancestry in any contracts with the public and in the selection and retention of employees or subcontractors, nor in the procurement of materials and leases of equipment.

38.0 INTEGRATION

38.1 This Contract represents the entire Contract between the parties hereto and supersedes any and all prior negotiations or representations, either written or oral.

38.2 Amendments or modifications to the Contract shall be in writing, signed by both parties, or by Change Orders.

38.3 The Contract Documents shall not be construed to create any contractual relationship of any kind between the Engineer and the Contractor, but the Engineer shall be entitled to performance of obligations intended for his benefit, and to the enforcement thereof.

39.0 HAZARD COMMUNICATION PROGRAM

39.1 All contractors working on City projects shall submit a copy of their hazard communication plan to the Fire Prevention Office prior to commencement of work on any project. This will ensure that other individuals on the job site are not unknowingly exposed to a hazardous substance or chemical.

The Fire Prevention Office shall be provided a list of the hazardous substances and the material safety data sheets that are applicable to the work areas of those contract employees.

All contract labor within City facilities will be treated the same as regular employees with regard to this hazard communication standard.

*** END OF SECTION **

SECTION 00800
SPECIAL PROVISIONS

1.0 SCOPE

These Special Provisions supplement and modify the General Conditions, Technical Specifications, and Plans. All requirements and provisions of the General Conditions, Technical Specifications and Plans apply except where modified by these Special Provisions.

2.0 DEFINITION OF TERMS

Wherever in these documents the word "ENGINEER" appears, it shall be understood to mean Lake Havasu City Public Works Department, Engineering Division.

3.0 PRECONSTRUCTION CONFERENCE

Within ten (10) days after the contract has been awarded, but before the start of construction, the ENGINEER will schedule a conference to be held at the site of the project for the purpose of discussing such matters as project supervision, onsite inspections, progress schedules and reports, payrolls, payments to Contractors, equal employment opportunity, contract change orders, insurance, safety, and any other items pertinent to the project. The Contractor shall arrange to have all supervisory personnel connected with the project on hand to meet with the representatives of the Owner and the Engineer.

4.0 DRAWINGS OF RECORD

Two sets of the Contract Documents are to be kept at the job site, maintained in good condition, and marked daily by the Contractor as the work proceeds. The Contract Documents shall be kept available for inspection by the OWNER at all times, and shall be kept up to date.

5.0 SURVEYS

The CONTRACTOR shall layout the WORK, in accordance with the drawings, shall establish all necessary lines, etc., required to complete the work in accordance with the Contract Documents. The CONTRACTOR shall employ an experienced and competent Arizona Registered Land Surveyor (R.L.S.) satisfactory to the OWNER to layout the WORK and to verify lines and elevations as the WORK progresses.

6.0 WEATHER CONDITIONS

In the event of temporary suspension of work, or during inclement weather, or whenever the OWNER shall direct, the Contractor will and will cause his Subcontractors to protect carefully his and their work and materials against damage or injury from the weather. If, in the opinion of the OWNER, any work or materials shall have been damaged or injured by reason of failure on the part of the Contractor or any of his subcontractors to so protect his work, such materials shall be removed or replaced at the expense of the Contractor.

7.0 SUBMITTALS

Prior to construction and as soon as possible, the Contractor shall supply all submittals required by the Technical Specifications or as requested by the Owner

8.0 INSPECTION OF THE WORK

Owner intends to provide a full-time resident inspector for the project. The resident inspector will be available for a forty (40) hour period during the week from Monday through Friday during the period of the Contract. In the event the Contractor elects to work outside the forty (40) hour week that occurs between Monday through Friday, such as Saturday, Sunday or legal holidays, in accordance with Article 17.0 of the General Conditions the Contractor will be responsible for all inspection, engineering, and testing costs incurred during that period. For any inspection work performed on Saturday, Sunday, or local municipal holidays the minimum chargeable time shall be four (4) hours. The Owner reserves the right to deduct these additional inspection, engineering, and testing costs directly from the Contractor's payments.

9.0 WATER AND POWER

A. WATER

Water is available from the Water Department at no cost to the Contractor. The Contractor shall make application and obtain a hydrant meter from the Water Department for the purpose of metering the use of water on the project. The Contractor shall adhere to all conditions stated in the Meter Application, including payment of a deposit for the meter, return of the meter to the Water Department each month during the project for reading, and notification to the Water Department prior to any change in the location of the hydrant meter. The maximum water to be drawn off a hydrant at any time is 200 gpm (water drawn from 4" hydrant whenever available). Water shall only be drawn off hydrants approved by the Lake Havasu City Water Superintendent or his authorized representative.

B. POWER

All power for lighting, operation of Contractor's plant or equipment or for any other use as may be required for proper completion of the work to be performed under the provisions of these contract documents, shall be provided by the Contractor at his sole cost and expense.

10.0 BURNING OF VEGETATION

No burning of vegetation will be allowed.

11.0 MATERIALS TESTING

A. CONSTRUCTION TESTING

All quality control testing must be provided by CONTRACTOR. The material and workmanship provided during construction will be tested on a regular basis by the CONTRACTOR. It shall be the responsibility of the CONTRACTOR, at no additional cost, to provide material samples for testing at the **OWNER's** request.

The CONTRACTOR shall be responsible for charges resulting from failed tests, costs for retesting shall be based upon hourly and/or individual test rates. In the event any portion of the project is rejected because of substandard work, all materials testing, engineering, and inspection costs associated with corrective measures shall be chargeable to the CONTRACTOR at the current respective rates.

B. PRELIMINARY MATERIALS TESTING

All preliminary materials testing and mix design testing required by the specifications to ensure materials and mix designs are suitable for project use will be the responsibility of the CONTRACTOR at no additional cost to the OWNER.

12.0 CLEANUP AND POLLUTION CONTROL

A. GENERAL

The CONTRACTOR shall be responsible for the removal of all debris, litter and waste from the job site(s) and/or equipment maintenance area and the restoration of any and all areas affected, directly or indirectly by the construction, transportation of equipment or materials and/or by the acts of neglect or omission by his employees.

All debris, litter, etc., shall be disposed of in accordance with prevailing ordinance or law. Open burning of trash, debris, etc., will not be permitted.

Such clean-up operations shall be on a daily basis. All pavement, concrete, brush, rocks, excess materials, etc. accumulated or removed during the course of construction must be disposed of in those areas designated by the Engineer or his authorized representative, including but not limited to the Lake Havasu City Landfill. All costs for disposal, including gate or tipping fees, etc. are the responsibility of the Contractor. This material must be disposed of within ten (10) days of time of removal. If the areas in question are not cleaned up to the satisfaction of the ENGINEER, progress payments will be withheld until clean-up is completed and approved by the ENGINEER, or, in the case of private projects, other legal action will be taken.

B. TEMPORARY FACILITIES

The CONTRACTOR shall provide temporary mailboxes and traffic control signs where necessary until completion of backfilling and clean-up.

C. SOLID WASTES

All solid wastes shall be removed and disposed of in accordance with prevailing ordinance or law. Clean-up shall be completed on a daily basis. All costs for disposal shall be the responsibility of the Contractor and shall be considered incidental to the costs of the various bid items.

All spilled paving material shall be removed and disposed of prior to final acceptance and payment.

D. MAINTENANCE AREAS

Maintenance areas shall be kept clean during construction and shall be free of litter at all times. All empty containers, debris, waste, etc., shall be removed and disposed of prior to final acceptance. Upon inspection by the ENGINEER, the CONTRACTOR may be required to dress the surface of the ground, dependent upon the extent of spillage of petroleum products on the surface. If so directed, such dressing shall consist of scarifying the surface to a depth of six (6) inches and moving and compacting the soil in such a way as to blend the spill areas into clean soil and restore the surface by partial compaction.

E. POLLUTION

The CONTRACTOR shall be held responsible for acts leading to pollution of water, air or land by any means.

Open burning of trash, debris, etc., will not be permitted anywhere in the City limits.

The discharge of any pollutants upon the surface of the ground, or into any stream, ravine, wash or body of water which may result in pollution of the public water supply, or of groundwater contributory thereto, will not be permitted.

Violation of these conditions will be cause for the termination of work, and possible legal action.

F. REMOVAL AND REPLACEMENT OF SIGNS, MAILBOXES, ETC.

It is the responsibility of the CONTRACTOR to remove all poles, etc. which are located within the construction area and replace at the time of backfilling and clean-up in the locations determined by the Street Superintendent. In the case of landscaping or other private items located in the construction area, the CONTRACTOR shall hand-deliver a written notice to all residences in that area stating his intentions to perform construction activities and shall do so at least five (5) working days prior to work commencing. If, at

the time of construction these items are still in the construction area, the CONTRACTOR is to remove and dispose of them properly. All signs and mailboxes shall be permanently installed within forty-eight (48) hours of completion of construction activities.

G. NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) GENERAL PERMIT

(NOT APPLICABLE)

13.0 DUST CONTROL

It shall be the Contractor's responsibility to provide adequate water for dust control. It is imperative that the air quality standards are maintained. In addition, dust could be quite hazardous in the everyday operations. It shall be the Contractor's responsibility to ensure that all regulations for air quality and safety are met.

14.0 SUPERVISORY PERSONNEL

It is the intent of these Specifications to provide a completed project which will in every way reflect the work of competent journeyman mechanics in the various trades represented. The Contractor shall ensure that each portion of the work is supervised by a qualified person, well versed in the operation of the various tools required for the trade, the method in which the work is to be done, and a knowledge of the general requirements of the construction work. All work is to be done in accordance with the latest methods devised for such work to ensure the highest quality product.

15.0 SAFETY REQUIREMENTS

The Contractor shall comply with all pertinent provisions of the Department of Labor "Safety and Health Regulations for Construction" (29 CFR Part 1518, 36 CFR 7340), with additions or modifications thereto, in effect during construction of this project.

THE FOLLOWING MEASURES OR PROVISIONS ARE TO BE ADHERED TO AT ALL TIMES DURING THE CONSTRUCTION OF THIS PROJECT:

A. All heavy construction machinery to include trenching machines, bulldozers, backhoes, etc., must be equipped with a roll bar meeting the requirements of the above regulation.
B. Safety helmets will be worn by all personnel working at the site. In addition, all spectators and inspectors will be required to wear safety helmets in construction zone.
C. Steel toe safety shoes or boots will be worn by all personnel working at the site.

16.0 PRESERVATION OF BENCH MARKS AND MONUMENTS

The Contractor shall exercise caution to ensure that permanent benchmarks, monuments, established property corners, survey lines, and points are not damaged or disturbed by this work. If any survey monuments, property corners, survey lines or points are damaged or disturbed, the Contractor's representative shall immediately notify the inspector. All centerline survey monumentation located in pavement removal areas shall be replaced by an Arizona Registered Land Surveyor (R.L.S.) after completion of the pavement removal and replacement operations. All costs incurred to re-establish such points shall be borne by the Contractor.

17.0 DISPOSAL OF EXCESS MATERIAL

Excess soil and unsuitable materials shall be removed from the site by the Contractor at his own expense and disposed of in accordance with the Contract Documents unless otherwise permitted herein. In the event the Contractor chooses to utilize local private lots to dispose of excess material, the Contractor must provide the Engineer with written permission from the lot owner prior to utilizing the lot. Placing material suitable for fill on vacant lots will require a Grading Permit in advance of placing the material.

18.0 REFERENCE STANDARD SPECIFICATIONS

Where standard specifications or testing methods have been referred to, such as ASTM or AASHTO, the intent is to refer to the latest applicable issue or revision of such specifications or testing methods. The following abbreviations are used in these specifications.

AWWA	American Waterworks Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AI	Asphalt Institute
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute (formerly the USA Standards Institute)
ASTM	American Society for Testing and Materials
NSF	National Sanitation Foundation
S.P.W.C.	Standard Specifications for Public Works Construction. (Wherever written herein shall mean "Maricopa Association of Governments, Arizona Specification for Public Works Construction".) The “Sample Forms” and “Part 100 – General Conditions” of these Standard Specifications for Public Works Construction are excluded from the documents for this project.

19.0 CODES, ORDINANCES AND LOCAL SPECIFICATIONS

All work under this project shall be performed in strict accordance with these specifications and the Standard Specifications for Public Works Construction (SPWC). Where any conflict occurs between these plans and specifications and the local codes and ordinances in effect at the time, such codes and ordinances shall take precedence over these plans and specifications only if these plans and specifications are inferior as to materials and workmanship called for by such codes and ordinances.

20.0 INTERFERING STRUCTURES AND UTILITIES

The Contractor shall notify Blue Stake (1-800-782-5348) at least three (3) working days prior to any excavations.

The Contractor shall exercise all possible caution to prevent damage to existing structures and utilities, whether above ground or underground. The Contractor shall notify all utility offices concerned at least seventy-two (72) hours in advance of construction operations in which a utility's facilities may be involved.

Any structure or utility damage caused by the work shall be repaired or replaced in a condition equal to or better than the condition prior to the damage. Such repair or replacement shall be accomplished at the Contractor's expense without additional compensation from the Owner.

If interfering structures or installations such as vaults, manholes, valves, utility poles, guy wires, or anchors are encountered, the Contractor shall notify the Engineer and contact the appropriate utility or structure owner at least seven (7) days in advance of construction to arrange for protection or relocation of the structure.

The Contractor shall remove, protect and/or replace all existing structures, utilities or other improvements and similar items within the proposed improvements at his own expense without additional compensation from the Owner unless specifically provided for as a pay item of work by the Specifications or as otherwise provided for on the Plans. Replacement shall be in a manner and in a condition at least equivalent to, or better than, the original condition.

If the Contractor encounters existing facilities which will prevent the construction of any facility and which are not properly shown on the Plans, he shall notify the Owner before continuing with the construction in order that the Owner may make such field revisions as necessary to avoid conflict with the existing structure. The cost of waiting or "down" time during such field revision shall be borne by the Contractor without additional cost to the Owner. If the Contractor fails to notify the Owner when an existing structure is encountered, but proceeds with the construction despite this interference, he does so at his own risk. In particular, when the location of the new construction will prohibit the restoration of existing structures to their original condition; the Contractor shall notify the Engineer and contact the utility or structure owner so a field relocation may be made if possible to avoid the conflict.

In the event of interruption to any utility service as a result of accidental breakage or as a result of being exposed or unsupported, the Contractor shall promptly notify the proper authority. He shall cooperate with the said authority in restoration of service as promptly as possible and shall bear all costs of repair. In no case shall interruption of any utility service be allowed to exist outside working hours unless prior approval of the Owner is received.

Neither the Owner nor its officers or agents shall be responsible for damages to the Contractor as a result of the locations of the water and sewer lines or utilities being other than those shown on the Plans or for the existence of water, sewer lines or utilities not shown on the Plans.

21.0 AIR QUALITY - OPERATING PERMITS (NOT APPLICABLE)

The Contractor may be required to obtain registration certificates and/or operating permits for sources of air pollution.

Information concerning these certificates and permits may be obtained from:

The Office of Air Quality
Arizona Department of Environmental Quality
P.O. Box 600
Phoenix, AZ 85001-0600
(602) 207-2300

22.0 ADJUST UTILITIES TO FINISHED GRADE

The Contractor shall be responsible for locating all manhole rims, valve boxes, meter boxes, utility vaults, etc., and setting them to finished grade. The Contractor shall adjust sewer and water facilities to finished grade in accordance with the specifications within seven (7) days after street surfacing has been completed on each street. All valves and/or manholes will be made visible and accessible for emergency use within 24 hours. It shall be the responsibility of the Contractor to coordinate with the various private utility companies so that they can adjust their facilities to finished grade at an appropriate time. Adjust all facilities in accordance with these specifications and the MAG Standard Details, as modified by Lake Havasu City.

23.0 SAFETY, HEALTH AND SANITATION PROVISIONS

The Contractor shall 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 and regulations of the Arizona State Department of Health.

The Contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions, on his own responsibility or as the Owner may determine, reasonably necessary to protect the life and health of employees on the job, the safety of the public and to protect property in connection with the performance of the work covered by the contract.

Precaution shall be exercised by the Contractor at all times for the protection of persons (including employees) and property. The Contractor shall comply with the provisions of all applicable laws, pertaining to such protection including all Federal and State occupational safety and health acts, and standards and regulations promulgated thereunder.

24.0 PUBLIC SAFETY AND TRAFFIC CONTROL

Every attempt shall be made to provide public safety during the construction of the project. Traffic control shall be performed in accordance with Section 2650, Traffic Control, of the Technical Specifications.

During all construction operations, the Contractor shall construct and maintain such facilities as may be required to provide access for all property owners to their property. No person shall be cut off from access to his residence or place of business for a period exceeding two (2) hours unless the Contractor has made a special arrangement with the affected persons. It shall be the Contractor's responsibility to notify all adjacent property owners of the construction activity and the schedule of such activities.

The CONTRACTOR shall submit for approval a traffic control and barricade plan within ten (10) days of receipt of Notification of Award of Contract. There shall be no deviations from the approved barricade plan unless a revised barricade plan is submitted and approved. The CONTRACTOR shall issue a news release once a week for duration of the project. The release will be published in Sunday's newspaper and shall indicate the area in which the CONTRACTOR will be performing work for that week.

Businesses must be notified forty-eight (48) hours prior to any restrictions on normal parking areas used by their employees or patrons.

The CONTRACTOR shall contact, cooperate with, and give notice to each resident, homeowner, business or school that will be affected by any part of the construction process, particularly concerning temporary interruptions to vehicular access.

Written notice of the approximate schedule and explanation of work shall be given to each resident, homeowner, business or school at least five (5) days prior to commencement of work in the area. Verbal door-to-door communication shall be made at least twenty-four (24) hours prior to construction to remind all affected parties of the construction to take place.

The OWNER shall receive a copy of all notifications to residents. In the event of complaints by residents, the OWNER may require the CONTRACTOR to provide documentation (i.e. check list) showing the date & time of the verbal door-to-door communication.

In addition, the CONTRACTOR is responsible to answer and resolve any conflicts that may arise between a homeowner or business owner and himself during the construction process.

The CONTRACTOR shall provide and station competent flaggers whose sole purpose shall be to direct the movement of public traffic through or around the work. Proper advanced warning signs

shall be in place when flaggers are working and removed when work requiring flaggers is completed. Flaggers must be used to assist trucks for safe ingress and egress whenever truck movements may interfere with safe passage through the work zone.

All traffic control devices that are not in use or will not be used for a period greater than 72 hours or that are determined by the Engineer to be unnecessary, confusing, or causing an unsafe condition, shall be removed by the CONTRACTOR from the public right-of-way immediately upon notification by the Engineer.

Every attempt shall be made to provide public safety during the construction of the project. Traffic control shall be performed in accordance with Section 2650, Traffic Control, of the Technical Specifications. No person shall be cut off from access to his residence or place of business for a period exceeding six (6) hours unless the Contractor has made a special arrangement with the affected persons. In addition, no work will be scheduled which will interrupt regular trash pickup to either residential or commercial properties. It will be the CONTRACTOR'S responsibility to coordinate his activities with the local trash haulers.

No streets, avenues, boulevards or cul-de-sacs will be closed to traffic unless prior arrangements have been made and approval has been obtained from the ENGINEER.

25.0 TEMPORARY FACILITIES ON SITE

A. General

Except as otherwise provided, the Owner shall bear no costs of temporary facilities and their removal.

B. Temporary Utility Services

The Contractor shall provide temporary electric power as necessary for the execution of the Work, including that required by all Subcontractors. He shall make the necessary arrangements with Owner, shall bear all costs for these temporary services and shall furnish and install all necessary transformers, metering facilities and distribution centers from branch circuits as he may require.

The Contractor shall provide lighting and outlets in temporary structures throughout the project as may be required for safety, proper performance and inspection of the Work. If operations are performed during hours of darkness, or if natural lighting is deemed insufficient by Owner, the Contractor shall provide adequate floodlights, clusters and spot illumination. The use of permanently installed lighting fixtures, lamps and tubes for work will not be permitted except by special permission of Owner. The Contractor shall make arrangements with Subcontractors for electrical services and lighting as may be necessary in the performance of their work.

Temporary water service lines, if required, shall be installed and removed by the Contractor, who shall pay all charges for making the connections, running the temporary lines, removing the temporary lines at the completion of the Work and disconnecting the services. All relocations required to clear the work of others shall be performed by the Contractor when requested by the Owner.

C. Temporary Structures

Prior to starting Work, the Contractor shall, as directed by Owner, provide and maintain suitable temporary office facilities for the duration of the Project as required for the Contractor's project administration; and all necessary sheds and facilities for the proper storage of tools, materials and equipment employed in the performance of the Work.

D. Toilet Facilities

The Contractor shall provide and maintain temporary toilet facilities for the duration of operations, which shall be maintained in a clean and sanitary condition acceptable to Owner and in full compliance with applicable regulations of any public authority.

E. Telephones

The Contractor shall provide, maintain and pay for telephone services for the duration of the Work as required for the Contractor's operation.

F. Fence and Barricades

The Contractor shall provide such protective fences and barricades as he may deem necessary for public safety and to protect his storage areas and the Work in place. The location and appearance of all fences shall be subject to the approval of the Owner.

G. Contractor Parking

The Contractor shall not park his equipment, nor allow his personnel to park, in any area except those specifically designated by the Owner.

H. Temporary Living Quarters

Temporary living quarters shall not be allowed on the job site or on publicly owned properties. In addition, all Lake Havasu City Zoning Codes for the area in question shall be strictly adhered to.

I. Removal of Temporary Construction

The Contractor shall remove temporary office facilities, toilets, storage sheds and other temporary construction from the site as soon as, in Owner's opinion, the progress of Work permits. He shall recondition and restore those portions of the site occupied by the same to a condition equal to or better than it was prior to construction.

26.0 ACCESS TO WASHES

A. Unless otherwise mentioned herein, the Contractor must obtain written permission from the Owner prior to gaining access or utilizing washes or City parcels for any purpose. Request for access to washes and City parcels will be reviewed on a case-by-case basis. The Contractor shall have access to washes and City parcels via public streets and/or private easements only. For the purposes of this paragraph, "private easement" means an Contract by and between the Contractor and a property owner, in writing, authorizing the Contractor to travel across the property owner's real property in order to have ingress or egress to washes, parcels or any portion thereof. Such Contracts, if any, shall be filed with the Office of the City Engineer before the Contractor may exercise the rights thereunder granted. Access to any wash, parcels, or portion thereof by any means not in compliance with the terms of this paragraph shall be deemed a trespass and a breach of the terms of the Contract.

B. Violations of the provisions of subparagraph (a.) hereof, shall entitle the City to deduct the sum of One Thousand Dollars ($1,000.00) from the monies due to Contractor as and for

liquidated damages for each such violation. For the purposes of this paragraph, each entry by a vehicle upon land for which Contractor has not received permission to enter shall be deemed a separate violation of subparagraph (a.) hereof.

27.0 COORDINATION AND COOPERATION WITH UTILITY COMPANIES AND OTHER TRADES

A. Coordination/Interruption

The Contractor is responsible to coordinate work with all utility companies and other trades, on or affecting the job, for an efficient and effective execution of the complete project. The Contractor shall carefully examine all work that may conflict, and plan removal and/or installation details in advance of the construction to avoid any such conflict. Failure on the contractor's part to coordinate with any and all utilities, public or private, shall preclude the City's consideration for additional time or cost.

B. Permission Required

Utility mains and utility service to buildings shall not be cut off or otherwise interrupted without the Contractor obtaining permission from the Owner in each and every instance.

C. Scheduling of Interruptions

Where utilities serve facilities or buildings in use, interruptions in service shall be scheduled during the hours when the facility is not in operation. Any overtime costs occasioned thereby shall be regarded as incidental to, and included within, the Contract Sum.

D. General Requirements

Prior to interrupting any utility service, the Contractor shall ascertain that he has the proper materials, together with adequate workmen and equipment, to complete the Work with a minimum of delay.

E. Project Electrical Service

The Contractor is responsible to coordinate with Unisource, Electric Division, to determine the extent of work to be performed by Unisource and by the Contractor to provide electric service for the finished product. The Contractor is also responsible to contact Unisource to determine the hardware required by Unisource to provide service to the final product. Unisource does not provide service to delta connections.

SECTION 01030

SUMMARY OF WORK

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Identification and summary description of the Project, the Work, location, OWNER furnished equipment, Work by OWNER, activities by others, and coordination.
B. The Project consists of
   1. Booster Pump Station Improvements: Partial demolition of existing booster pump and appurtenances, electrical service panels and related components, and installation of a new booster pump, valves and piping, replacing existing hydropneumatic tank with new hydropneumatic tank and appurtenances, electrical panels and wiring, shade canopy, and construction of a new PRVstation on Cherry Tree Lane.

1.02 LOCATION OF PROJECT

A. The Project is located at the following addresses:
   1. Site 4A Booster Pump Station: 336 Pacific Drive, Lake Havasu City, AZ 86406.

1.03 WORK BY THE OWNER

A. Concurrent to this Project, the OWNER will:
   1. Provide site access.
   2. Provide water needed for construction.
   3. Coordinate startup and shutdown of facilities.

1.04 ACTIVITIES BY OTHERS

A. OWNER, utilities, and others may perform activities within Project area while the Work is in progress:
   1. Schedule the Work with OWNER, utilities, and others to minimize mutual interference.

B. Cooperate with others to minimize interference and delays:
   1. When cooperation fails, submit recommendations and perform Work in coordination with work of others as directed.
   2. When the Work depends for proper execution or results upon work performed by others, inspect and promptly report apparent discrepancies or defects in work performed by others.
   3. Assume responsibility for work performed by others, except for defects reported as specified in this paragraph and defects which may become apparent in work performed by others after execution of the Work.

1.05 OPERATION OF EXISTING FACILITIES

A. All work must be scheduled with the OWNER to avoid interference with existing facilities. Refer to Section 01040 for additional requirements.

B. To the extent possible, the existing booster pump station shall remain in operation during construction of the new facilities. See Section 01040 for Order of Construction.

1.06 COORDINATION OF WORK

A. Maintain overall coordination of the Work:

1. As more fully set forth in the General Conditions, CONTRACTOR shall be solely responsible for coordination of all of the work. Supervise, direct and cooperate fully with all subcontractors, manufacturers, fabricators, suppliers, distributors, installers, testing agencies and all others whose services, materials or equipment are required to ensure completion of the work within the Contract time.
2. As more fully set forth in the General conditions, CONTRACTOR shall cooperate with and coordinate work with the work of any other contractors, utility service companies or OWNER's employees performing additional work related to the Project site.
3. CONTRACTOR shall coordinate work with the work of others to assure compliance with schedules.
4. CONTRACTOR shall attend and participate in all project coordination or progress meetings and report on the progress of all work and compliance with construction schedule.

1.07 POTABLE WATER SUPPLY PROTECTION

A. All materials of construction which may come into contact with drinking water shall conform to NSF International Standards 60 and 61.

1.08 PERMITS

A. CONTRACTOR shall include the cost for and obtain all construction related permits, except permits described in Paragraph 1.08.B. These permits include, but are not limited to:

1. Necessary ADEQ De Minimus permits for discharge of hydrostatic test water and chlorinated water used to disinfect piping and equipment.

B. OWNER will pay for and provide the following permits to the CONTRACTOR: Arizona Department of Environmental Quality's (ADEQ) Approval to Construct (ATC) and Approval of Construction (AOC), if needed.

1.09 CONTRACTOR'S USE OF PREMISES

A. CONTRACTOR shall limit his use of the premises for Work and storage, and allow for work by other contractors/subcontractors.

B. CONTRACTOR assumes full responsibility for the protection and safekeeping of products and materials CONTRACTOR has stored on the site.

C. CONTRACTOR shall move any stored products, or materials, under CONTRACTOR's responsibility, which interfere with operations of OWNER and separate contractors/subcontractors.

D. CONTRACTOR shall obtain and pay for the use of any additional storage or work areas if needed for CONTRACTOR's operations.

E. CONTRACTOR shall restore any areas used for materials storage, equipment storage, or employee and subcontractor parking to their original condition or better, unless specified otherwise.

1.10 MAINTENANCE OF TRAFFIC

A. Conduct Work to interfere as little as possible with public travel, whether vehicular or pedestrian.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01040

ORDER OF CONSTRUCTION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Order of construction activities to allow the OWNER normal operation of the existing facilities located on the Project site.

B. Related Sections include, but are not necessarily limited to:

1. Division 1.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

A. Milestone Dates - The construction duration to reach substantial completion shall not exceed 365 calendar days.

1. CONTRACTOR shall include sufficient and complete overhead costs in base Bid for a 365 calendar day construction duration to reach substantial completion at each site as listed above. No change orders or claims for extended overhead will be considered unless the actual duration to reach substantial completion exceeds 365 calendar days and OWNER was responsible for extending the timeline:

a. No credit or refund will be given to CONTRACTOR if the work is substantially completed sooner than 365 calendar days.

B. Tie-ins shall be coordinated with the OWNER and shall be scheduled as to minimize the disruption of services:

1. Thirty calendar days before start of tie-ins between new and existing facilities and shutdown of facilities, CONTRACTOR shall provide a written proposed maintenance of plant operation (MOPO) for tie-in activities and shutdowns for review by the OWNER.
2. CONTRACTOR, with input from OWNER, can identify the timeframe and duration of facility shutdowns.
3. At no time shall CONTRACTOR or his employees modify operation of the existing facilities or start construction modifications without approval of the OWNER.
4. CONTRACTOR shall plan his work to allow OWNER access to existing facilities to perform maintenance and repair work.
5. Operation of existing valves shall only be performed by OWNER's personnel.

C. Order of Construction - The Contractor shall follow a phased approach for

constructing the booster pump station as follows:

1. The existing primary booster pumps shall always remain in service and associated electrical components.
2. Install booster pumps, hydropneumatic tanks, piping and header piping with valves and associated electrical panels, soft starts and wiring.
3. Verify new pipe connection to existing booster pipe station connections and coordinated with Owner for tap and testing.
4. After installation of new Booster Station components, demolish existing electrical panels. Complete testing and transfer existing booster and electrical service to new panels (one pump panel at a time to be coordinated with Owner).
5. Any damage to existing property/equipment must be replaced to original working conditions.

*** END OF SECTION ***

SECTION 01060

SPECIAL CONDITIONS

PART 1 - GENERAL

1.01 SITE MAINTENANCE AND TEMPORARY FACILITIES

A. Maintain in good repair temporary structures, fences, barricades and related items.

B. Keep site clean of debris. Store and stockpile materials in an orderly manner and protect against damage.

1.02 TESTING (NOT REQUIRED)

1.03 PROJECT MEETINGS

A. The OWNER/ENGINEER shall conduct a preconstruction conference and progress meetings involving:

1. CONTRACTOR's Project Manager.
2. CONTRACTOR's Project Superintendent.
3. OWNER's designated Representative(s).
4. CONTRACTOR's Subcontractors as appropriate to the work in progress.

B. Progress meetings will be held bi-weekly at a location designated by OWNER.

C. The CONTRACTOR shall have available at each meeting up-to-date red line as-built drawings.

1.04 SPECIAL CONSIDERATIONS

A. CONTRACTOR shall be responsible for negotiations of any waivers or alternate arrangements required to enable transportation of materials to the site.

1.05 CONSTRUCTION SCHEDULE AND WORK HOURS

A. The CONTRACTOR shall prepare a construction schedule:

1. The CONTRACTOR shall submit a complete computer software generated critical path method schedule (CPM) to the OWNER at the pre-construction meeting (Primavera or approved equal). This schedule shall include a complete critical path schedule to cover the CONTRACTOR's anticipated time schedule.
2. The schedule shall include a detailed network diagram acceptable to the OWNER with the following features:
   a. The schedule shall be time-scaled in calendar days.
   b. The schedule shall show the order and interdependence of activities and the sequence of work as reflected in the schedule report as described below. The critical activities shall be prominently distinguished.

c. The schedule shall include, in addition to all construction activities, such tasks as mobilization and demobilization, submittal and approval of samples of materials and shop drawings, procurement of significant materials and equipment, fabrication of special items, installation, startup, commissioning, site work, cleanup, and interfacing with other projects/contractors/utility companies, etc.
d. The schedule diagram shall be organized and described as to conform to the schedule of values.
e. The diagram shall be accompanied by a schedule report of the network with a tabulation of the following data for each activity:
    1) preceding and following event numbers
    2) activity description
    3) activity duration
    4) earliest start date
    5) earliest finish date
    6) latest start date
    7) latest finish date
    8) total float time
    9) responsibility for activity (for example, CONTRACTOR, subcontractor, supplier, etc.)

3. The CONTRACTOR shall provide updated schedules and reports every month commencing from notice to proceed in conformation with the following:
    a. The OWNER or ENGINEER shall determine if the detailed network diagram and/or report requires revision in whole or in part, and shall so inform the CONTRACTOR of noncompliance with Contract schedule within 5 calendar days.
    b. The report shall show the activities or portion of activities completed during the one month period and the portion completed on the project to date; actual start and finish dates shall be shown plus future activities for the next four week period.
    c. The report shall state the percentage of revenue actually earned as of the report date.
    d. The report shall be accompanied by a narrative description of progress, problem areas, and current and anticipated delaying factors and their anticipated effect, and any correction actions proposed or taken. This report shall identify departures from earlier schedules or changes in logical sequence or logical ties.
    e. The report shall include a summary of all activities scheduled to begin in the next four week period that are critical path, those activities whose float had changed and those activities with less than the ten day float. The activities shall be sequenced by critical path activities, by least total float and by greatest float respectively.
    f. The CONTRACTOR shall use computer generated critical path scheduling software.

4. At each progress meeting the CONTRACTOR shall provide a two week look ahead schedule.
5. Acceptance of the CONTRACTOR's schedule by the OWNER is not to be construed as relieving the CONTRACTOR of its obligation to complete the Contract work within the Contract time.

B. The CONTRACTOR shall plan construction activities between normal work hours (6:00 a.m. to 6:00 p.m.) Monday through Friday excluding National holidays:
1. Work hours outside these hours including Saturday may be permissible provided a construction schedule has been prepared, submitted to, and found acceptable to the OWNER. Work hours on Saturday shall be between 7:00 am to 6:00 pm.
2. The schedule shall identify the Work to be performed, including the location and duration of planned activities.
3. Submittals shall be made a minimum of seven days prior to the planned work to allow sufficient time for the OWNER and to review the request and schedule any necessary inspections.
4. The CONTRACTOR shall be responsible for payment for all overtime and off-hours inspection for ENGINEER and testing that occur outside the normal and expected working hours indicated above.

1.06 SITE SECURITY
A. CONTRACTOR shall store small equipment and tools in secure, locked storage containers at the end of the work day.
B. CONTRACTOR assumes all risk associated with leaving construction materials, tools, vehicles, and equipment on site. OWNER is not liable for any damages or theft.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01072

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Prepare and maintain record documents for the project to accurately reflect the construction work as built. The record documents must be submitted at completion of the construction work as a condition of final acceptance of the Work by the OWNER.

1.02 MAINTENANCE OF RECORD DOCUMENTS

A. The CONTRACTOR shall maintain one copy each of the following record documents:
   1. Contract Drawings.
   2. Specifications.
   3. Design addenda.
   4. Reviewed shop drawings.
   5. Contract Change Orders and field orders.
   6. Supplemental drawings and written material provided by the ENGINEER to clarify the Contract Documents.
   7. Other contract modifications.
   8. Approved samples and/or sample results.

1.03 MARKING DEVICES

A. Mark all changes with red pencil or pen.

1.04 RECORDING

A. The CONTRACTOR shall keep the record documents current with construction in progress. Completed construction work shall not be permanently concealed until required information has been recorded.

B. The CONTRACTOR shall neatly stamp, in red, each record document “PROJECT RECORD”, and legibly mark the Contract Drawings to record actual construction deviations as follows:
   1. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.
   2. Field changes of dimension and detail.
   3. Changes made by design addenda, change order or field order.
   4. Details not on original Contract Drawings.

C. The red line as-builts shall also include buried conduit in yard.

1.05 SUBMITTAL

A. Red line record drawings shall be available for review by the OWNER whenever an application for a monthly progress payment is made. The partial record drawings shall be up-to-date through the end of the progress payment application period.

B. At completion of construction, and prior to the final inspection and final acceptance of the project by the OWNER, the CONTRACTOR shall deliver the project record documents to the ENGINEER bound into rolls of convenient size for ease of handling and properly labeled.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01200

MOBILIZATION/DEMOBILIZATION

PART 1 - GENERAL

1.1 Description

A. Description of Work

1. The work to be performed in accordance with this section includes the movement of personnel, equipment, supplies, and incidentals to the project site; for the establishment of offices, buildings and other facilities necessary for work on the project; for premiums on bonds and insurance for the project and for all other work and operations which must be performed, or costs incurred before beginning work on the various contract items.

2. Demobilization at the end of the job includes removal of tools, materials, equipment, and facilities used by the **CONTRACTOR** during construction of the project. Also included is final cleanup to leave the site with a neat, clean appearance.

PART 2 - MATERIALS

2.1 General

A. Materials shall consist of equipment, buildings, and tools necessary to move to the project site to perform work. Material for bid items shall not be included in Mobilization.

PART 3 - EXECUTION

3.1 General

A. Setting up of offices, and the use of private property for storage or work area shall be executed in a legal manner in accordance with local and state codes and ordinances.

B. Use of private property will require a signed agreement with the property owner and shall be submitted to Engineer for approval prior to use. Sign off from property owner regarding restored property conditions will be required prior to project closeout.

3.2 Measurement and Payment

A. Measurement

1. No measurement will be made.

B. Payment

Payment for mobilization will be made as follows:

1. When 5% of the total original contract amount is earned from other Bid Items, 50% of the amount bid for Mobilization, or 5% of the total original contract amount, whichever is the least, will be paid.
2. When 10% of the total original contract amount is earned from other Bid Items, 100% of the amount bid for Mobilization, or 10% of the total original contract amount, whichever is the least, will be paid.
3. Upon completion of all work on the project, payment of any amount bid for Mobilization in excess of 10% of the total original contract amount will be paid. Demobilization shall be considered incidental to the Mobilization Bid Item.

Table A

Payment for Mobilization on First Partial Payment	Not to exceed 2.5% of the Lump sum Base Bid
Subsequent payments for Mobilization	Not to exceed 2.5% of the Lump sum Base Bid
Payment for Mobilization on Final Partial Payment	Any remaining Mobilization in excess of 5% of the Lump Sum Base Bid

See Section 00310 Bid Schedule for Bid Items.

END OF SECTION

SECTION 01300

FORCE ACCOUNT

PART 1 - GENERAL

1.1 Description of Work

A. The work to be performed in accordance with this section includes additional work that is outside the general scope of the proposed project. The work to be performed shall be specifically requested in writing by the OWNER or the ENGINEER. As the project is completed, it is anticipated that the OWNER may request additional work to be performed that currently is not a part of this Contract and it is the intent that the requested work shall be performed in accordance with this section.

PART 2 - MATERIALS

2.1 General

A. Any materials utilized under this Section shall conform specifically with the appropriate Materials Section of these Specifications unless the OWNER specifically requests in writing a deviation from the Specifications. If the materials are not covered by an appropriate Specification of this document, then the OWNER will provide a written specification for the materials requested.

PART 3 - EXECUTION

3.1 Workmanship

A. Furnish all materials, equipment and labor required to complete the work. All workmanship shall meet or exceed the appropriate Specifications included in this document or any supplemental Specifications that may be provided. Perform work in accordance with the contract Plans or in accordance with any supplemental plans that may be provided by the OWNER.

3.2 Measurement and Payment

A. Measurement

1. The method of measurement shall be in accordance with the appropriate specification or as included in specific written instructions from the OWNER or the ENGINEER.

B. Payment

1. Payment for work performed under this section shall be made for those items specifically requested in writing by the OWNER. The value of any work performed in this Section shall be determined by one or more of the following methods in the order of precedence listed below.

C. Unit prices previously approved.
D. An agreed upon price.
   1. The amount specified for Force Account in the Bid Documents is an estimate that is provided so each potential bidder has an equal opportunity in the bidding. The amount does not in any way represent what work may be requested or the quantity or value of the work. The CONTRACTOR shall only be compensated for the actual work requested and performed.
   2. See Section 00310 Bid Schedule for Bid Items.

END OF SECTION

SECTION 01320

PROJECT MEETINGS, SCHEDULES, AND REPORTS

PART 1 - GENERAL

1.1 Summary

This Section includes the following administrative and procedural requirements:

A. Project Meetings
   1. Preconstruction conference.
   2. Progress/Coordination meetings.

B. Schedules and Reports
   1. Initial Project schedules.
   2. Weekly Construction progress schedule.
   3. Procurement schedule.
   4. Construction progress reports.
   5. Schedule of values.
   6. Special reports.
   7. Quality Control Testing Plan and Reports.
   8. Health and Safety Plan.

C. Related Work Specified Elsewhere

Submittal .....Section 01330

1.2 Project Meetings

A. Preconstruction Conference

1. Engineer will conduct a meeting as described in Section 800, Special Provisions, Paragraph 4.0, to review items stated in the following agenda and to establish a working understanding between the parties as to their relationships during performance of the Work.
2. Preconstruction conference shall be attended by the following.
   a. Contractor and his superintendent
   b. Engineer/Owner
   c. Utilities
   d. City Departments
   e. Representatives of principal Subcontractors and Suppliers.

3. Meeting Agenda
    a. Construction schedules.
    b. Critical Work sequencing plan/Baseline schedule with milestones
    c. Designation of responsible personnel
    d. Project coordination.
    e. Procedures and Processing of:
        (1) Field decisions.
        (2) Substitutions.
        (3) Submittals.
        (4) Change Orders.
        (5) Applications for Payment.
    f. Procedures for testing.
    g. Procedures for maintaining record documents.
    h. Use of Premises:
        (1) Office, work, and storage areas.
        (2) Owner's requirements.
    i. Construction facilities, controls, and construction aids.
    j. Temporary utilities.
    k. Safety and first-aid.
    l. Security.
4. Location of Meeting: To Be Determined.
5. Reporting:
    a. Within 5 working days after the meeting, Engineer will prepare and distribute minutes of the meeting to Owner and Contractor.
    b. Contractor shall provide copies to Subcontractors and major Suppliers.

B. Coordination Schedules
1. Engineer will conduct a meeting at least 10 days before submission of the first Application for Payment to finalize the initial coordination schedules requested under ARTICLE 1.3 this Section.
2. The meeting shall be attended by:
    a. Contractor and his superintendent.
    b. Representatives of principal Subcontractors and Suppliers.
    c. Engineer

C. Progress Meetings

1. Engineer will schedule and conduct a weekly meeting, and as necessary, as determined by the Engineer Representative as the Owner. Engineer, and Contractor shall be present at each meeting. .With Engineer's concurrence, Contractor may request attendance by representatives of Subcontractors, Suppliers,or other entities concerned with the Project or involved with planning, coordination, or performance of future activities. All participants in the meeting shall be familiar with the Project and authorized to conclude matters relating to the Work.
2. Contractor and each Subcontractor represented shall be prepared to discuss the current construction progress report and any anticipated future changes to the schedule. Each Subcontractor shall comment on the schedules of Contractor and other Subcontractors and advise if their current progress or anticipated activities are compatible with the proposed Work.
3. Contractor shall be responsible for addressing any issues with subcontractors, and provide directions as are necessary to resolve the situation and promote construction progress.
4. Meeting Agenda:
    a. Review of construction progress since previous meeting.
    b. Field observations, interface requirements, conflicts.
    c. Problems which impede construction schedule.
    d. Off-site fabrication.
    e. Delivery schedules.
    f. Submittal schedules and status.
    g. Site use and responsibilities.
    h. Temporary facilities and services.
    i. Hours of Work.
    j. Hazards/Safety.
    k. Housekeeping.
    l. Quality and Work standards.
    m. Change Orders.
    n. Documentation of information for payment requests.
    o. Corrective measures and procedures to regain construction schedule if necessary.
    p. Revisions to construction schedule.
    q. Review of proposed activities for succeeding Work period.
    r. Review proposed Contract modifications for:
        (1) Effect on construction schedule and on completion date.
        (2) Effect on other contracts of the Project.
    s. Other business.

5. Location of Meetings: Meeting shall be held at the office of the Owner, unless otherwise approved.
6. Reporting:
    a. Within 5 working days after each meeting, Engineer will prepare and distribute minutes of the meeting to Contractor. Contractor shall distribute copies to principal Subcontractors and Suppliers.

1.2 Schedules and Reports

A. Initial Coordination Schedules

1. Within 10 days after the Effective Date of the Agreement, Contractor shall submit to Engineer for review and acceptance:
    a. A preliminary procurement schedule of Equipment and Materials.
    b. A preliminary schedule of values for partial pay purposes.
    c. A preliminary schedule of Submittals, as stated in Section 01330.
    d. Preliminary cash requirement prediction.

B. Baseline Construction Schedule

1. Within 20 days after issuance of Notice of Award of the Contract, Contractor shall submit to Engineer for review and acceptance a detailed baseline construction schedule employing the critical path scheduling method.
    a. The schedule shall show the Work in a horizontal bar chart, and indicate the start date, duration, and end date for each activity.
    b. The Contractor shall submit to the Engineer, 1 electronic copy in approved format for review. Sheet size shall be a minimum 11 x 17-inches.
    c. No single activity shall be more than 15 days in duration.
    d. The Contractor shall include all work by Subcontractors in the baseline construction schedule.
    e. The schedule shall be resourced base and include work breakdown structures.
    f. Within each activity, indicate estimated completion percentage in 10% increments.
2. After the construction schedule is approved, the schedule shall serve as the Contractor's Baseline Schedule for all Work on the project. Activity ID's shall not be changed without the Engineer's written permission from this point forward. New activity ID's will be allowed, but only for new work outside the original project baseline schedule activities.
3. If required by Engineer, the Contractor shall provide sub schedules to define in more detail, critical portions of the baseline schedule,

including inspections and tests.

4. The Contractor shall coordinate the baseline construction progress schedule with the schedule of values, Submittal schedule, procurement schedule, progress reports, and payment requests.
5. The Contractor shall revise the construction baseline schedule after each meeting, event, or activity where revisions have been recognized and accepted in accordance with the GENERAL CONDITIONS.
6. The Contractor shall update and submit one (1) electronic copy in approved format of the revised schedule to the Engineer at least once each month to show actual progress compared to the originally accepted baseline construction schedule and any proposed changes in the schedule of remaining Work. The revised schedule shall be updated and submitted to the Engineer prior to each payment request. Engineer's approval for payment will not be recommended to be paid by the Owner until the monthly revised schedule is accepted by the Engineer. Include the schedule with construction rogress report (See Section 1320.1.3.D).

C. Procurement Schedule

1. After submittal of preliminary procurement schedule as stated above under "Initial Coordination Schedules", submit a detailed schedule for procurement of Equipment and Materials to be furnished by Contractor, Subcontractors, manufacturers, and Suppliers. Do not include minor items which are known to be regularly stocked by local suppliers or readily available upon short notice. Submit to Engineer for review with the construction progress schedule.
2. Engineer will review and comment on the schedule for procurement. Contractor shall make all required revisions as specified, prior to acceptance of schedule.
3. Procurement schedule shall coincide with the construction progress schedule and the Submittal schedule, and shall indicate the date each item will be needed at the Site and the time required for delivery after order is placed.
4. Update the accepted schedule for procurement at least once each month to show the status of orders placed, Submittals, and delivery. Submit with the construction progress report.
5. If requested by Engineer, submit copies of purchase orders placed by Contractor or Subcontractors.

D. Construction Progress Reports

1. Submit a report on actual construction progress on a monthly basis. More frequent reports may be required should the Work fall behind the accepted schedule.
    a. Submit a weekly report to coordinate with, and supplement the monthly construction progress report, and which details

Work scheduled for the following one-week interval, including:

(1) Work activities which will occur.
(2) Number and size of crews.
(3) Construction equipment on Site.
(4) Major items of Equipment and Material to be installed. CONTRACTOR quality control testing update.
(5) Health and safety update.

b. Format shall be on 11 x 17- inch paper, submitted to Engineer in seven (7) copies.

2. Construction progress reports shall consist of the revised construction progress schedule and a narrative report which shall include but not be limited to the following:
   a. Comparison of actual progress to planned progress shown on originally accepted schedule.
   b. Summary of activities completed since the previous construction progress report.
   c. Identification of problem areas and proposed corrective actions.
   d. A description of current and anticipated delaying factors, if any.
   e. Impact of possible delaying factors.
3. Submit a construction progress report to Engineer with each application for partial payment. Work reported complete but not readily apparent to Engineer must be substantiated with supporting data when requested by Engineer.
4. If a schedule update reveals that, through no fault of Owner, the Work is likely to be completed later than the Contract completion date, Contractor shall:
   a. Establish a plan for making up lost time.
      (1) Increase number of workers, or
      (2) Increase amount or kinds of tools, or
      (3) Work overtime or additional shifts, or
      (4) A combination of the above actions.
   b. Submit plan to Engineer before implementing the plan.
   c. Take actions as accepted to get the Work back on schedule at no additional cost to Owner.

E. Schedule of Values
1. Submit as set forth in GENERAL CONDITIONS, based on the preliminary schedule of values.
2. Coordinate preparation of schedule of values with preparation and content of construction progress schedule.

3. Content
    a. Schedule shall list the installed value of the component parts of the Work in sufficient detail to serve as a basis for computing values for progress payments during construction.
    b. Follow the construction progress schedule breakdown of Work activities as format for listing component items and assigning values.
    c. For each major line item, list subvalues of major products or operations under the item.
        (1) Each item shall include a directly proportional amount of the Contractor's overhead and profit.
        (2) For items on which progress payments will be requested for stored materials received, but not installed, break down the value into:
            (a) The cost of the materials delivered and unloaded, including taxes paid, unless taxes are exempted. Contractor shall provide a paid in full invoice.
            (b) The total installed value.
    d. The sum of all values listed in the schedule shall equal the total Contract Price.

F. Special Reports
1. When an event of an unusual and significant nature occurs at the site, prepare and submit a special report. List the chain of events, persons participating, and response by Contractor's personnel, an evaluation of the results or effects, and similar pertinent information. Advise the Owner in advance when such events are known or predictable.
2. Submit original report to Engineer.

G. Quality Control Testing Plan and Reports
1. A Quality Control Testing Plan shall be developed by the CONTRACTOR and submitted to the ENGINEER no later than the Preconstruction Conference. The Plan will include the following items:
    a. Qualifications of the proposed laboratory including laboratory accreditations and certifications for technicians proposed for the work.
    b. Test Frequency Table (one table for each specification section requiring CONTRACTOR quality control) establishing the proposed number of tests. The Table shall include columns for:
        (1) Material Tested
        (2) Sampling and Testing Points
        (3) Test Method

(4) Minimum Sampling Frequency

(5) Estimated Quantity of Materials
Number of Tests RequiredThe Table shall also include columns for number of tests complete and % of tests complete. These last two columns are for use in periodic reporting of QC testing to the ENGINEER.

2. The CONTRACTOR shall submit reports of Quality Control Testing to the ENGINEER at each Coordination Meeting. The report shall include all Quality Control test reports for testing completed during the prior week, and shall include updated Test Summary Tables. The Tables shall include updated values for cumulative number of tests completed and % of required number of tests completed. One Table shall be submitted for each specification item requiring CONTRACTOR quality control testing, and it shall be updated through the end of the prior week.

PART 2 - PRODUCTS - Not Applicable.

PART 3 - EXECUTION - Not Applicable.

** END OF SECTION 01320 **

SECTION 01325

CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

1.1 Summary

This Section specifies administrative and procedural requirements for construction photographs.

1.2 Submittals

A. Submit CD's as specified in Section 01330, Submittals and in PART 3 - this Section.

B. Photographer shall submit a digital sample set of the type and quality required during construction, for review and acceptance by Engineer.

1.3 Quality Assurance

Contractor shall provide adequate photography such that he can document conditions. Inadequate documentation not being able to prove responsibility for damages will hence cause the contractor to be responsible.

PART 2 - PRODUCTS

2.1 Photographic Requirements

Specified in PART 3, this Section.

PART 3 - EXECUTION

3.1 Project Site Photographs

A. The CONTRACTOR shall be responsible for photographing the entire project site to show the existing and general condition of the site prior to construction. Each photograph must be time stamped with the date of the photograph. In addition, the CONTRACTOR shall take photographs before, during, and after each of the following phases of construction:

1. Site clearing
2. Demolitions
3. Excavations
4. Installation
5. Final completion

B. Photographs shall be taken of the following areas and at the following times at a minimum.

1. Existing Site conditions before Site work is started. Number of views shall be adequate to cover the Site.

2. Finished Project after completion of Work. Number of views shall be adequate to show the finished Work. It is particularly important to provide a view of the restoration of each property upon completion of construction.
3. If Project is not completed during the Contract Time or authorized extensions, photographs shall continue to be taken at no increase in Contract Price.

C. The principal reason for obtaining photographs is to document the existing condition of items not scheduled for replacement or items to be removed and replaced in kind such as landscaping, privacy walls, wash locations, etc., as may be necessary for the completion of the WORK. The photographs may, in some degree, preclude the possibility of post construction litigation between CONTRACTOR, adjacent property owners, and the OWNER.

D. Digital Images
1. Submit one (1) complete set of digital image electronic files for each area of work prior to starting work.
a. Provide images in JPEG format, with minimum sensor size of 5.0 mega pixels.
b. Submit images that have same aspect ratio as the sensor, uncropped.
c. The photos of each residence and areas adjacent shall be labeled electronically on each photograph by address. Any media submitted shall be labeled with Project name, area and street. Station and/or address shall be included as applicable.
d. Identify electronic media with date digital photographs were taken.

E. Deliver to Engineer/Owner

3.2 Property Photographs for Work on Private Property

Photographs shall be taken at each residential property in sufficient detail to record the existing condition of the property and all existing improvements including trees, shrubs decorative rock and other ornamental or functional improvements. The photographs must be approved by the Engineer and Owner prior to any construction activities on the property. When taking property photos, the street name needs to be properly defined.

3.3 Additional Photographs

A. From time-to-time Engineer/Owner may issue requests for additional photographs, in addition to periodic photographs specified.
1. Engineer will give the contractor notice, where feasible.
2. In emergency situations, the contractor shall take additional photographs within 24 hours of Engineer's request.

3. Circumstances that could require additional photographs include, but are not limited to:
    a. Substantial Completion of a major phase or component of Work.
    b. Owner's request for special publicity photographs. Special events planned at Project Site.
    c. Immediate follow-up when on-site events result in construction damage or losses.
    d. Photographs to be taken at fabrication locations away from Project Site.
    e. Extra record photographs at time of final acceptance.

3.4 Measurement and Payment - Not Applicable.

** END OF SECTION 01325 **

SECTION 01331

REFERENCE FORMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section contains the required forms for CONTRACTOR's use in documenting testing Work and other Work required under this Contract. This Section supplements but does not supercede specific testing requirements found elsewhere in the Contract Documents.

B. The forms listed below are included in this Section are referenced from other Sections in the Contract Documents. Forms will include, but will not necessarily be limited to the following:

	Title
1.	Request for Change Order Proposal
2.	Change order Proposal
3.	Request for Information
4.	Contractor's Daily Construction Report
5.	Field Order
6.	Work Change Directive
7.	Shop Drawing Transmittal Form

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

*** END OF SECTION ***

SECTION 01325

CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

1.1 Summary

This Section specifies administrative and procedural requirements for construction photographs.

1.2 Submittals

A. Submit CD's as specified in Section 01330, Submittals and in PART 3 - this Section.

B. Photographer shall submit a digital sample set of the type and quality required during construction, for review and acceptance by Engineer.

1.3 Quality Assurance

Contractor shall provide adequate photography such that he can document conditions. Inadequate documentation not being able to prove responsibility for damages will hence cause the contractor to be responsible.

PART 2 - PRODUCTS

2.1 Photographic Requirements

Specified in PART 3, this Section.

PART 3 - EXECUTION

3.1 Project Site Photographs

A. The CONTRACTOR shall be responsible for photographing the entire project site to show the existing and general condition of the site prior to construction. Each photograph must be time stamped with the date of the photograph. In addition, the CONTRACTOR shall take photographs before, during, and after each of the following phases of construction:

1. Site clearing
2. Demolitions
3. Excavations
4. Installation
5. Final completion

B. Photographs shall be taken of the following areas and at the following times at a minimum.

1. Existing Site conditions before Site work is started. Number of views shall be adequate to cover the Site.

2. Finished Project after completion of Work. Number of views shall be adequate to show the finished Work. It is particularly important to provide a view of the restoration of each property upon completion of construction.
3. If Project is not completed during the Contract Time or authorized extensions, photographs shall continue to be taken at no increase in Contract Price.

C. The principal reason for obtaining photographs is to document the existing condition of items not scheduled for replacement or items to be removed and replaced in kind such as landscaping, privacy walls, wash locations, etc., as may be necessary for the completion of the WORK. The photographs may, in some degree, preclude the possibility of post construction litigation between CONTRACTOR, adjacent property owners, and the OWNER.

D. Digital Images
1. Submit one (1) complete set of digital image electronic files for each area of work prior to starting work.
a. Provide images in JPEG format, with minimum sensor size of 5.0 mega pixels.
b. Submit images that have same aspect ratio as the sensor, uncropped.
c. The photos of each residence and areas adjacent shall be labeled electronically on each photograph by address. Any media submitted shall be labeled with Project name, area and street. Station and/or address shall be included as applicable.
d. Identify electronic media with date digital photographs were taken.

E. Deliver to Engineer/Owner

3.2 Property Photographs for Work on Private Property

Photographs shall be taken at each residential property in sufficient detail to record the existing condition of the property and all existing improvements including trees, shrubs decorative rock and other ornamental or functional improvements. The photographs must be approved by the Engineer and Owner prior to any construction activities on the property. When taking property photos, the street name needs to be properly defined.

3.3 Additional Photographs

A. From time-to-time Engineer/Owner may issue requests for additional photographs, in addition to periodic photographs specified.
1. Engineer will give the contractor notice, where feasible.
2. In emergency situations, the contractor shall take additional photographs within 24 hours of Engineer's request.

3. Circumstances that could require additional photographs include, but are not limited to:
    a. Substantial Completion of a major phase or component of Work.
    b. Owner's request for special publicity photographs. Special events planned at Project Site.
    c. Immediate follow-up when on-site events result in construction damage or losses.
    d. Photographs to be taken at fabrication locations away from Project Site.
    e. Extra record photographs at time of final acceptance.

3.4 Measurement and Payment - Not Applicable.

** END OF SECTION 01325 **

SECTION 01330

SUBMITTALS

PART 1 - GENERAL

1.1 Summary

A. This Section includes definitions, descriptions, transmittal, and review of Submittals.

B. Related Work Specified Elsewhere:

Project Meetings, Schedules, and Reports	Section 01320
Construction Photographs	Section 01325
Equipment and Materials	Section 01600
Substitutions	Section 01631
Contract Closeout	Section 01780

1.2 General Information

A. Definitions

1. Shop Drawings, product data, and Samples are technical Submittals prepared by Contractor, Subcontractor, manufacturer, or Supplier and submitted by Contractor to Engineer as a basis for approval of the use of Equipment and Materials proposed for incorporation in the Work or needed to describe installation, operation, maintenance, or technical properties.

a. Shop Drawings include custom-prepared data of all types including drawings, diagrams, performance curves, material schedules, templates, instructions, and similar information not in standard printed form applicable to other projects.

b. Product data includes standard printed information on materials, products, and systems; not custom- prepared for this Project. Designation of selection for the specific item must highlight the proposed choice.

c. Samples include both fabricated and not fabricated physical examples of materials, products, and Work; both as complete units and as smaller portions of units of Work; either for limited visual inspection or (where indicated) for more detailed testing and analysis. Mock-ups are a special form of Samples, which are too large to be handled in the specified manner for transmittal of Sample Submittals.

2. Informational Submittals are those technical reports, administrative Submittals, certificates, and guarantees not defined as Shop Drawings, product data, or Samples.
    a. Technical reports include laboratory reports, tests, technical procedures, technical records, and Contractor's design analysis.
    b. Administrative Submittals are those non-technical Submittals required by the Contract Documents or deemed necessary for administrative records. These Submittals include maintenance agreements, Bonds, Project photographs, physical work records, statements of applicability, copies of industry standards, Project record data, security/protection/safety data, and similar type Submittals.
    c. Certificates and guarantees are those Submittals on Equipment and Materials where a written certificate or guarantee from the manufacturer or Supplier is called for in the Specifications.
3. Refer to ARTICLES 1.3 and 1.4 of this Part for detailed lists of documents and specific requirements.

B. Quality Requirements
1. Submittals such as Shop Drawings and product data shall be of suitable quality for legibility and reproduction purposes. Every line, character, and letter shall be clearly legible.

   Drawings such as reproducible shall be useable for further reproduction to yield legible hard copy.
2. Documents submitted to Engineer that do not conform to specified requirements shall be subject to rejection by Engineer, and upon request by Engineer, Contractor shall resubmit conforming documents. If conforming Submittals cannot be obtained, such documents shall be retraced, redrawn, or photographically restored as may be necessary to meet such requirements. Contractor's (or his Subcontractor's) failure to initially satisfy the legibility quality requirements will not relieve Contractor (or his Subcontractors) from meeting the required schedule for Submittals.

C. Language and Dimensions
1. All words and dimensional units shall be in the English language.
2. Metric dimensional unit equivalents may be stated in addition to the English units. However, English units of measurement shall prevail.

D. Submittal Completeness
1. Submittals shall be complete with respect to dimensions, design criteria, materials of construction, and other information specified to enable Engineer to review the information effectively.

2. Where standard drawings are furnished which cover a number of variations of the general class of Equipment, each drawing must be annotated to indicate exactly which parts of the drawing apply to the Equipment being furnished. Use hatch marks to indicate variations that do not apply to the Submittal. The use of "highlighting markers" will not be an acceptable means of annotating Submittals. Annotation shall also include proper identification of the Submittal permanently attached to the drawing.
3. Reproductions or copies of Contract Drawings or portions thereof will not be accepted as complete fabrication or erection drawings. Contractor may use a reproduction of Submittals Contract Drawings for erection drawings to indicate information on erection or to identify detail drawing references. Whenever the Drawings are revised to show this additional Contractor information, Engineer's title block shall be replaced with a Contractor's title block, and Engineer's professional seal shall be removed from the drawing. The Contractor shall revise these erection drawings for subsequent Engineer revisions to the Contract Drawings.

E. Items shall include, but not be limited to, the following:
1. Manufacturer's specifications.
2. Catalogs, or parts thereof, of manufactured Equipment.
3. Shop fabrication and erection drawings.
4. Instruction books and operating manuals.
5. Material lists or schedules.
6. Performance tests on Equipment by manufacturers.
7. Concrete mix design information.
8. All drawings, catalogs, or parts thereof, manufacturer's specifications and data, samples, instructions, and other information specified or necessary:
    a. For Engineer to determine that the Equipment and Materials conform to the design concept and comply with the intent of the Contract Documents.
9. Equipment List.
10. Hourly rate for equipment and labor.

F. Schedule of Submittals
1. Schedule all submittals required prior to fabrication, manufacture, or installation, for submission within 14 calendar days of the Notice to Proceed. Prepare for Engineer's concurrence, a schedule for submission of all Submittals specified or necessary for Engineer's approval of the use of Equipment and Materials proposed for incorporation in the Work or needed for proper installation, operation, or maintenance. Submit the schedule with the procurement schedule and construction progress schedule. Schedule submission of all Submittals to permit review, fabrication, and

delivery in time so as to not cause a delay in the Work of Contractor or his Subcontractors or any other contractors as described herein.

2. In establishing schedule for Submittals, allow 20 calendar days in Engineer's office for reviewing original Submittals and 5 calendar days in Engineer's office for reviewing resubmittals.
3. The schedule shall indicate the anticipated dates of original submission for each item and Engineer's approval thereof and shall be based upon at least one resubmission of each item.
4. Schedule Submittals pertaining to storage, installation, and operation at the Site for Engineer's approval prior to delivery of the Equipment and Materials.
5. Submittals shall be resubmitted until the Engineer determines the submittals are acceptable. Any delay in the submittal acceptance, due to the submission of unacceptable submittals, does not warrant any extension of contract times.
6. Contractor shall provide submittals for the following items no later than 30 days after Notice to Proceed:
   A. Pumps and motors
   B. Valves 20" and larger
   C. Emergency Generator
   D. Precast Electrical Building
   E. Electrical Switchgear
   F. Work Plan for Existing Pump Station Shutdown and Connections

G. Transmittal of Submittals

1. All Submittals for Equipment and Materials furnished by Contractor, Subcontractors, manufacturers, and Suppliers shall be submitted to Engineer by Contractor.
2. After checking and verifying all field measurements, transmit all Submittals to Engineer for approval as follows:

   a. Mark each Submittal by Project name and number, Contract title and number, and the applicable Specification Section and Article number. Include in the letter of transmittal the Drawing number and title, sheet number (if applicable), revision number, and electronic filename (if applicable). Unidentifiable Submittals will be returned for proper identification.
   b. Check and include Contractor's approval for Submittals of Subcontractors, Suppliers, and manufacturers prior to transmitting them to Engineer. Contractor's approval shall constitute a representation to Owner and Engineer that Contractor has either, determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, or

Contractor assumes full responsibility for doing so, and that Contractor has coordinated each Submittal with the requirements of the Work and the Contract Documents.

c. At the time of each submission, call to the attention of Engineer in the letter of transmittal any deviations from the requirements of the Contract Documents.

d. Make all modifications noted or indicated by Engineer and return revised Submittals until approved. Direct specific attention in writing, or on revised Submittals, to changes other than the modifications called for by Engineer on previous Submittals. After Submittals have been approved, submit copies thereof for final distribution. Previously approved Submittals transmitted for final distribution will not be further reviewed and are not to be revised. If errors are discovered during manufacture or fabrication, correct the Submittal, and resubmit for review.

e. Following completion of the Work, and prior to final payment, furnish record documents and approved Samples and Shop Drawings necessary to indicate "as constructed" conditions, including field modifications, in the number of copies specified. Furnish additional copies for insertion in Equipment instruction books and operating manuals as required. All such copies shall be clearly marked "PROJECT RECORD."

f. Keep a copy or sample of each Submittal in good order at the project site.

3. Information to Manufacturer's District Office: Contractor shall arrange for manufacturers and Suppliers of Equipment and Materials to furnish copies of all agreements, drawings, specifications, operating instructions, correspondence, and other matters associated with this Contract to the manufacturer's district office servicing the Owner. Insofar as practicable, all business matters relative to Equipment and Materials included in this Contract shall be conducted through such local district offices.

H. Engineer's Review

1. Engineer will review and take appropriate action on Submittals in accordance with the accepted schedule of Submittals. Engineer's review and approval will be only to determine if the items of Equipment and Materials covered by the Submittals will, after installation or incorporation into the Work, conform to information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer's review and approval will not extend to design data reflected in Submittals, which is peculiarly

within the special expertise of Contractor or Contractor's Subcontractors or Suppliers. Review and approval of a component item as such will not indicate approval of the assembly in which the item functions.

2. Engineer's review and approval of Shop Drawings, product data, or Samples will not relieve Contractor of responsibility for any deviation from requirements of the Contract Documents unless Contractor has in writing called Engineer's attention to such deviation at the time of submission, and Engineer has given written approval of the specific deviation. Approval by Engineer shall not relieve Contractor from responsibility for errors or omissions in Submittals.

I. Submittal Action Stamp

1. Engineer's review action stamp, appropriately completed, will appear on all Submittals of Contractor when returned by Engineer. Review status designations listed on Engineer's action stamp are defined as follows:

A - APPROVED: Signifies Equipment or Material represented by the Submittal, conforms to the design concept and complies with the intent of the Contract Documents and is approved for incorporation in the Work. Contractor is to proceed with fabrication or procurement of the items and with related Work. Copies of the Submittal are to be transmitted by Engineer for final distribution.

B - APPROVED AS NOTED (RESUBMIT): Signifies Equipment and Material represented by the Submittal conforms to the design concept and complies with the intent of the Contract Documents and is approved for incorporation in the Work in accordance with Engineer's notations. Contractor is to proceed with fabrication or procurement of the items and with related Work in accordance with Engineer's notations and is to submit a revised Submittal responsive to notations marked on the returned Submittal or written in the letter of transmittal.

RETURNED FOR REVISION (RESUBMIT): Signifies Equipment and Material represented by the Submittal appears to conform to the design concept and comply with the intent of the Contract Documents, but information is either insufficient in detail or contains discrepancies which prevent Engineer from completing his review. Contractor is to resubmit revised information responsive to Engineer's annotations on the returned Submittal or written in the letter of transmittal. Fabrication or procurement of items represented by the Submittal and related Work is not to proceed until the Submittal is approved.

C - NOT APPROVED (SUBMIT ANEW): Signifies Equipment and Material represented by the Submittal does not conform to the design concept or comply with the intent of the Contract Documents and is disapproved for use in the Work. Contractor is to provide Submittals responsive to the Contract Documents.

D - PRELIMINARY: Signifies Submittals of such preliminary nature that a determination of conformance with the design concept or compliance with the intent of the Contract Documents must be deferred until additional information is furnished. Contractor is to submit such additional information to permit layout and related activities to proceed.

E - REFERENCE ONLY, NO APPROVAL IS REQUIRED: Signifies Submittals which are for supplementary information only; pamphlets, general information sheets, catalog cuts, standard sheets, bulletins and similar data, all of which are useful to Engineer or Owner in design, operation, or maintenance, but which by their nature do not constitute a basis for determining that items represented thereby conform with the design concept or comply with the intent of the Contract Documents. Engineer reviews such Submittals for general content but not for basic details.

F - FOR DISTRIBUTION: (PREVIOUSLY APPROVED): Signifies Submittals which have been previously approved and are being distributed to Contractor, Owner, Resident

Project Representative, and others for coordination and construction purposes.

J. Instruction Books and Operating Manuals

1. Equipment instruction books and operating manuals prepared by the manufacturer shall include the following:
    a. Index and tabs.
    b. Instructions for installation, start-up, operation, inspection, maintenance, parts lists and recommended spare parts, and data sheets showing model numbers.
    c. Applicable drawings.
    d. Warranties and guarantees.
    e. Address of nearest manufacturer-authorized service facility.
    f. All additional data specified.
2. Information listed above shall be bound into hard-back binders of three-ring type. Sheet size shall be 8-1/2 x 11. Binder color shall be white. Capacity shall be a minimum of 1-1/2-inches, but sufficient to contain and use sheets with ease.

a. Provide with following accessories:
   (1) Label holder.
   (2) Business card holder.
   (3) Sheet lifters.
   (4) Horizontal pockets.

b. The following information shall be imprinted, inserted or affixed by label on the binder front cover:
   (1) Equipment name.
   (2) Manufacturer's name.
   (3) Project name: Contract name and number.

c. The following information shall be imprinted, inserted, or affixed by label on the binder spine:
   (1) Equipment name.
   (2) Manufacturer's name.
   (3) Volume number (if applicable).

K. Samples

1. Office Samples shall be of sufficient size and quantity to clearly illustrate the following:
   a. Functional characteristics of the product, with integrally related parts and attachment devices.
   b. Full range of color, texture, and pattern.
2. Field Samples and Mock-ups:
   a. Contractor shall erect field Samples and mock-ups at the Project Site and at a location acceptable to Engineer.
   b. Size or area shall be as specified in the respective Specification Section.
   c. Fabricate each Sample and mock-up complete and finished.
   d. Remove mock-ups at conclusion of Work or when acceptable to the Engineer if not a permanent part of construction.

1.3 Information Submittals

A. Informational Submittals are comprised of technical reports, administrative Submittals, and guarantees, which relate to the Work, but do not require Engineer approval prior to proceeding with the Work. Informational Submittals include:

1. Welder qualification tests.
2. Welding procedure qualification tests.
3. X-ray and radiographic reports.
4. Hydrostatic testing of pipes.
5. Field test reports.
6. Concrete cylinder test reports.

7. ASME pressure vessel test reports.
8. Certification on Materials:
    a. Steel mill tests.
    b. Brick and concrete masonry unit lab tests.
9. Soil test reports.
10. Piping stress analysis.
11. Warranties and guarantees.

B. Transmittal of Informational Submittals
1. All informational Submittals furnished by Subcontractors, manufacturers, and Suppliers shall be submitted to Engineer by Contractor unless otherwise specified.
    a. Identify each informational Submittal by Project name and number, Contract title and number, and the Specification Section and Article number marked thereon or in the letter of transmittal. Unidentifiable Submittals will be returned for proper identification.
    b. At the time of each submission, call to the attention of Engineer in the letter of transmittal any deviations from the requirements of the Contract Documents.
2. Format Requirements:
    a. Technical reports and administrative Submittals except as otherwise specified shall be submitted in a .pdf format
    b. Responsibilities of Contractor, Owner, and Engineer regarding tests and inspections of Equipment and Materials and completed Work are set forth elsewhere in these Contract Documents.
    c. The party specified responsible for testing or inspection shall in each case, unless otherwise specified, arrange for the testing laboratory or reporting agency to distribute test reports in pdf format.

C. Engineer's Review
1. Engineer will review informational Submittals for indications of Work or Material deficiencies.
2. Engineer will respond to Contractor on those informational Submittals, which indicate Work or Material deficiency.

PART 2 - PRODUCTS - Not Applicable.

PART 3 - EXECUTION – Not Applicable.

*** END OF SECTION 01330 **

SECTION 01331

REFERENCE FORMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section contains the required forms for CONTRACTOR's use in documenting testing Work and other Work required under this Contract. This Section supplements but does not supercede specific testing requirements found elsewhere in the Contract Documents.

B. The forms listed below are included in this Section are referenced from other Sections in the Contract Documents. Forms will include, but will not necessarily be limited to the following:

	Title
1.	Request for Change Order Proposal
2.	Change order Proposal
3.	Request for Information
4.	Contractor's Daily Construction Report
5.	Field Order
6.	Work Change Directive
7.	Shop Drawing Transmittal Form

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

*** END OF SECTION ***

REQUEST FOR CHANGE ORDER PROPOSAL

Date:	
Contractor:	
Project Name:	
Project No	
Request for Change Order Proposal No.	

NOTICE TO CONTRACTOR: Please submit a Change Order Proposal for the proposed modifications to the Contract Documents as described below. If acceptable, a Change Order will be issued to authorize the work. THIS IS NOT A CHANGE ORDER FOR AUTHORIZATION TO PROCEED WITH THE WORK AS DESCRIBED!

SCOPE OF WORK:

OWNER _____

CHANGE ORDER PROPOSAL

Date:	
Contractor:	
Project Name:	
Project No	
Change Order Propsoal	

Dear Sir:
Certain items of extra work have been found necessary which are not covered by the Contract for the above referenced Project. Therefore, we submit the following amounts as the basis of compensation for such extra work:

JUSTIFICATION:

The Contract Time will be (increased)(decreased)_____calendar days.

The Contract Amount will be (increased)(decreased) $_____dollars.

By:_____

Contractor:_____ Title: _____

REQUEST FOR INFORMATION

Project Name:	
Contractor	RFI#
Requested By_	Directed to
Subject_	Date Received _
Spec. Section_	Date Transmitted
Drawing References_	Date Reply Received _
Date Reply Needed_	Date Reply Transmitted _
Information Needed:	
Date:	Signature:
Reply:	
Date:	Signature

CONTRACTOR'S DAILCONSTRUCTION REPORT

Date:	
Contractor:	
Project Name:	
Project No	

CONTRACTORS WORK FORCE:	SUBCONTRACTORS WORK FORCE	EQUIPMENT ON SITE In Use --- Not in Use
Administrative	**Mechanical**	**Cranes**
Supervisors	**Electrical**	**Loaders**
Carpenters	**Instrumentation**	**Dozers**
Iron Workers:	**Sitework**	**Scrapers**
Operators	**Masonry**	**Compactors**
Finishers	**Roofing**	**Compressors**
Welders	**Rebar**	**Welders**
Electricians	**Foundation**	**Graders**
Laborers	**Painting**	**Trucks**
		Backhoe
Work Performed:		
Material and Equipment Deliver:		
Remarks:		
Authorized Signature:		

Field Order

Date:	
Contractor:	
Project Name:	
Field Order No	

By:_____ **By**_____

Owner's Authorized Signature Acknowledged **Contractor's Receipt**

Date:_____ Date:_____

WORK CHANGE DIRECTIVE

PROJECT:	
DATE OF ISSUANCE EFFECTIVE DATE	
OWNER:	
CONTRACTOR:	

You are directed to proceed promptly with the following change(s):

Description:

Purpose of Work Change Directive:

Attachments: (List documents supporting change)

If a claim is made that the above change(s) have affected Contract Price or Contract Times, any claim for a Change Order based thereon will involve one or more of the following methods of determining the effect of the change(s).

Method of determining change in Contract Price	Method of determining Change in Contract Times
☐ United Price	☐ Contractor's records
☐ Lump Sum	☐ OWNER's records
☐ Other: _____	☐ Other: _____
Estimated increase (decrease) in Contract Price $ _____ If the change involves an increase, the estimated amount is not to be exceeded without further authorization.	Estimated increase (decrease) in Contract Times: Substantial Completion _____ days Ready for final payment _____ days If the change involves an increase, the estimated time is not to be exceeded without further authorization.

AUTHORIZED: WNER

Owner: _____

By: _____

SECTION 01350

SPECIAL PROCEDURES

PART 1 - GENERAL

1.01 CONCEALED EXISTING FACILITIES

A. Verify locations of utilities and facilities which may exist by consulting with OWNER, utility companies, and Blue Stake before you dig:
   1. Abide by easement and right-of-way restrictions.

B. Notify owners of facilities when the Work will be in progress. Make arrangements for potential emergency repairs in accordance with requirements of owners of facilities including individual or residential facilities.

C. Assume responsibility for repair of facilities damaged by performance of the Work.

D. Expose sanitary and storm sewers, water, gas, electric, telephone utility lines, and other underground facilities indicated to permit survey of location and elevation prior to commencement of Work in affected area.

E. Expose in ample time to permit relocation of interfering utilities with minimum delaying effect on contract time.

F. Work required for raising, lowering, or relocating utilities in right of way not indicated will be performed by affected utility owners or as part of the Work at option of affected owners of utilities and OWNER.

1.02 PROTECTION OF THE WORK AND PROPERTY

A. CONTRACTOR shall assume responsibility for taking all precautions, providing all programs, and taking all actions necessary to protect the Work and all public and private property and facilities from damage as specified in the General Conditions and herein.

B. In order to prevent damage, injury or loss, CONTRACTOR'S actions shall include, but not be limited to the following:
   1. Store apparatus, materials, supplies, and equipment in an orderly, safe manner that will not unduly interfere with the progress of the Work or the Work of any other contractor or utility service company.
   2. Provide suitable storage facilities for all materials which are subject to injury by exposure to weather, theft, breakage, or otherwise.
   3. Place upon the Work or any part thereof only such loads as are consistent with the safety of that portion of the Work.

4. Clean up frequently all refuse, rubbish, scrap materials, and debris caused by CONTRACTOR's operations, to the end that at all times the site of the Work shall present a safe, orderly and workmanlike appearance.
5. Provide barricades and guard rails around openings, for scaffolding, for temporary stairs and ramps, around excavations, elevated walkways and other hazardous areas.

C. CONTRACTOR shall not, except after written consent from proper parties, enter or occupy privately owned land with personnel, tools, materials or equipment, except on easements provided herein.

D. CONTRACTOR shall assume full responsibility for the preservation of all public and private property or facility on or adjacent to the site. If any direct or indirect damage is done by or on account of any act, omission, neglect or misconduct in the execution of the Work by the CONTRACTOR, it shall be restored by the CONTRACTOR, at his expense, to a condition equal to that existing before the damage was done.

E. Underground Structures:
1. Underground structures are defined to include, but are not limited to, all sewer, water, gas, and other piping, and manholes, chambers, electrical conduits, tunnels and other existing subsurface work located within or adjacent to the limits of the Work.
2. All underground structures known to ENGINEER, except water, gas, sewer, electric, and telephone service connections, are shown on Drawings. This information is shown for the assistance of CONTRACTOR, in accordance with the best information available, but is not guaranteed to be correct or complete.
3. CONTRACTOR shall explore ahead of trenching and excavation Work and shall uncover all obstructing underground structures sufficiently to determine their location, to prevent damage to them and to prevent interruption to the services which such structures provide. If CONTRACTOR damages an underground structure, restore it to original condition at his expense.
4. Necessary changes in the location of the Work may be made by the OWNER to avoid unanticipated underground structures.
5. If permanent relocation of an underground structure or other subsurface facility is required and is not otherwise provided for in the Contract Documents, OWNER will direct CONTRACTOR, in writing, to perform the Work, which shall be paid for under the provisions of the General Terms and Conditions.

F. Surface Structures: Surface structures are defined as all existing buildings, structures and other facilities above the ground surface. Included with such structures are their foundations or any extension below the surface. Surface structures include, but are not limited to, buildings, tanks, walls, roads, open drainage, piping, poles, wires, posts, signs, markers, curbs, walks and all other

facilities that are visible above the ground surface.

G. Protection of Underground and Surface Structures:
   1. CONTRACTOR shall sustain in their places and protect from direct or indirect injury all underground and surface structures located within or adjacent to the limits of the Work. Such sustaining and supporting shall be done carefully and as required by the party owning or controlling such structure. Before proceeding with the work of sustaining and supporting such structure, CONTRACTOR shall satisfy the OWNER that the methods and procedures to be used have been approved by the party owning same.
   2. CONTRACTOR shall assume all risks attending the presence or proximity of all underground and surface structures within or adjacent to the limits of the Work. CONTRACTOR shall be responsible for all damage and expense for direct or indirect injury caused by his Work to any structure. CONTRACTOR shall repair immediately all damage caused by his work, to the satisfaction of the OWNER of the damaged structure.

H. All other existing surface facilities, including but not limited to guard rails, posts, guard cables, signs, poles, markers, and curbs, which are temporarily removed to facilitate installation of the Work, shall be replaced and restored to their original condition at CONTRACTOR's expense.

1.03 DAILY WORK REPORTS

A. CONTRACTOR shall provide to OWNER and ENGINEER one copy of his daily field report indicating work completed, number and classification of personnel on site, number and types of construction equipment on site and weather conditions. The field reports shall be in pdf format and shall be submitted on Monday for the prior week.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01420

DEFINITIONS AND STANDARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Definitions

1. Basic contract definitions used in the Contract Documents are defined in the GENERAL CONDITIONS. Definitions and explanations are not necessarily either complete or exclusive but are general for the Work.
2. General Requirements are the provisions or requirements of DIVISION 1 Sections, and which apply to the entire Work of the Contract.

B. Related Information Specified Elsewhere: Specification standards and associations applicable to the Work are specified in each Section.

1.2 Specification Format and Content Explanations

A. Specification Format: The Specifications are organized into Divisions and Sections based on the Construction Specifications Institute's (CSI) Section Format and Master Format numbering system. Some portions may not fully comply, and no particular significance will be attached to such compliance or noncompliance.

1. Divisions and Sections: For convenience, a basic unit of Specification text is a "Section," each unit of which is numbered and named. These are organized with related Sections, into "Divisions," which are recognized as the present industry consensus on uniform organization and sequencing of Specifications. The Section title is not intended to limit meaning or content of Section, nor to be fully descriptive of requirements specified therein, nor to be an integral part of text.
2. Section Numbering: Used for identification and to facilitate cross-references in Contract Documents. Sections are placed in numeric sequence; however, numbering sequence is not complete, and listing of Sections in Table of Contents at beginning of the Project Manual must be consulted to determine numbers and names of Specification Sections in these Contract Documents.
3. Page Numbering: Numbered independently for each Section. Section number is shown with page number at bottom of each page, to facilitate location of text.

4. Parts: Each Section of Specifications generally has been subdivided into three basic "parts" for uniformity and convenience (PART 1 - GENERAL, PART 2 - PRODUCTS, and PART 3 - EXECUTION). These "Parts" do not limit the meaning of text within. Some Sections may not contain all three "Parts" when not applicable, or may contain more than three "Parts" to add clarity to organization of Section.
5. Underscoring of Titles: Used strictly to assist reader of Specification in scanning text for key words in content. No emphasis on or relative importance is intended except where underscoring may be used in body of text to emphasize a duty, critical requirement, or similar situation.
6. Project Identification: Project file number and identification are recorded at bottom of each page of Specifications to minimize possible misuse of Specifications, or confusion with other Project Specifications.

B. Specification Content

1. These Specifications apply certain conventions in the use of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:
   a. Imperative and Streamlined Language: These Specifications are written in imperative and abbreviated form. This imperative language of the technical Sections is directed at the Contractor, unless specifically noted otherwise. Incomplete sentences shall be completed by inserting "shall," "the Contractor shall," and "shall be," and similar mandatory phrases by inference in the same manner as they are applied to notes on the Drawings. The words "shall be" shall be supplied by inference where a colon (:) is used within sentences or phrases. Except as worded to the contrary, fulfill (perform) all indicated requirements whether stated imperatively or otherwise.
   b. Specifying Methods: The techniques or methods of specifying requirements varies throughout text, and may include "prescriptive," "compliance with standards," "performance," "proprietary," or a combination of these. The method used for specifying one unit of Work has no bearing on requirements for another unit of Work.
   c. Overlapping and Conflicting Requirements: Where compliance with two or more industry standards or sets of requirements is specified, and overlapping of those different standards or requirements establishes different or conflicting minimums or levels of quality, notify Engineer for a decision as specified in GENERAL CONDITIONS.

d. Abbreviations: Throughout the Contract Documents are abbreviations implying words and meanings which shall be appropriately interpreted. Specific abbreviations have been established, principally for lengthy technical terminology and in conjunction with coordination of Specification requirements with notations on Drawings and in schedules. These are normally defined at first instance of use. Organizational and association names and titles of general standards are also abbreviated.

C. Assignment of Specialists: In certain instances, Specification text requires that specific Work be assigned to specialists in the operations to be performed. These specialists shall be engaged for performance of those units of Work, and assignments are requirements over which Contractor has no choice or option. These assignments shall not be confused with, and are not intended to interfere with, enforcement of building codes and similar regulations governing the Work, local trade and union jurisdictions, and similar conventions. Nevertheless, final responsibility for fulfillment of Contract requirements remains with Contractor.

D. Trades: Except as otherwise specified or indicated, the use of titles such as "carpentry" in Specification text, implies neither that the Work must be performed by an accredited or unionized tradesperson of corresponding generic name (such as "carpenter"), nor that specified requirements apply exclusively to work by tradespersons of that corresponding generic name.

1.3 Drawing Symbols

A. Except as otherwise indicated, graphic symbols used on Drawings are those symbols recognized in the construction industry for purposes indicated. Refer instances of uncertainty to Engineer for clarification.

1.4 Industry Standards

A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference and are stated in each Section.

1. Referenced standards, referenced directly in Contract Documents or by governing regulations, have precedence over nonreferenced standards which are recognized in industry for applicability to the Work.
2. Where compliance with an industry standard is required, standard in effect shall be as stated in GENERAL CONDITIONS.
3. Where an applicable code or standard has been revised and reissued after the date of the Contract Documents and before performance of Work affected, the Engineer will decide whether

to issue a Change Order to proceed with the updated standard.

4. In every instance the quantity or quality level shown or specified shall be the minimum to be provided or performed. The actual installation may comply exactly, within specified tolerances, with the minimum quantity or quality specified, or it may exceed that minimum within reasonable limits. In complying with these requirements, indicated numeric values are minimum or maximum values, as noted, or appropriate for the context of the requirements. Refer instances of uncertainty to the Engineer for a decision before proceeding.

5. Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents.

   a. Where copies of standards are needed for performance of a required construction activity, Contractor shall obtain copies directly from the publication source.

B. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards generating organization, authority having jurisdiction, or other entity applicable to the context of the text provision.

PART 2 - PRODUCTS - Not Applicable.

PART 3 - EXECUTION - Not Applicable.

** END OF SECTION 01420 **

SECTION 01423

REFERENCE STANDARDS

PART 1 - GENERAL

1.01 DESCRIPTION

A. When a reference standard is specified, comply with requirements and recommendations stated in that standard, except when they are modified by the Contract Documents, or when applicable laws, ordinances, rules, regulations or codes establish stricter standards. The latest provisions of applicable standards shall apply to the Work, unless otherwise specified. Reference standards include, but are not necessarily limited to, the following:

1. American Association of State Highway and Transportation Officials (AASHTO).
2. American Concrete Institute (ACI).
3. American Gear Manufacturers Association (AGMA).
4. American Institute of Steel Construction (AISC).
5. American Iron and Steel Institute (AISI).
6. American National Standards Institute (ANSI).
7. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
8. American Society of Mechanical Engineers (ASME).
9. American Society for Testing and Materials (ASTM).
10. American Water Works Association (AWWA).
11. American Welding Society (AWS).
12. Concrete Reinforcing Steel Institute (CRSI)
13. Factory Mutual (FM).
14. Institute of Electrical and Electronics Engineers (IEEE).
15. National Electrical Manufacturer's Association (NEMA).
16. Occupational Safety and Health Administration (OSHA).
17. National Fire Protection Association (NFPA).
18. Underwriters' Laboratories, Inc. (UL).
19. All other applicable standards listed in the Specifications and the standards of utility service companies, where applicable.
20. NSF International (NSF).
21. State Division of Industrial Safety (DIS)
22. Institute of Makers of Explosives (IOMOE)
23. Enclosures for Industrial Controls and Systems (ICS)
24. (ISA) See 13329-3
25. National Association of Corrosion Engineers (NACE)

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01520
FIELD OFFICES AND SHEDS

PART 1 - GENERAL

1.1 Summary

A. This Section includes requirements for temporary field offices and other structures required for office and storage space required by Contractor.

B. Related Work Specified Elsewhere

Equipment and Materials ..... Section 01600
Temporary Utilities and Facilities ..... Section 01560

PART 2 - PRODUCTS

2.1 Field Offices

A. General

1. Provide trailers, mobile buildings, or buildings constructed with floors raised aboveground, with steps, landings, and railings at entrance doors.
2. Buildings shall be structurally sound, secure, and weathertight.
3. Provide appropriate type fire extinguishers at each office and storage area.

B. Contractor's Office (optional)

1. Provide a field office or conex for Contractor's superintendent on the Site. It shall be of size required for general use, with lights, heat, air, furnishings, telephone service, and other necessary facilities and utilities required by Contractor's operations.

2.2 Storage Sheds and Trailers

A. On Site

1. Provide temporary buildings or trailers needed for storage of Equipment and Materials installed under this Contract (and those furnished by Owner or others under separate contract).
2. Provide ventilation, heating and plackards as required by Equipment and Material stored.

B. Off Site

1. Advise Engineer of any arrangements made for storage of Equipment and Materials in a place other than Owner's Site. Furnish evidence of insurance coverage with Application for Payment in conformance with the GENERAL CONDITIONS.

PART 3 - EXECUTION

3.1 Location, Installation and Maintenance

A. General

1. Place temporary buildings, trailers, and stored materials in locations acceptable to Owner or Engineer.
2. Install field offices and sheds to resist winds and elements of the locality where installed.
3. Remove when no longer needed at the Site or when Work is completed.
4. Keep approach walks free of leaves, mud, water, ice, or snow.
5. At completion of Work, remove temporary buildings and trailers, foundations (if any), utility services, and debris. Prepare ground or paved areas as specified in applicable Sections.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable

** END OF SECTION 01520 **

SECTION 01530

TEMPORARY UTILITIES AND FACILITIES

PART 1 - GENERAL

1.1 Summary

A. This Section includes contractor requirements of a temporary nature not normally incorporated into final Work. It includes the following:
   1. Utility services.
   2. Construction and support facilities.
   3. Construction aids.
   4. Safety and health.
   5. Fire protection.

B. Related Work Specified Elsewhere

Temporary Barriers and Controls ..... Section 01530
Field Offices and Sheds ..... Section 01520

1.2 Quality Assurance

A. Reference Standards and Specifications
   1. American National Standards Association (ANSI)
      A10 Series - Safety Requirements for Construction and Demolition.
   2. National Electrical Contractors Association (NECA)
   3. Electrical Design Library-Temporary Electrical Facilities.
   4. National Fire Protection Association (NFPA)
      10 - Portable Fire Extinguishers.
      70 - National Electrical Code.
      241 - Safeguarding Construction, Alterations, and Demolition Operations.

B. National Electrical Manufacturers Association (NEMA).

C. Underwriters Laboratories (UL).

D. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to:
   1. Building Code requirements.
   2. Health and safety regulations.
   3. Utility company regulations.
   4. Environmental Protection Regulations.

E. Standards
   1. Comply with NFPA 10 and 241, and ANSI A10 Series standards “Temporary Electrical Facilities."
   2. Comply with NEMA, NECA, and UL standards and regulations for temporary electric service. Install service in compliance with NFPA 70.

F. Inspections

Contractor shall obtain required certifications and permits. Arrange for authorities having jurisdiction to inspect and test each temporary utility before use.

1.3 Submittals

Temporary Utilities

Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.

1.4 Project Conditions

Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not allow hazardous, dangerous, unsanitary conditions, or public nuisances to develop or persist on the Site.

PART 2 - PRODUCTS

2.1 Materials and Equipment

A. Provide new materials and equipment. Provide materials and equipment suitable for the use intended, of capacity for required usage, and meeting applicable codes and standards. Comply with requirements of DIVISIONS 2 through 16.

PART 3 - EXECUTION

3.1 Temporary Utilities

Furnish, install, and maintain temporary utilities required for adequate construction, safety, and security. Modify, relocate, and extend systems as Work progresses. Repair damage caused by installation or use of temporary facilities. Remove on completion of Work or until service or facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 Temporary Sanitary Facilities

Contractor-Furnished Facilities

1. Furnish, install, and maintain temporary sanitary facilities for use through construction period. Remove on completion of Work.
2. Provide for all construction workers under this Contract and representatives at the Site.
3. Toilet facilities shall be of the chemical, aerated recirculation, or combustion type, properly vented, and fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
4. Drinking Water Fixtures: Provide containerized tap dispenser type drinking water units.
5. Supply and maintain toilet tissue, paper towels, paper cups and similar disposable materials as appropriate for each facility. Provide appropriate covered waste containers for used material.
6. Supply garbage containers for misc. construction trash and debris, with cover.

3.3 Temporary Safety and Health

General: Contractor shall be responsible for development of safety and health programs for personnel at Project Site as specified in the GENERAL CONDITIONS.

3.4 Installation and Removal

A. Relocation: Relocate construction aids as required by progress of construction, storage limitations, or Work requirements and to accommodate requirements of Owner and other contractors at the Site.

B. Removal: Remove temporary materials, equipment, and services when construction needs can be met and allowed by use of permanent construction, or at completion of the Project.

C. Repair: Clean and repair damage caused by installation or by use of temporary facilities.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable.

** END OF SECTION 01560 **

SECTION 01560

ENVIRONMENTAL PROTECTION
AND SPECIAL CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

A. The CONTRACTOR shall perform all work in such manner as to minimize the polluting of air, water, or land, and shall, within reasonable limits, control noise and the storage of solid waste materials.

1.02 QUALITY ASSURANCE

A. Employ and utilize environmental protection methods, and obtain all necessary permits required at the site for air quality, solid waste, storm water pollution, and hazardous wastes. CONTRACTOR shall comply with all state, county, and Federal regulations.

1.03 SUBMITTALS

A. See Section 01340.

B. See Section 3.01.C.

PART 2 -

PART 3 - PRODUCTS (NOT USED)

PART 4 - EXECUTION

4.01 ERECTION AND INSTALLATION

A. Land Protection:

1. Manage and control all work or storage areas, access routes and embankments to prevent sediment from entering nearby water or land adjacent to site of work.
2. Restore all disturbed areas including haul areas and establish permanent type of locally adaptable vegetative cover.
3. Unless earthwork is immediately paved or surfaced, protect all side slopes and backslopes immediately upon completion of final grading.
4. Plan and execute earthwork in a manner to minimize duration of exposure of unprotected soils.

B. Erosion Protection:

1. Utilize methods necessary to effectively prevent erosion and control of sediment and include the following:
   a. Retardation: Mechanically retard rate of runoff by construction of diversion ditches, terraces, and berms. Divert run off to protect damage courses.
   b. Borrow constraints: Do not borrow soils from areas where environmental controls are not possible.

c. Protect side and backslopes as soon as rough grading is complete by accelerated growth of permanent vegetation, temporary vegetation, mulching or netting. Where slopes are too steep for stabilization, use hydroseeding, mulching anchored in placed, cover anchored in placed, cover by anchored netting, sodding, or combination to prevent erosion. Remove temporary protection prior to final grading.

2. Comply with requirements of NPDES storm water regulations for construction sites.

C. Control of Responsibilities:

1. Collect and dispose of solid waste on a daily basis.
2. Provide disposal of degradable debris to an approved solid waste disposal site.
3. Provide disposal of nondegradable debris to an approved solid waste disposal site or in an alternate manner approved by OWNER and regulatory agencies.
4. Store chemical wastes in watertight containers and remove from project site and dispose of to sites approved by regulatory agencies. Assure maximum disposal frequency of 1 month.
5. Control dust at all times, including nonworking hours, weekends and holidays. Sprinkle site or treat with dust suppressors as necessary to control dust. Utilize methods and practices of construction to eliminate dust in full observance of regulatory agencies.
6. Minimize noise by fitting equipment with appropriate mufflers. The use of explosives or blasting operations are not approved.
7. On completion of work, leave area in a clean condition representative of current conditions. Assure all signs of temporary construction and activities incidental to construction of required permanent work in place are obliterated.

D. Historical Protection:

1. If during the course of construction evidence of deposits of historical or archaeological interests are found, cease work affecting find and notify the OWNER. Do not disturb deposits until written notice from OWNER is given to proceed. Lost time or changes in construction to avoid the find shall be compensated for based upon partial suspension of work.

*** END OF SECTION ***

SECTION 01580

PROJECT IDENTIFICATION AND SIGNS

PART 1 - GENERAL

1.1 Summary

A. This Section includes basic requirements for temporary Project identification and informational signs required during construction.

B. Related Work Specified Elsewhere

Submittals ..... Section 01330

1.2 Quality Assurance

A. Design sign and structure to withstand wind and environmental conditions of locality. Provide with finish adequate to withstand weathering, fading, chipping, and peeling for duration of construction.

1.3 Submittals

A. Submit as specified in Section 01330.

B. Includes, but not limited to, the following

1. Shop Drawings and product data as applicable.
2. Show content, layout, lettering, colors, structure,and foundation.

PART 2 - PRODUCTS

2.1 Identification Signs

A. Project Identification

1. Construct to design, size, and material indicated.
2. Construct structure and framing of wood, structurally adequate to resist design requirements of locality. Construct sign surface of minimum 3/4-inch thickness exterior grade plywood with medium density overlay. Panels shall be of size to minimize joints. Overall size shall be 4’ x 8’.
3. Rough hardware shall be galvanized or aluminum.
4. Coating: Paint as specified of colors selected by Engineer.
5. Information Content:
   a. Project title, logo, and name of Owner as shown on Contract Documents.
   b. Names and titles of authorities.
   c. Name and title of Engineer.
   d. Name of prime Contractor and major Subcontractors.
   e. Responsible Individual Phone Number

B. Contractor Identification: If not part of Project identification sign, provide and install Contractor's standard sign.

2.2 INFORMATIONAL SIGNS

A. Construction

1. This includes signs for traffic, construction workers, and general public in regard to directions, warnings, hazards, locations of areas, facilities, equipment, and others of a similar nature.
2. Provide signs of design, size, color, and lettering as required by regulatory agencies. Signs shall be painted metal, wood, plastic, or fiberglass and of materials suitable for the conditions in which they are placed, such as weathering and fading.
3. Construct structure and framing of wood or metal, structurally adequate to resist design requirements of area of Project. If within ROW signs should be designed with quick releases or break points.

PART 3 - EXECUTION

3.1 Installation

A. Project and Contractor Identification Sign

1. CONTRACTOR shall obtain OWNER's approval for the location of the CONTRACTOR's identification sign. The sign shall be installed in an appropriate location so as not to obstruct traffic, pedestrians, or construction operations.
2. Erect on framing or foundation, and rigidly brace.
3. Maintain sign in good repair, in a clean and neat condition.
4. Remove upon completion of Project.

B. Informational Signs

1. Install at appropriate locations and in sufficient quantities to assure visibility. Relocate as required by progress of work, or Engineer's request.
2. Maintain signs in good repair, in a neat, clean, readable condition.
3. Remove all signs, framing, supports, and foundations upon completion of Project.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable.

** END OF SECTION 01580 **

SECTION 01600

EQUIPMENT AND MATERIALS

PART 1 - GENERAL

1.1 Summary

A. This Section includes administrative and procedural requirements governing Contractor's selection of products for use in the Project.

B. Related Work Specified Elsewhere

1. For the applicability of industry standards to products specified: DIVISIONS 2 through 16.
2. For submittal of Contractor's construction progress schedule and the Submittal schedule: Section 01320 and Section 01330.
3. For handling requests for substitutions made after award of the Contract: Section 01631.

1.2 Definitions

A. Definitions used in this Article are not intended to change the meaning of other terms used in these Contract Documents, such as "specialties," "systems," "structures," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well- recognized meanings in the construction industry.

1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "Material," "Equipment," "system," and terms of similar intent.
    a. "Named Products" are items identified by the manufacturer's product name, including make or model number or other designation, shown or listed in the manufacturer's published product literature, that is current as of the date of the Contract Documents. "Foreign Products," as distinguished from "domestic products," are items substantially manufactured (50% or more of value) outside the United States and its possessions. Products produced or supplied by entities substantially owned (more than 50%) by persons who are not citizens of, nor living within, the United States and its possessions are also considered to be foreign products.
2. "Materials" are products substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.

3. "Equipment" is a product with operational or non-operational parts, whether motorized, or manually operated, that may require service connections, such as wiring or piping.

1.3 Submittals

A. Submittal of preliminary procurement schedule is specified in Section 01320 - PROJECT MEETINGS, SCHEDULES, AND REPORTS.

B. Submittals for products are specified in Section 01330 and in applicable Sections of DIVISIONS 2 through 16.

1.4 Quality Assurance

A. Source Limitations: To the fullest extent possible, provide products of the same kind from a single source.

B. Nameplates: Along with required labels and operating data, manufacturer or producer's nameplates, imprints, or trademarks may be placed on surfaces exposed to view.

1. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous.

a. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated Equipment. Locate on an easily accessible surface that is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data: Name of product and manufacturer including address (and telephone number).

b. Model and serial number.

c. Capacity.

d. Speed.

e. Ratings.

1.5 Transportation and Shipment

A. Shipment Preparation

1. Contractor shall require manufacturers and Suppliers to prepare

products for shipment in a manner to facilitate unloading and handling, and to protect against damage, deterioration, or unnecessary exposure to the elements in transit and storage. Provisions for protection shall include the following:

a. Crates or other suitable packaging materials.
b. Covers and other means to prevent corrosion, moisture damage, mechanical injury, and accumulation of dirt in motors, electrical equipment, and machinery.
c. Suitable rust-preventive compound on exposed machined surfaces and unpainted iron and steel.
d. Grease packing or oil lubrication in all bearings and similar items.

1.6 Marking: Each product item shall be tagged or marked as identified in the delivery schedule or on Submittals. Complete packing lists and bills of material shall be included with each shipment. Each piece of every item need not be marked separately, provided that all pieces of each item are packed or bundled together and the packages or bundles are properly tagged or marked. Product Delivery, Storage and Handling

A. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.

1. Schedule delivery to minimize long-term storage at the Site and to prevent overcrowding of construction spaces. Allow ample time to avoid delay of the Work.
2. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products in an undamaged condition in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected. Inspect shipment to assure:
   a. Product complies with requirements of Contract Documents and reviewed Submittals.
   b. Quantities are correct.
   c. Containers and packages are intact and labels are legible.
   d. Products are properly protected and undamaged.
5. Store products at the Site in a manner that will facilitate inspection and measurement of quantity or counting of units. Mark deliveries of component parts of Equipment to identify the Equipment, to permit easy accumulation of parts, and to facilitate inspection and measurement of quantity or counting of units.
6. Store heavy materials in a manner that will not endanger the supporting construction.

7. Store products subject to damage by the elements above ground, under cover in a weather tight enclosure, and with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.
8. Protect motors, electrical Equipment, plumbing fixtures, and machinery of all kinds against corrosion, moisture deteriorations, mechanical injury, and accumulation of dirt or other foreign matter.
9. Protect exposed machined surfaces and unpainted iron and steel as necessary with suitable rust-preventive compounds.
10. Protect bearings and similar items with grease packing or oil lubrication.
11. Handle and store steel plate, sheet metal, and similar items in a manner to prevent deformation.
12. For storage of pipe and other products on easements and rights-of-way in residential and commercial areas, do not exceed the minimum required by scheduled laying operations, and conform to all requirements of public authorities. Store or place pipe along roads, set back from shoulder or curb, and at an angle tending to deflect vehicles if struck. Place or block pipe to preclude its accidental movement.

B. Handling
1. Provide equipment and personnel necessary to unload and handle products, by methods to prevent damage or soiling to products, or packaging.
2. Handle by methods to prevent bending or overstressing. Where lifting points are designated, lift components only at those points.
3. Provide additional protection to surrounding surfaces as necessary to prevent damage.

C. Maintenance of Storage
1. Inspect stored products on a scheduled basis as approved by engineer.
2. Verify that storage facilities comply with manufacturer's product storage requirements, including environmental conditions continually maintained.
3. Verify that surfaces of products exposed to elements are not adversely affected; that any weathering of finishes is acceptable under requirements of Contract Documents.
4. For mechanical and electrical Equipment in long-term storage, provide manufacturer's service instructions to accompany each item, with notice of enclosed instructions on exterior of package. Service Equipment on a regularly scheduled basis.

D. Protection After Installation: Provide substantial coverings as necessary to protect installed products from damage from subsequent construction operations.

PART 2 - PRODUCTS

2.1 Product Selection

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise specified or indicated, new at the time of installation.

1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and the intended use and effect.
2. Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Continued Availability: Where, because of the nature of its application, Owner is likely to need replacement parts or additional amounts of a product at a later date, either for maintenance and repair, or replacement, provide standard products for which the manufacturer has published assurances that the products and its parts are likely to be available to Owner at a later date. Conform to applicable Specifications, codes, standards, and regulatory agencies.
4. Comply with size, make, type, and quality specified, or as specifically approved in writing by Engineer.
5. Manufactured and Fabricated Products:
   a. Design, fabricate, and assemble in accordance with the best engineering and shop practices.
   b. Manufacture like parts of duplicate units to standard sizes and gages, to be interchangeable.
   c. Equipment and Materials shall be suitable for service conditions intended.
   d. Equipment capacities, sizes, and dimensions indicated or specified shall be adhered to unless variations are specifically approved in writing by Engineer.
   e. Provide labels and nameplates where required by regulatory agencies or to state identification and essential operating data.
6. Do not use products for any purpose other than that for which designed.
7. To the fullest extent possible, provide products of the same kind from a single source.

PART 3 - EXECUTION

3.1 Installation of Products

A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place except as required for proper movement and performance, and accurately located and aligned with other Work.

1. Obtain and distribute copies of manufacturer's printed instructions and recommendations if not a part of Submittals, containers, or packaging to parties involved in the installation, including a copy to Engineer (and Resident Project Representative).
2. Maintain one complete set of instructions at the Site during installation and until completion.
3. Handle, install, connect, clean, condition, and adjust products in accordance with such instructions and in conformance with specified requirements. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Engineer for further instructions.

B. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of completion.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable

** END OF SECTION 01600 **

SECTION 01610
REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Description of applicable codes, ordinances, and regulations.

1.02 CODES AND ORDINANCES

A. Applicable Codes: Compliance with all laws, ordinances, and regulations of authorities having jurisdiction is an integral requirement of the Contract Documents, whether each code is mentioned or not in the Contract documents.

B. Compliance: Comply with all applicable codes, ordinances and regulations in effect at the time of bid opening, including but not necessarily limited to the following:
1. 2015 International Building Code with Local amendments.
2. 2014 National Electrical Code with Local amendments.
3. 2015 International Plumbing Code with Local amendments.
4. 2015 International Fire Code with Local amendments and supplemental rules and regulations.
5. National Fire Protection Association Standards.
6. Utility Company requirements.
7. State and Federal Safety and Health Laws.
8. National Electrical Safety Code (NESC).
9. Amendments to Codes.
10. Clean Water Act compliance for storm water and potable water discharges.
11. NSF International Standards 60 and 61.

C. Detailed Requirements: Be familiar with and verify detailed requirements of applicable codes to verify that items and their installation provided under Work of this Contract meet or exceed legal requirements.
1. Discrepancies: If discrepancies occur between the Contract Documents, local codes, local utility requirements, etc., most stringent requirements shall apply.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

*** END OF SECTION ***

SECTION 01612

SEISMIC DESIGN CRITERIA

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Seismic design criteria for the following:
   1. Anchorage of mechanical and electrical equipment.
   2. Seismic design and anchorage of tanks and vessels, unless indicated otherwise in tank and vessel specifications.
   3. Other structures or items as specified or indicated on the Drawings.

1.02 REFERENCES

A. International Building Code, 2015.

B. American Society of Civil Engineers Standard 7 - Minimum Design Loads for Buildings and Other Structures, to the extent referenced by the 2015 International Building Code

1.03 SYSTEM DESCRIPTION

A. Design requirements: Design in accordance with the requirements of the International Building Code:
   1. International Building Code Site Classification of "D" and Risk Category III shall be utilized for design, along with following:

Table 1 – 2015 International Building Code Seismic Design Criteria

Seismic Design Factors	**Value**
Site Class	D
Site Coefficient, F_a	1.6
Site Coefficient, F_v	2.4
Mapped Spectral Response Acceleration at 0.2-second Period, S_s	0.164 g
Mapped Spectral Response Acceleration at 1.0-second Period, S_1	0.055 g
Spectral Response Acceleration at 0.2-second Period Adjusted for Site Class. S_{MS}	0.262 g
Spectral Response Acceleration at 1.0-second Period Adjusted for Site Class. S_{M1}	0.132 g
Design Spectral Response Acceleration at 0.2-second Period, S_{DS}	0174 g
Design Spectral Response Acceleration at 1.0-second Period, S_{D1}	0.088 g

2. Seismic Importance factor For Anchorage of Mechanical and Electrical Equipment: 1.25.
3. Seismic Importance Factor for The Design of Tanks And The Anchorage Of Tanks: 1.25.
4. Do not use friction to resist sliding due to seismic forces.
5. Use anchor bolts, bolts, studs for anchors for resisting seismic forces. Anchor bolts used to resist seismic forces shall have a standard hex bolt head. Do not use anchor bolts fabricated from rod stock with an L or J shape:
   a. Do not use concrete anchors, flush shells, chemical anchors, powder actuated fasteners, or other types of anchors unless indicated on the Drawings or accepted by the ENGINEER.
   b. Seismic forces must be resisted by direct bearing on the fasteners used to resist seismic forces. Do not use connections which use friction to resist seismic forces.

1.04 SUBMITTALS

A. Shop Drawings and Calculations: Provide seismic calculations and required details with the applicable equipment shop drawing.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01631

SUBSTITUTIONS

PART 1 - GENERAL

1.1 Summary

A. This Section includes administrative and procedural requirements for handling requests for substitutions made after award of the Contract.

B. Related Work Specified Elsewhere:

1. Requirements for submitting Contractor's Construction Schedule and the Submittal Schedule: SECTIONS 01320 and 01330.

2. Requirements governing Contractor's selection of products: SECTION 01600.

1.2 Definitions

A. Definitions in this Article do not change or modify the meaning of other terms used in the Contract Documents.

B. Substitutions: Changes in products, Materials, Equipment, and methods of construction required by the Contract Documents proposed by the Contractor after award of the Contract are considered to be requests for substitutions. The following are not considered to be requests for substitutions:

1. Revisions to the Contract Documents requested by Owner or Engineer.

2. Specified options of products and construction methods included in the Contract Documents.

1.3 Submittals

A. Substitution Request Submittal: Engineer will consider written requests for substitution if received within 14 calendar days of Notice to Proceed. Requests received more than 14 calendar days after Notice to Proceed may be considered or rejected solely at the discretion of the Owner.

1. Submit 3 copies of each request for substitution for consideration. Submit requests in the form and according to procedures required for Change Order proposals. Requests for substitution shall not be submitted in the form of a Request for Information (RFI).

2. Identify the Equipment or Material, the fabrication, or installation method to be replaced in each request. Include related Specification Section/Article and Drawing numbers.

3. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:

    a. Statement indicating why specified product or method of construction cannot be provided.

    b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate the proposed substitution.

    c. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

    d. Product data, including drawings and descriptions of products and fabrication and installation procedures.

    e. Samples, where applicable or requested.

    f. Identification of available sales, maintenance, repair, and replacement services.

    g. A statement indicating the effect of the substitution on Contractor's construction progress schedule compared to the schedule without approval of the

substitution. Indicate the effect of the proposed substitution on the overall Contract Times. If specified product cannot be provided within the Contract Times, provide letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delay in delivery.

h. An itemized estimate of costs that will result directly or indirectly from approval of the substitution, including:

(1) A proposal of the net change, if any, in the Contract Price.

(2) Costs of redesign required by the proposed change.

(3) Costs of resulting claims as determined in coordination with other contractors having work on the Project affected by the substitution.

i. Statement indicating whether or not incorporation or use of the substitute is subject to payment of any license fee or royalty.

j. Contractor's certification that the proposed substitution conforms to requirements in the Contract Documents, will perform adequately the functions and achieve the results called for by the general design, is similar in substance to that specified, and is suitable for same use as that indicated and specified.

k. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.

4. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a request for substitution. Engineer will notify Contractor of acceptance or rejection of the substitution within 14 calendar days of receipt of the request, or one week of receipt of additional information or documentation, whichever is later. Acceptance, if granted, will be in the form of a Change Order.

PART 2 - PRODUCTS

2.1 Substitutions

A. Conditions: Engineer will receive and consider Contractor's request for

substitution when one or more of the following conditions are satisfied, as determined by Engineer. If the following conditions are not satisfied, Engineer will return the requests without action except to record noncompliance with these requirements.

1. Extensive revisions to the Contract Documents are not required.

2. Proposed substitution is in keeping with the general intent of the Contract Documents and will produce indicated results.

3. Substitution request is timely, fully documented, and properly submitted.

4. The specified product or method of construction cannot be provided within the Contract Times. Engineer will not consider the request if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.

5. The requested substitution offers Owner a substantial advantage, in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Engineer for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.

6. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.

7. The specified product or method of construction cannot be provided in a manner that is compatible with other materials and where Contractor certifies that the substitution will overcome the incompatibility.

8. The specified product or method of construction cannot be coordinated with other materials and where Contractor certifies that the proposed substitution can be coordinated.

9. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where Contractor certifies that the proposed substitution provides the required warranty.

B. Engineer’s review and acceptance of Submittals shall not relieve Contractor from responsibility for any variation from the requirements of

the Contract Documents. Engineer's acceptance of Submittals not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval of a substitution. Acceptance by Engineer shall not relieve Contractor from responsibility for errors or omissions in the Submittals.

PART 3 - EXECUTION - Not Applicable.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable.

** END OF SECTION 01631 **

SECTION 01650

DEMONSTRATION OF SYSTEMS / COMMISSIONING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Pre-operational, Startup, and Commissioning.

B. Related Sections include but are not necessarily limited to:
   1. Division 1 - General Requirements.

1.02 DEFINITIONS

A. Pre-operational Period: The period of time after the initial installation/construction.

B. Startup Period: A period of time (anticipated one week) immediately following the completion of the pre-operational period during which the CONTRACTOR initiates flow through the facility, starts up process equipment, calibrates and adjusts systems, completes OWNER training, and confirms the equipment is working as a system. During this period, the CONTRACTOR, manufacturer's agents, and OWNER's equipment pre-purchase suppliers verify installation requirements.

C. Commissioning Period: A specified consecutive period of time (up to four weeks) immediately following the completion of the startup period during which the ENGINEER operates the water treatment facility with support from the CONTRACTOR and OWNER.

D. Post Demonstration Period: The period of time after successful completion of the commissioning period but before final acceptance of Project during which the CONTRACTOR completes all punch list items and Project closeout procedures, and the OWNER has accepted ownership of the facility.

1.03 SUBMITTALS

A. General:
   1. Approved Operation and Maintenance manuals prior to start of startup.
   2. Written request for OWNER and ENGINEER to witness each system start-up. Request to be received by OWNER minimum two weeks before scheduled training of OWNER's personnel on that system.
   3. Equipment installation and start-up certifications.
   4. Letter verifying completion of all pre-operational testing and start-up activities including receipt of all specified items from manufacturers/suppliers as final item prior to initiation of commissioning.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 EXECUTION

A. General:
   1. Demonstration of systems and commissioning of the facilities constructed under this Contract shall be performed in three phases, as indicated in Article 1.02.

B. Pre-operational Period:
   1. CONTRACTOR requirements:
      a. Properly connect, align, calibrate, and adjust all system components. Check out procedures include but are not limited to:
         1) Ring out all power, control and monitoring circuits prior to connection.
         2) Voltage check of all circuits.
         3) Phase sequence check.
         4) Connecting piping system cleanliness check.
         5) Alignment check of all connected machinery.
         6) Pressure and vacuum testing of all closed systems.
         7) Check of lubrication.
         8) Calibration of all safety equipment.
         9) Manual rotation/movement of moving parts to assure freedom of movement.
         10) "Bump starting" of electrical motors to verify proper rotation.
         11) Check of valving orientation and position status for manual operating mode.
         12) Clean water testing of tankage for integrity.
         13) Verify proper instrumentation and control signal generation, transmission, reception and response.
         14) Check that all tagging/identification systems are in place.
         15) Achieve successful bateriological test for piping, equipment, and tanks.
      b. OWNER shall witness CONTRACTOR operation of each system prior to training to verify functional integrity.
      c. Provide all labor, supervision, utilities, equipment, vehicles, and required items necessary to perform work during this period.
      d. Provide certificate signed by equipment manufacturer's representative and CONTRACTOR that equipment was correctly installed and is ready for operation (as shown in Exhibit A-1650).

C. Startup Period:
   1. CONTRACTOR Requirements:
      a. Startup pumping equipment and support systems.
      b. Calibrate and adjust system.

c. Provide training of OWNER personnel on all equipment during the startup period:
    1) OWNER personnel training on individual systems will not be considered as meeting the Contract requirements unless:
        a) All pretraining deliverables are received and approved.
        b) During training, all system malfunctions are addressed.
        c) All provisions of field/classroom training specifications are met.
    2) Training not in compliance with the above will be performed again in its entirety by the manufacturer at no additional cost to OWNER.
    3) Training shall not be conducted until water is running through the wells and the treatment plant, and the equipment is operational.
d. Maintain the facilities.

*** END OF SECTION ***

SECTION 01780

CONTRACT CLOSEOUT

PART 1 - GENERAL

1.1 Summary

A. This Section includes administrative and procedural requirements for Contract closeout including, but not limited to, the following:

1. Inspection procedures.
2. Project record document submittal.
3. Instruction book and operating manual submittal.
4. Submittal of warranties.
5. Final cleaning.

B. Closeout requirements for specific construction activities are included in the appropriate Sections of the Specifications.

C. Related Work Specified Elsewhere

1. Prerequisites to Contract Completion and Final Acceptance: GENERAL CONDITIONS.
2. Submittals: SECTION 01330.

1.2 Contract Completion

A. Preliminary Procedures: Before requesting inspection for Notice of Completion, complete the following. List exceptions in the request.

1. In the Application for Payment that coincides with, or first follows, the date Final Acceptance is claimed, show 100% completion for the portion of the Work.
    a. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Price.
    b. If 100% completion cannot be shown, include a list of incomplete items, the value of incomplete Work, and reasons the Work is not complete.
2. Advise Owner of pending insurance changeover requirements.
3. Submit specific warranties, workmanship Bonds, maintenance agreements, final certifications, and similar documents.
4. Obtain and submit releases enabling Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Submit record drawings, instruction books and operating manuals, final project photographs, damage or settlement surveys, property surveys, and similar final record information.
6. Deliver tools, spare parts, extra stock, and similar items.
7. Make final changeover of permanent locks and transmit keys to Owner. Advise Owner's personnel of changeover in security provisions.

8. Complete start-up testing of systems and instruction of Owner's operation and maintenance personnel. Discontinue and remove temporary facilities from the Site, along with mockups, construction tools, and similar elements.
9. Submit consent of Certificate of Completion from Contractor.
10. Inspection Procedures: On receipt of a request for inspection, Engineer will either proceed with inspection or advise Contractor of unfilled requirements. Owner will prepare the Notice of Completion following inspection or advise Contractor of construction that must be completed or corrected before the notice will be issued. Engineer will repeat inspection when requested and assured by Contractor that the work is complete.
11. Results of the completed inspection will form the basis of requirements for Final Acceptance.

1.3 Final Acceptance

A. Preliminary Procedures: Before requesting final inspection for Notice of Completion of Final Acceptance and final payment, complete the following. List exceptions in the request.

1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include insurance certificates for products and completed operations where required.
2. Submit an updated final statement, accounting for final additional changes to the Contract Price.
3. Submit a certified copy of Engineer's final inspection list of items to be completed or corrected, endorsed and dated by Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance and shall be endorsed and dated by Engineer.
4. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of the Date of Contract Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
5. Submit consent of surety to final payment.
6. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
7. Submit a final liquidated damages settlement statement.
8. Reinspection Procedure: Engineer will re-inspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to Engineer. Upon completion of re-inspection, Owner will prepare a Notice of Completion of Final Acceptance. If the Work is incomplete, Engineer will advise Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for Final Acceptance.

9. If necessary, re-inspection will be repeated.

1.4 Record Document Submittals

A. General: Do not use record documents for construction purposes. Protect record documents from deterioration and loss in a secure, fire-resistant location. Provide access to record documents for Engineer's reference during normal working hours.

B. Record Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation. This will require an “as constructed” elevation of the manhole top and invert elevations of all pipes entering and leaving the manhole.

1. Record information concurrently with construction progress.
2. Mark record sets with red erasable pencil. Use other colors to distinguish between variations in separate categories of the Work. Mark each document "PROJECT RECORD" in neat, large, printed letters.
3. Mark new information that is important to Owner but was not shown on Contract Drawings or Shop Drawings.
4. Note related Change Order numbers where applicable.
5. Organize record drawing sheets into manageable sets. Bind sets with durable-paper cover sheets; print suitable titles, dates, and other identification on the cover of each set.
6. Upon completion of the Work, submit record drawings to Engineer for Owner's records.
7. Include the following:
    a. Depths of various elements of foundation in relation to finish first floor datum. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
    b. Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of construction.
    c. Where Submittals are used for mark-up, record a cross-reference at corresponding location on Drawings.
    d. Field changes of dimension and detail.
    e. Changes made by Change Order or other Modifications.
    f. Details not on original Contract Drawings.
    g. As constructed information shall include a GPS coordinate of the sanitary manhole including the invert elevation of the pipes entering and leaving the manhole. The GPS level of accuracy shall be to centimeters. A registered land surveyor of the state of Arizona shall conduct the survey. This information shall be recorded on the record information set submitted to the Engineer. The information shall also be provided in an electronic format compatible with AUTOCAD release 2004.

h. Provide a record location of all service laterals where they connect to the main sewer. The separation distance between the service lateral at the crossing of a water line shall be recorded by the Contractor on his record documents.

C. Record Specifications: Maintain one complete copy of the Project Manual including Addenda. Include with the Project Manual one copy of other written construction documents, such as Change Orders and Modifications issued in printed form during construction.

1. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications.
2. Give particular attention to substitutions and selection of options and information on concealed construction that cannot otherwise be readily discerned later by direct observation.
3. Note related record drawing information and product data.
4. Upon completion of the Work, submit record Specifications to Engineer for Owner's records.
5. Include the following:
   a. Manufacturer, trade name, catalog number, and Supplier of each product and item of Equipment actually installed, particularly optional and substitute items.
   b. Changes made by Addendum, Change Order, or other Modifications.
   c. Related Submittals.

D. Record Product Data: Maintain one copy of each product data Submittal. Note related Change Orders and markup of record drawings and specifications.

1. Mark these documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the Site and from the manufacturer's installation instructions and recommendations.
2. Give particular attention to concealed products and portions of the Work that cannot otherwise be readily discerned later by direct observation.

E. Upon completion of markup, submit complete set of record product data to Engineer for Owner's records. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record keeping and Submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order. Identify miscellaneous records properly and bind or file, ready for continued use and reference. Submit to Engineer for Owner's records.

F. Warranties and Bonds: Specified in GENERAL CONDITIONS, Section 01330.

PART 2 - PRODUCTS - Not Applicable.

PART 3 - EXECUTION

3.1 Closeout Procedures

A. Operation and Maintenance Instructions: Arrange for each installer of Equipment that requires regular maintenance to meet with Owner's personnel at Project Site to provide instruction in proper operation and maintenance. Provide instruction by manufacturer's representatives if installers are not experienced in operation and maintenance procedures. Include a detailed review of the following items:

1. Instruction books and operating manuals.
2. Record documents.
3. Tools.
4. Lubricants.
5. Fuels.
6. Identification systems.
7. Control sequences.
8. Hazards, hazardous chemicals data sheets.
9. Cleaning.
10. Warranties and bonds.
11. Maintenance agreements and similar continuing commitments.

B. As part of instruction for operating Equipment, demonstrate the following procedures:

1. Start-up.
2. Shutdown.
3. Emergency operations.
4. Noise and vibration adjustments.
5. Safety procedures.
6. Economy and efficiency adjustments.
7. Effective energy utilization.

3.2 Final Restoration

A. General: The GENERAL CONDITIONS requires general cleaning during construction.

1. Remove temporary structures, tools, equipment, supplies, and
2. Remove temporary protection devices and facilities, which were installed, to protect previously completed Work.
3. Restore the entire construction area to pre-construction condition.

B. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.

C. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the Site and dispose of lawfully.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable.

** END OF SECTION 01780 **

DIVISION 2

SITEWORK

SECTION 02100

CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 Description

A. Description of Work

The work to be performed in accordance with this section includes clearing, grubbing, and disposal of materials, for all ground surfaces within the limits designated on the plans. The work shall include the furnishing of all labor, tools, equipment, materials and the performing of all operations required to provide a complete item in accordance with the project plans and these specifications.

Clearing and grubbing includes the removal of all brush, undergrowth, heavy growth of grass or weeds, debris, rubbish of any nature, obstructions or material which is unsuitable for the foundation of fills, pavements, or other required structures and the disposal of all spoil materials resulting from clearing and grubbing in an approved landfill.

B. Related Work Specified Elsewhere

Removal of Existing Improvements .....Section 02110
Earthwork .....Section 02200

1.2 Protection of Property

Protect existing improvements, adjacent property, utilities, trees, plants, or any other existing items which are not specifically intended to be removed.

1.3 Submittals

A. Disposal Area

Describe the location of the disposal area and provide written approval for the use of the area for disposing of waste from the operation. Work performed at the disposal area shall meet all local codes and ordinances.

PART 2 - MATERIALS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 Limits of Work

Clearing and grubbing operations are to remain within the limits of construction and/or the right-of-way as shown on the plans. Clear and grub only in areas that are affected by excavation or other earthwork operations.

3.2 Construction Methods

Remove all stumps, roots, buried logs, brush, grass, and other unsuitable materials. Grub roots and other projections over 1-1/2 inches in diameter to a depth of at least 18 inches below the finished subgrade or slope elevation.

Backfill all holes remaining after the grubbing operation in accordance with Section 2200, Earthwork.

3.3 Disposal

Dispose of all debris at an approved landfill.

3.4 Burning

No burning shall be permitted.

3.5 Existing Vegetation to Remain

Save all trees and shrubs which will not interfere with excavation or embankment or cause disintegration of the improvements. Coordinate removal of vegetation with the OWNER. Protect trees, shrubbery, vines, plants, grasses and other vegetation growing outside of the limits of construction.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

No measurement will be made for this item.

4.2 Payment

No payment will be made for Clearing and Grubbing. Clearing and grubbing shall be considered incidental to other items.

END OF SECTION

SECTION 02110

REMOVAL OF EXISTING IMPROVEMENTS

PART 1 - GENERAL

1.1 Summary

A. Description of Work

The work to be performed in accordance with this section includes the removal and disposal of various existing improvements, such as pavements, structures, pipes, curbs and gutters, and other items necessary for the accomplishment of the improvement. The work shall include the furnishing of all labor, tools, equipment, materials and the performing of all operations required to provide a complete item in accordance with the project plans and these specifications.

B. Related Work Specified Elsewhere

Clearing and Grubbing ..... Section 02100

1.2 Protection of Property

Protect existing improvements, adjacent property, utilities, trees, plants, or any other existing items which are not specifically intended to be removed.

1.3 Disposal

All materials shall be disposed of at an approved landfill, unless otherwise approved by the Owner.

1.4 Submittals

A. Landfill

Provide a copy of the permit to use the landfill.

B. Disposal Area

For sites other than the landfill, describe the location of the disposal area and provide written approval for the use of the area for disposing of waste from the operation. Work performed at the disposal area shall meet all local codes and ordinances.

PART 2 -MATERIALS

2.1 General

Materials required for relocation work shall be as specified herein or as otherwise indicated.

PART 3 - EXECUTION

3.1 Limits of the Work

Confine removal of existing improvements to within the area of construction. Pavement removal shall be limited to an area that is no more than the one week ahead of the projected work. At no time shall the Contractor have asphalt removed from any street longer than 60 days.

3.2 Construction Methods

A. Removal of Existing Portland Cement Concrete Sidewalks, Curb and Gutter and Pavements.

1. Saw cut concrete to neat, vertical, true lines in such a manner that the adjoining surface will not be damaged. The full depth of the existing concrete shall be saw cut.

B. Removal of Existing Asphalt Concrete Pavement

1. Saw cut asphalt concrete to neat, vertical, true lines in such a manner that the adjoining surface will not be damaged. The full depth of the existing asphalt shall be saw cut.
2. Existing asphalt concrete not used in fill areas shall be removed from the site and disposed in an approved landfill or used in a recycling operation.

3.3 Miscellaneous Removals

Perform all miscellaneous removals as required by the Owner or where indicated on the plans. The miscellaneous removals shall include but not be limited to the following tasks:

A. Relocate existing fences and gates.

B. Remove planter boxes, block walls, concrete walls and footings.

C. Remove existing irrigation systems and replace or plug.

D. Removal and relocation of signs and mailboxes. All City owned signs shall be removed from the areas of construction and delivered to the City as directed. All privately owned signs located within the areas of construction shall be removed and delivered to the property Owner or placed on the adjacent property as directed.

All mailboxes located within the areas of construction shall be removed and temporarily reset on the adjacent property for use. When grading and construction is adequately completed, the mailboxes shall be permanently reset at the back of the curb and restored to a better than or equal condition than existing.

3.4 Backfill and Densification

Backfill all holes remaining after removal of existing improvements.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

No Measurement shall be made for this item.

4.2 Payment

A. Removal of Existing Improvements

If no item is listed in the bid tab or the measurement and payment section, this item is to be considered incidental.

B. Removal of Existing Improvements

Payment will be made at the contract lump sum price. This price shall be full compensation for furnishing all materials, labor, equipment, tools and appurtenances necessary to complete the work.

C. Miscellaneous Removals

All other removals shall be considered incidental to other items. No payment will be made for miscellaneous removals.

See Section 00310 Bid Schedule for Bid Items.

** END OF SECTION 02110 **

SECTION 22000
EARTHWORK

PART 1 - GENERAL

1.1 Description

A. Description of Work

The work to be performed in accordance with this section includes excavation, fill, borrow, spoil and compaction for roadways, structures, channels and embankments. The work shall include the furnishing of all labor, tools, equipment, materials and the performing of all operations required to provide a complete item in accordance with the project plans and these specifications.

B. Related Work Specified Elsewhere

Clearing and Grubbing ..... Section 2100
Removal of Existing Improvements ..... Section 2110
Trench Excavation and Backfill ..... Section 2300
Subgrade Preparation..... Section 2600

1.2 Quality Assurance

A. Reference Test Standards and Specifications

ASTM D698, Test Methods for Moisture Density of Soils and Soil-Aggregate Mixtures Using 5.5 lb. Rammer and 12-inch Drop.
ASTM D1556, Density of Soil in Place by the Sand-Cone Method.
ASTM D6938-08a, Density of Soil and Soil-Aggregate in Place by Nuclear Methods.
ASTM D6938-08a, Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods.
Rock Correction Procedure for Maximum Density Determination, ARIZ 227.

B. Frequency of Testing

1. Maximum Dry Density and Optimum Moisture Content, ASTM D698.
   a. One test for each different class or type of material shall be provided by the CONTRACTOR prior to any earthwork operations.
   b. CONTRACTOR shall provide additional test when previous test is suspect, due to subtle changes in the material, as determined by the OWNER.

2. Density of Soil In-Place by the Sand Cone or by Nuclear Methods, ASTM D1556 or D6938-08a.
   a. OWNER will perform a minimum of one test per lift per 5,000 square yards per each type of material.
   b. OWNER will perform additional tests as required to ensure proper compaction.

C. Testing Tolerances
   1. Relative Percent Compaction
      Not less than as specified on plans or in these specifications.
   2. In-Place Moisture Content
      As required to achieve minimum relative compaction.
   3. Soft or Yielding Surfaces
      Regardless of the percent compaction obtained by test, areas which are soft and yield under the load of construction equipment are to be removed and replaced at no additional cost.

1.3 Submittals

A. Materials Test Reports
   Report on maximum dry density and optimum moisture content of soils proposed for use in the work prior to beginning of construction.

B. Disposal Area
   Provide the location of the disposal area(s) and provide written approval for the use of the area(s) for disposing of excess soils from the operation. Work performed at the disposal areas shall meet all local codes and ordinances.

PART 2 - MATERIALS

2.1 Soil and Soil Aggregate Materials

A. Unsuitable materials not to be incorporated in the work.
   1. Organic matter such as peat, mulch, organic silt or sod.
   2. Soils containing expansive clays.
   3. Material containing excessive moisture.
   4. Poorly graded coarse material.
   5. Material with particle sizes in excess of 12 inches.
   6. Material which will not achieve density and/or bearing requirements.
   7. Asphalt concrete or Portland cement concrete that does not conform to 3.5 Engineered Fill under Section 2200, Earthwork.

PART 2 – MATERIALS (cont'd)

2.2 Earthwork Balance

No attempt has been made to estimate cut and fill earthwork quantities. The CONTRACTOR is solely responsible for the estimation of the earthwork quantities required to construct the project as indicated on the plans and described herein.

PART 3 - EXECUTION

3.1 Preliminary Investigation of the Work

Verify that all preliminary work including clearing, grubbing and staking has been performed in accordance with these specifications prior to earthwork operations.

3.2 Blasting

No blasting will be permitted unless approved by the OWNER. All permits shall be obtained by the CONTRACTOR at his own expense.

3.3 Spoil Disposal Area

Disposal of surplus excavated material shall be in an approved spoil area, outside of the project right-of-way. Make all arrangements necessary for disposal of material at an off-site location. The disposal of surplus materials in the designated area shall meet all local codes and ordinances.

3.4 Excavation

A. Unsuitable Material

Overexcavate existing unsuitable material below the lower limit of excavation to a depth that will provide adequate bearing, as determined by the OWNER. Remove unsuitable material from the site and dispose of the material at approved spoil area. Replace the overexcavated material with suitable material in accordance with Subsection 3.5 Engineered Fill.

B. Slides and Slipouts

Excavate and grade material outside the finished work which is unstable, or which has slipped out, to the slope and elevation determined by the OWNER. Dispose of excess material at approved spoil disposal area.

C. Slopes

Finish excavation slopes to the lines and grades shown on the plans. Remove all debris and loose materials. Round all grade breaks and slope transitions. Finish elevations on slopes shall not deviate from the plan elevation by more than ".25 feet. Variations from the plan grade and cross section shall be compensating so that the averagegrade and cross section are obtained.

D. Foundation Excavation

1. Cast in Place Concrete on Rock

Remove sufficient depth of rock surface to expose sound rock. Cut rock to approximate horizontal and vertical steps to provide minimum dimensions. Grout seams and faults in rock surfaces as directed by the OWNER.

2. Cast in Place Concrete on In-Situ Soil

Excavate to the lines shown such that the surface on which the concrete is to rest is undisturbed native material with no loose materials or debris. Replace overexcavation with concrete as specified for the structure.

E. Roadway Excavation

Remove the existing pavement and excavate the existing base course and subgrade materials to the new subgrade elevation. Excavate to the cross section as shown on the plan. Prepare the existing soil at the new subgrade elevation in accordance with Section 2600, Subgrade Preparation.

F. Shoring and Sheeting

Provide such bracing, sheeting or shoring necessary to perform and protect the excavation as required for safety. Shore, sheet and brace excavations as set forth in the rules, orders and regulations of the United States Department of Labor Occupational Health and Safety Administration (OSHA). Provide detailed plan and calculations as prepared by a registered professional engineer for excavations 20 feet in depth or greater or when shoring, sheeting or bracing deviates from OSHA standards. Place and remove shoring, sheeting and bracing so as not to damage adjacent improvements, utilities or utility being placed. Costs for shoring, sheeting and bracing to be incidental to the other items.

3.5 Engineered Fill

A. Subgrade Preparation

Prior to fill placement, plow or scarify the surface to a minimum depth of 6 inches. Moisture condition and compact surface to 95 percent of the maximum density in accordance with Section 2600, Subgrade Preparation.

B. Moisture Conditioning

Condition the soil by aerating or wetting to obtain the moisture content required to achieve the relative percent compaction. Mix the soil such that the moisture content is uniform throughout the lift.

C. Fill Placement

1. Lift Thickness

The uncompacted lift thickness shall not exceed eight (8) inches. When material contains more than 25 percent of rock larger than six (6) inches, the uncompacted lift thickness shall not exceed the maximum particle size dimension.

2. Rock Fill

Rock, broken Portland cement concrete and crushed asphalt concrete is permitted in fill areas when conforming to the following:

a. Place earth or other fine material around the interstices of the pieces to form a dense fill layer. Nesting is not permitted.

b. Do not place pieces larger than 4 inches closer than 12 inches from any structure.

c. Do not place pieces larger than 2-1/2 inches closer than 12 inches from the finish subgrade.

d. Existing asphalt concrete conforming to these requirements for rock fill may be used as fill material only in areas to receive pavement.

3. Benching

When fill is to be placed and compacted on slopes steeper than 5:1 or where new fill is to be compacted against existing fill or where embankment is

built 1/2 width at a time, the slopes of original and old or new fills shall be benched as the fill is placed. A new bench shall be started wherever the vertical cut of the next lower bench intersects the existing ground. Material thus cut out shall be recompacted along with the new embankment material by the CONTRACTOR at no additional cost. The vertical bench cut shall not exceed three (3) feet.

D. Compaction

1. Compaction Methods

Water consolidation will not be permitted.

2. Percent Relative Compaction

Compact fill and backfill as indicated on the plan. When not indicated on the plan, compact as specified herein.

a. 95% of maximum dry density

1. Areas to receive fill
2. Areas to receive structures, including pavement, upper two feet of fill
3. Structural backfill

b. 90% of maximum dry density

1. All other areas

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for the item, Earthwork.

B. Over excavation

Over excavation shall be measured by the cubic yard. The quantity will be computed by the average end area method. The end area is that bound by the original ground line established by field cross sections and the final theoretical pay line established by cross sections shown on the plans subject to verification by the OWNER. After completion of all operations and prior to the placing of base or subbase material, the final embankment shall be verified by the OWNER by means of field cross sections taken randomly at intervals not exceeding 500 linear feet.

Final field cross sections shall be employed if the following changes have been made:

1. Plan width of embankments or excavations are changed by more than plus or minus 1.0 foot; or
2. Plan elevations of embankments or excavations are changed by more than plus or minus 0.5 foot.

4.2 Payment

A. Earthwork

Payment for earthwork will be made at the contract lump sum price. The lump sum payment shall be full compensation for excavation of existing materials to the new subgrade elevation, subgrade preparation, fill placement, waste, borrow, hauling, and testing required to complete the item. The item shall be full

compensation for all materials; for all preparation, hauling, and placing of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

B. Over excavation

Payment for over excavation will be made at the contract cubic yard price. The payment shall be full compensation for excavating the existing material to the depth and section required, hauling and wasting the over excavated material and backfilling with suitable material. This item shall be full compensation for all work including furnishing all materials; for all preparation, hauling, and placing of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

The quantity of this item listed in the bid schedule represents no actual estimate, is nominal only, and may be greatly increased or decreased or reduced to zero. The increase or reduction of this quantity as compared with that set forth in the bid schedule shall not constitute a basis for claim by the CONTRACTOR for extra payment or damages.

See Section 00310 Bid Schedule for Bid Items.

SECTION 02300
TRENCH EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 Description

A. Description of Work

The work to be performed in accordance with this section includes the excavation, trenching, backfilling, and surface repair for all pipelines, pipe culverts, box culverts, accessories and lines connected thereto, complete including sheeting and shoring, dewatering, grading and cleanup.

Excavation for appurtenant structures such as manholes, inlets, transition structures, junction structures, vaults, valve boxes, catch basins, etc. shall be included in this section.

The work shall include the furnishing of all labor, tools, equipment, materials and performing all operations to provide a complete item in accordance with the project plans and these specifications.

B. Related Work Specified Elsewhere

Earthwork ..... Section 02200
Ductile Iron Pipe ..... Section 02648
Cement-Mortar Lined and Coated Steel Pipe and Fittings ..... Section 02651
General Piping Systems and Appurtenances ..... Section 15000
Valves and Appurtenances ..... Section 15020

C. Definitions

1. Trench
   An excavation in which the depth is greater than the width of the bottom of the excavation.
2. Foundation
   Material on which bedding is to be directly placed.
3. Bedding
   Granular material on which pipe or structure is to be directly placed. The bedding extends from 6 inches below the pipe to 12 inches above the top of the pipe.
4. Select Backfill
   Material placed from top of the bedding to finished subgrade.

1.2 Quality Assurance

A. Reference Test Standards and Specifications

ASTM C94, Standard Specification for Ready Mix Concrete.
ASTM C117, Standard Test Method for Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing.

ASTM C131, Standard Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

ASTM C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregate.

ASTM D1556, Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.

ASTM D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).

ASTM D6938, Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

ASTM D4215, Standard Specification for Cold Mixed, Cold Laid Bituminous Paving Mixture.

ASTM D4318, Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

Rock Correction Procedure for Maximum Density Determination, ARIZ 227.

Moisture – Density Relationship Using Typical Moisture – Density Curves (One Point Proctor) Method A, ARIZ 232

B. Frequency of Testing

1. Maximum Dry Density and Optimum Moisture Content, ASTM D698.
   a. One test for each different class or type of material shall be provided by the CONTRACTOR.
   b. CONTRACTOR shall provide additional test when previous test is suspect, as determined by the ENGINEER.
   c. The ENGINEER at the discretion of the OWNER may perform quality assurance testing for compaction, gradation and plasticity index of bedding sand and select backfill. If any test results show non-compliance with the project specifications, the non-complying materials shall be removed and replaced or reworked by the CONTRACTOR. The CONTRACTOR shall perform additional tests at his cost to verify an acceptable condition prior to acceptance by the ENGINEER.
2. Density of Soil In-Place by Sand Cone or by Nuclear Methods
   a. CONTRACTOR shall perform a minimum of one test per lift per 500 linear feet of trench for each type of material.
   b. CONTRACTOR shall perform additional tests as required to ensure proper compaction.

3. Sieve Analysis of Aggregate, ASTM C136
   a. CONTRACTOR shall perform one test per 1,000 cy per material type of Bedding Sand Material incorporated into the WORK.
   b. CONTRACTOR shall perform one test per 1,000 cy per material type of Select Backfill Material incorporated into the WORK.
4. Plasticity Index of Soils, ASTM D4318
   a. CONTRACTOR shall perform one test per 1,000 cy per material type of Bedding Sand material incorporated into the WORK.
   b. CONTRACTOR shall perform one test per 1,000 cy per material type of Select Backfill material incorporated into the WORK.
5. Moisture – Density Relationship Using Typical Moisture – Density Curves (One Point Proctor) Method A, ARIZ 232
   a. CONTRACTOR shall perform this test any time the fill material appears to have changed or as directed by the ENGINEER or DESIGNEE to verify the appropriate proctor is being utilized.

C. Testing Tolerances
1. Percent Relative Compaction
   Not less than as specified on plans or in these specifications.
2. In-Place Moisture Content
   As required to achieve specified percent relative compaction.
3. Soft or Yielding Surfaces
   Regardless of percent relative compaction obtained by test, areas which are soft and yield under the load of construction equipment are to be removed and replaced at no additional cost.

1.3 Submittals

A. Materials Test Reports
1. Report on maximum dry density and optimum moisture content prior to beginning of construction.
2. Report on bedding and backfill materials compliance tests as required. Compaction test reports shall be submitted to the ENGINEER within two (2) business days of completion of each test.

B. Spoil Disposal Area
Provide location and written approval for area to dispose of spoil from operation, as approved by ENGINEER.

C. Shoring Plan
Provide plans, details, and calculations by a professional ENGINEER registered in the State of Arizona if shoring or sheeting is required. See Section 02254

D. Dewatering Plan
Provide plans, details and calculations by a professional Engineer registered in the State of Arizona if dewatering is required.

1.4 **Job Conditions**

E. Dewatering

It is the CONTRACTOR'S responsibility to dewater if groundwater is encountered.

F. Protection of Existing Utilities

Maintain all utilities both underground and overhead in continuous service throughout the contract period. Liability for damages to, or interruption of services caused by the construction shall be borne by the CONTRACTOR.

PART 2 - MATERIALS

2.1 Soil and Soil Aggregate Materials

A. Unsuitable materials not to be incorporated in the work include:

1. Organic matter such as peat, mulch, organic silt or sod.
2. Soils containing expansive clays.
3. Material containing excessive moisture.
4. Poorly graded coarse material.
5. Particle size in excess of 6-inches.
6. Material which will not achieve density and/or bearing requirements.
7. Material containing asphalt concrete or Portland cement concrete.

B. Bedding

Bedding for all water, sewer, storm drain lines, and manholes specified in Sections 2500, 2551, 2550, 2560, and 2570 shall be bedded in bedding sand. Culverts, specified in Section 2520, shall be bedded on aggregate base course per subsection 2.1.E unless otherwise specified.

1. Bedding Sand

Bedding sand shall consist of non-plastic sandy material conforming to the following requirements:

Sand Equivalent (SE), 30 Minimum PH 6.5 – 8.5
Resistivity 2,000 – 50,000 ohm-cm Sulfate
(optional) 1500 PPM or less

SIEVE SIZES	PERCENTAGE BY WEIGHT
3/8"	100
No. 4	90-100
No. 50	10-40
No. 100	3-20
No. 200	0-15

C. Granular Backfill

Native excavated or approved import granular material, free draining and free of unsuitable materials defined herein. Granular backfill shall be non-plastic, well graded and meet the following requirements:

Sieve Size	Percent by Weight Passing
4 inches	100
No. 4	30-75
No. 8	20-60
No. 30	10-40
No. 200	0-12

D. Aggregate Base Course

Crushed aggregate or processed natural material, clean, hard, sound, and free of any detrimental quantity of soft, friable, elongated, or laminated pieces, organic matter or other deleterious substances. Properties of which shall meet the following requirement:

a. Grading, ASTM C136 and ASTM C117.

Sieve Size	Percent by Weight
1 1/2"	100
No. 4	30-70
No. 8	20-60
No. 30	10-40
No. 200	0-12

b. Percentage of Wear, ASTM C131, maximum percentage of wear of 40 after 500 revolutions.

c. Plasticity Index and Liquid Limit, ASTM D4318, maximum plasticity index of 5, maximum liquid limit of 25 percent.

2.2 Portland Cement Concrete

ASTM C94 and Specification Section 3300.

2.3 Asphalt Cement Concrete

As required in Specification Section 2630.

2.4 Cold Mix, Cold Laid Bituminous Paving Mixture

ASTM D4215

2.5 Buried Warning and Identification Tape

Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for locating, warning, and identification of buried utility lines. Provide tape on rolls, 3-inch minimum width, color coded as stated below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing is to be permanent, unaffected by moisture or soil.

WARNING TAPE COLOR CODES	
RED	ELECTRIC
YELLOW	GAS, OIL, DANGEROUS MATERIALS
ORANGE	TELEPHONE AND OTHER COMMUNICATIONS
BLUE	WATER
GREEN	SEWER
WHITE	STEAM, AIR
PURPLE	REUSE

A. Warning Tape for Metallic Piping
Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements indicated above. Minimum thickness of the tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise with a maximum 350 percent elongation.

B. Detectable Warning Tape for Non-Metallic Piping
Polyethylene plastic tape to the width, color, and printing requirements indicated above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise.

PART 3 - EXECUTION

3.1 Preliminary Investigation of the Work
Verify that all of the preliminary work including construction staking has been performed in accordance with the plans and specifications prior to trenching and backfill operations.

3.2 Trenching in Fill Areas
Grade fill areas to within 1 foot of the finish grade prior to trenching and placement of the pipeline.

3.3 Excavation

A. General
Perform all excavations of every description and of whatever substances encountered to the depths indicated on the plans and including excavation ordered by the ENGINEER of compacted fill for the purpose of performing tests. Use open cut excavation methods unless otherwise indicated on the plans or approved by the ENGINEER.

B. Trench Widths
Trenches shall be excavated per LHC Standard Detail 200A

Maintain trench walls as vertical as possible except as required by safety standards and as required for sheeting and shoring.

If the maximum trench width is exceeded at the top of the pipe, the CONTRACTOR shall provide necessary additional load bearing capacity by means approved by the ENGINEER at no additional cost to the OWNER.

C. Over excavation

1. Unauthorized

   Fill and compact unauthorized excavation beyond the specified grade line, at the CONTRACTOR'S expense, with bedding material, compact to 95 percent of the maximum density. No payment will be made for unauthorized over excavation.

2. Rock

   Over excavate rock encountered in the trench to provide a minimum of six inches of bedding below the pipe and the minimum width at the springline.

3. Unsuitable Material

   Over excavate unsuitable material to the depth necessary to provide the required support as determined by the ENGINEER. Backfill the over excavation with bedding material and compact to at least 95 percent of the maximum density.

D. Excavation for Manholes, Valves, Inlets, Catch Basins and Other Accessories

Provided the excavated surfaces are firm and unyielding, the CONTRACTOR may elect to cast concrete for the structure directly against excavated surfaces. Over excavate to provide bedding where shown on the plans.

E. Pavement and Concrete Cutting and Removal

Sawcut, remove and dispose of existing pavements and concrete per Specification Section 2110.

F. Grading and Stockpiling

1. Grading

   Grade in the vicinity of the trench to prevent surface water from flowing into the trench. Remove any water accumulated in the trench by pumping or by other approved methods. Stockpile excavated material in an orderly manner a sufficient distance back from the edges of the trench to avoid overloading and to prevent slides or cave-ins.

2. Topsoil

   Excavate topsoil and stockpile separately. Replace topsoil upon completion of backfill and grade to the elevations indicated on the plans.

3. Shoring and Sheeting

   Shore, sheet and brace excavations as set forth in the rules, orders and regulations of the United States Department of Labor Occupational Health and Safety Administration (OSHA), and as specified in section 02254 of these specifications. Provide detailed plan and calculations as prepared by a registered professional ENGINEER for excavations 20 feet in depth or greater or when shoring, sheeting or bracing deviates from OSHA standards. Place and remove shoring, sheeting and bracing so as not to damage adjacent improvements, utilities or utility being placed. Costs for shoring, sheeting, and bracing is considered incidental.

3.4 **Open Trench**

4. Maximum Length
   The maximum length of open trench within developed, dedicated right of way is not to exceed 500 feet per trench and pipeline crew, provided that all proper barricades and safety procedures have been addressed. The trench is considered to be open until backfill is completed to adjacent finish grade elevation.
5. Street Crossing
   Complete backfill of trench across streets at the end of each work day. Use temporary patch material (cold mix asphalt concrete) or steel plates as required.
6. Temporary Provisions

   Furnish and install trench bracing and steel plating required to provide safe and convenient vehicular and pedestrian passage across trenches where required. Maintain access to and from emergency facilities at all times.

3.4 Foundation, Bedding, Backfilling and Compaction

A. Foundation
   Excavate trench bottom to the depth and width as shown. Remove all loose, disturbed material from the bottom of the trench such that the bedding shall rest on firm, undisturbed soil.
B. Bedding
   Moisture condition and place bedding material to required thickness. Compact bedding material to the specified density.
C. Fine Grading
   Accurately grade the bottom of the trench to provide uniform bearing and support for each section of pipe at every point along its entire length, except where it is necessary to excavate for joints.
D. oisture Conditioning

   Moisture condition all bedding and backfill materials by aerating or wetting to obtain the moisture content required to achieve specified percent relative compaction. Completely mix the material until the moisture content is uniform throughout the lift.

E. **Lift Thickness**

1. The following table applies when using mechanical compaction:

LIFT DESCRIPTION	MAXIMUM LOOSE LIFT THICKNESS, INCHES
Bedding	8-Inches in all cases
Backfill	
Aggregate Base Course	

Lift thickness may be increased if CONTRACTOR can prove, through a series of density tests, to be approved by the Engineer, that minimum density is achieved throughout the lift thickness.

F. Compaction

1. Compaction Methods
Construction shall be accomplished by mechanical methods. Rubber tire wheel rolling will not be allowed.

2. Pipe Haunch
When using mechanical methods, hand compact initial backfill in pipe haunch with a pipe haunch compactor (J-bar) or mechanical vibrator sized to fit the narrow width between the pipe and the trench. Give special attention to provide proper compactive effort in the pipe haunch zone.

3. Compaction Densities
Thoroughly compact trench bedding and backfill to not less than the percent relative compaction as presented in the following table, unless more stringent requirements are called for on the plans.

PERCENT RELATIVE COMPACTION MINIMUM DENSITY REQUIRED				
Backfill Type	Location	From Subgrade Surface To 2' Below Surface	From 2' Below Surface To 1' Above Top of Pipe	From 1' Above Top of Pipe To Bottom of Trench
I	Under any existing or proposed pavement, curb, gutter, sidewalk, or such construction included in the contract or when any part of the trench excavation is within 2' of the above.	95%	95%	95%
II	On any utility easement, street, road or alley right-of-way out- side of (I).	95%	95%	95%
III	Around any structures or exposed utilities.	95% in all cases		
IV	Outside of right-of-way and not below any curb, gutter sidewalk or other structures.	90% in all cases		

3.5 Buried Warning and Identification Tape

Place warning and identification tape to the depth indicated on the plan. Center tape over pipeline.

3.6 Backfill for Manholes, Valves, Inlets, Catch Basins and Other Accessories

Backfill appurtenances and structures including bedding, backfill, lift thicknesses and compaction as indicated.

3.7 Pavement Replacement and Surface Restoration

A. Grading

Perform all grading adjacent to backfilled trenches and structures necessary to leave the area in a neat and satisfactory condition as approved by the Engineer.

B. Surface Restoration

Restore all streets, alleys, driveways, sidewalks, curbs or other surfaces which were broken or damaged by the installation of the new work, to a condition as good as or better than originally encountered in accordance with these specifications, accepted standards and as acceptable to the ENGINEER.

1. Landscape

   Replace landscape rock, sod, shrubs, trees, grass, sprinkler systems as required to a condition as good as or better than originally encountered in accordance with these specifications, accepted standards and as acceptable to the Engineer.

2. Temporary Pavement

   Place cold mix, cold laid bituminous paving mixture in accordance with ASTM D4215 immediately following backfilling and compaction of trenches through existing pavement. Maintain pavement in safe and smooth condition until final pavement can be placed.

3. Pavement Replacement

   Replace permanent asphalt cement, concrete pavement per the requirements of Specification Section 2630, Asphalt Concrete Pavement.

4. Clean Up

   Remove all excess soil, concrete, etc. from the premises. Leave job site in a neat and clean condition.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

A. Trench Excavation and Backfill

No measurement will be made for trench excavation and backfill.

B. Over excavation

Over excavation of unsuitable material will be measured by the average end area method per Section 2200, Earthwork.

C. Surface Repair

Measure surface repair along the centerline of utility over which it occurs from junction center to center.

4.2 Payment

A. Trench Excavation and Backfill

No payment will be made for trench excavation and backfill. All trench excavation and backfill work including but not limited to excavation, material testing, disposal, backfill grading is incidental to the pipelines and appurtenant bid items.

B. Over excavation

Payment for over excavation will be made per Specification Section 2200, Earthwork.

END OF SECTION 02300

SECTION 02321

EXCAVATION, FILLING, AND BACKFILLING FOR STRUCTURES

PART 1 - GENERAL

1.1 Summary

A. This Section includes all necessary excavation, filling, and backfilling for structures and all related Work, including duct banks and manholes.

B. Related Work Specified Elsewhere

Trench Excavation and Backfill… .....Section 02300
Concrete… .....DIVISION 3

1.2 Quality Assurance

A. Reference Standards and Specifications

1. American Society for Testing and Materials (ASTM)

ASTM D1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

ASTM D4253 - Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

ASTM D4254 - Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

2. Occupational Safety and Health Administration (OSHA)

Part 1926 - Safety and Health Regulations for Construction.

1.3 Submittals

A. Submit as specified in Section 01330.

B. Where selecting an option for excavation, trenching, and shoring in compliance with local, state, or federal safety regulations such as "OSHA Part 1926" or successor regulations, which require design bya registered professional engineer, submit (for information only and not for Engineer approval) the following:

1. Copies of design calculations and notes for sloping, benching, support systems, shield systems, and other protective systems prepared by or under the supervision of a professional engineer legally authorized to practice in the jurisdiction where the Project

is located.

2. Documents provided with evidence of registered professional engineer's seal, signature, and date in accordance with appropriate state licensing requirements.

PART 2 - MATERIALS

2.1 Fill and Backfill Material

A. Earth Backfill:
Use suitable material as specified in SECTION 02300, PART 2 for granular backfill.

B. Granular Fill:
Native excavated or approved import granular material, free draining and free of unsuitable materials defined herein. Granular backfill shall be non-plastic, well graded and meet the following gradation:

Sieve Size	Percent by Weight Passing
¾ inches	100
No. 4	40 - 85
No. 8	30 - 75
No. 40	10 - 50
No. 100	5 - 20
No. 200	3 - 12

2.2 Concrete

A. Includes all concrete used to restore bottom of excavation to proper elevation, and in concrete seal coats.

B. Concrete shall be as specified in DIVISION 3.

PART 3 - EXECUTION

3.1 Excavation

A. Perform as specified in Section 02300 and as follows:

1. Excavate area adequate to permit efficient erection and removal of forms.
2. Trim to neat lines where details call for concrete to be deposited against earth.

3. Excavate by hand in areas where space and access will not permit use of machines.
4. Notify Engineer immediately when excavation has reached the depth indicated. Do not proceed further until approved.
5. Restore bottom of excavation to proper elevation with compacted fill in areas over excavated, as approved.
6. Top with 75-mm (3-inch) concrete seal coat if required to provide satisfactory subgrade for structural base slabs:
   a. Seal coat shall conform to applicable requirements of DIVISION 3.
7. Use sides of trenches to form sides of duct banks where possible and where sides of trench are vertical, stable, and excavated to the proper line.

B. Sheeting and Shoring:
1. Sheeting and Shoring shall be provided when soil conditions indicate the need for sheeting and shoring.

2. Damages:
   a. Repair all damage resulting from Contractor's excavation and remove and replace all undermined pavements with Owner-approved equal, either concrete or asphalt, at Contractor's expense and in accordance with Section 02630.

3.2 Filling and Backfilling

A. Granular Fill:
1. Place on prepared subgrade where indicated, prior to placing concrete in slabs on grade.
2. Lifts shall not exceed 150 mm (6 inches) in loose-layer thickness.
3. Compact to 95% relative density as referenced to ASTM D4253 and D4254.

B. Earth Backfill:
1. Backfill only after concrete has attained 70% design strength.
2. Backfill adjacent to structures only after, in the opinion of Engineer, a sufficient portion of the structure has been built to resist the imposed load.
3. Remove all debris from excavation prior to placement of material.
4. The slope bounding the excavation, if steeper than 6 horizontal: 1 vertical, shall be stepped or serrated prior to placing the backfill material.
5. Perform backfilling simultaneously on all sides of structures.
6. Place backfill in level layers not exceeding 100 to 200 mm (4 to 8 inches) in loose-layer thickness.
7. Exercise extreme care in the use of heavy equipment in areas adjacent to structures.

8. Compact to 95% of maximum dry density within the moisture content range from 2% below optimum to 2% above optimum. Optimum moisture and maximum dry density shall be determined by ASTM D1557. Accomplish without inundation or flooding.

3.3 Field Quality Assurance

A. Compaction:

1. Contractor shall, through services of an independent laboratory, test all filling and backfilling for structures to determine conformance with density relationships specified.
2. Method of test shall be as specified in SECTION 02300, PART 3.
3. The frequency of tests shall be in compliance with jurisdictional requirements.

PART 4 - MEASUREMENT AND PAYMENT – Not Applicable

*** END OF SECTION **

SECTION 02515

UTILITY VALVES AND ACCESSORIES

PART 1 - GENERAL

1.1 Summary

A. Description of the Work

The work to be performed in accordance with this Section includes all work associated with the installation and testing of all valves, hangers and supports, gauges, and other accessories associated with the project piping.

The work shall include the furnishing of all labor, tools, equipment, materials and performing all operations to install all valves hangers and supports, gauges, and other accessories.

B. Related Work Specified Elsewhere

Water Line Construction ..... Section 2550
Protective Coatings..... Section 9900
Electrical.....Division 16

1.2 Quality Assurance

A. Reference Standards and Specifications

1. American National Standards Institute (ANSI)

ANSI B16.1 - Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.

2. American Society for Testing and Materials (ASTM)

ASTM A126 - Gray Iron Castings for Valves, Flanges and Pipe Fittings.

ASTM A276 - Stainless and Heat Resisting Steel Bars and Shapes.

ASTM A536 - Ductile Iron Castings.

3. American Water Works Association (AWWA)

AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

AWWA C207 - Steel Pipe Flanges for Waterworks Service, Sizes 4 Inch through 144 Inch.

AWWA C504 - Rubber Seated Butterfly Valves. AWWA

C507 - Ball Valves, 6 Inch through 48 Inch.

AWWA C508 - Swing-Check Valves for Waterworks Service, 2 Inch through 24 Inch NPS.

AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.

AWWA C512 - Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.

AWWA C550 - Protective Epoxy Interior Coatings for Valves and Hydrants.

AWWA C600 - Installation of Ductile-Iron Water Mains and their Appurtenances.

B. Manufacturer Quality Assurance

Manufacturers shall be experienced in the design and manufacture of specific valves and accessories for a minimum period of 5 years and all values and fittings shall be manufactured in U.S.

C. Field Testing

1. Perform on piping and valves as specified in Section 2560 and for the following:
   a. Check valves.
   b. Butterfly valves.
   c. Plug valves.
   d. Gate valves.
   e. Ball vales
   f. Air and air vacuum valves
   g. Surge relief valves
   h. Gauges

1.3 Submittals

A. Submit as specified in Section 1330.
B. Include, but not limited to, the following:
   1. Catalog data or illustrations showing principal dimensions, parts, and materials.
   2. Spare parts list referenced to illustration of parts.
   3. Assembly and disassembly or repair instructions.
   4. Dimensions of the clearance required for butterfly valve discs, handwheels, actuators or any other moving part.
C. Certificates and Affidavits: Furnish prior to shipment. Include the following:
   1. Test certificates.
   2. Affidavit of compliance with applicable AWWA Standard.

1.4 Delivery, Storage, and Handling

A. Ship all valves with suitable end covers to prevent entrance of foreign material into valve body.
B. Protect valve threads, flanges, stems, and operators from damage.
C. Ship valves 2-1/2-inch and larger to the Project Site tagged with the valve number shown on the Drawings and valve schedule. Tag smaller valves to show the piping system in which it is to be used.

1.5 Responsibility

Actuators, their controls, and accessories shall be the responsibility of the valve manufacturer for sizing, assembly, certification, field testing, and any adjustments necessary to operate the valve as specified.

PART 2 - MATERIALS

2.1 Eccentric Plug Valves

A. Acceptable Manufacturers
   1. DeZurik, a unit of General Signal Corporation.
   2. Keystone Valve USA, Inc.
   3. Milliken Valve Company, Inc.
   4. Val-Matic Valve and Manufacturing Corporation.
   5. Victaulic Company of America.
   6. Or approved equal

B. Design

1. Quarter-turn nonlubricated eccentric type with resilient faced plug. Valves with vane type seat rings are not acceptable. Shutoff up to scheduled rating with pressure in reverse direction where scheduled.
2. Suitable for 250 psi operating pressure.
3. Port areas for valves through 16-inch shall be at least 80% of full pipe area and 24-inch and larger shall be at least 70% full pipe area.
4. Plugs shall be eccentric type with no backing ring or frame.
5. Valve body cavity shall be smooth without protrusions or baffles.

C. Materials and Construction

1. Bodies shall be of ASTM A126, Class B cast iron.
2. Valve plug shall be ASTM A126, Class B cast iron or ASTM A536 ductile iron. Resilient plug facing or replaceable style body seats shall be synthetic rubber, neoprene, or Buna N compound suitable for use with wastewater applications.
3. Seat rings shall be threaded, or welded of corrosion-resistant 18-8 stainless steel, nickel, or Monel conforming to AWWA C504. Sprayed or plated mating seat surfaces are not acceptable.
4. Bearings shall be replaceable. Sleeve type and thrust bearings in the upper and lower journals shall be corrosion-resistant stainless steel.
5. Shaft seals shall be multiple O-ring or self-adjusting U-cup or chevron type packing conforming to AWWA C504. Pull-down packing is not acceptable.
6. Shaft seals shall be field adjustable or replaceable under pressure and without valve disassembly.
7. All exposed fastening hardware shall be zinc plated or stainless steel. Provide stainless steel for buried service.

D. Connections

1. Valve connections to be flanged for valves within the wet well, valve vault and flowmeter vault and mechanical joint for all buried valves.
2. Flanged valve ends shall be faced and drilled to conform to ANSI B16.1, Class 125 for thickness and drilling.

E. Actuators

1. Manual Actuators
   a. All valves shall open counterclockwise.
   b. Provide indicators to show position of plug.

c. Worm gear actuators shall be totally enclosed, grease sealed, gear type furnished with AWWA nut, crank, handwheel, or chainwheel. All buried valves shall be provided with worm gear actuators, AWWA nut, and enclosed cover plate. All valves with reverse pressure capacity requirement shall be provided with worm gear actuators. Worm gear actuators shall be self- locking at all variable opening positions and sized to meet the torque ratings of AWWA C504. The shaft in a worm gear actuator shall have a nonmetallic sleeve type bearing. Submit manufacturer's parts and materials drawings.

d. Handwheels shall be located in positions indicated or as otherwise determined when manufacturer's drawings are s ubmitted.

F. Shop Painting: Apply interior coating conforming to AWWA C550 to exposed ferrous metal surfaces. Provide affidavit or certificate of compliance per AWWA C550.

a. Cushioned Swing Check Valves

1. Acceptable Manufacturers
2. APCO, Valve and Primer Corporation.
3. GA Industries, Inc.

ii. Operational Requirements

1. Prevent reverse flow without shock or hammer.
2. Seat tightly with internal pipeline forces.
3. Cushioned with air cylinder controls in permitting adjustment of speed of closure.

manner

iii. Design: Conform to AWWA C508 and as specified.

1. Swing disc type with single shaft and body. Flanges shall be ANSI B16.1, Class

flanged

125.

2. Cushion chamber shall be mounted on valve body.

externally

3. Valve disc shall have external lever and counterweight of initiate closure.
4. Suitable for 250 psi operating pressure.

iv. Materials and Construction

1. Valve body shall be cast iron, ductile iron, steel.

or

2. Valve disc shall be cast iron, ductile iron, or stainless steel.
3. Seats and seat ring shall be renewable. Seats shall be bronze or stainless steel. Seat rings shall be Buna-N or bronze.

b. Bronze Swing Check Valves
   i. Acceptable Manufacturers
      1. Crane
      2. Nibco
      3. Approved equal.
      4. Design
      5. “Y” Pattern check swing type.
      6. Rated for 200 psi cold working pressure.
      7. Operation
      8. Prevent reverse flow without shock or hammer.
      9. Seat tightly with internal pipeline forces.
      10. For use on service water lines 2” and less.
      11. Materials and Construction
      12. Valve body shall be bronze ASTM B62.
      13. Valve disc shall be composition or PTFE.
      14. Seats and seat ring shall be renewable. Seats shall be bronze.
      15. Bonnet to be screwed cap type.
      16. Connections
      17. Connections to be threaded.
      18. Automatic Air/Vacuum Release Valves
      19. Acceptable Manufacturers
      20. APCO, Valve and Primer Corporation.
      21. Crispin Valves, Multiplex Manufacturing Company.
      22. G.A. Industries, Inc.
      23. Val-Matic Valve and Manufacturing Corporation.
      24. Design: Conform to AWWA C512 and as specified.
      25. Valve shall be heavy-duty air and vacuum valve; sewer style.
      26. Body and cover shall be ASTM 126 cast iron.
      27. Float shall be ASTM A276 Type 316 stainless steel Valve seats shall be Teflon or Buna-N.
      28. All internal parts shall be stainless steel.
      29. Single body construction built for 300 psi service.
      30. Provide valves 3 inches and smaller with internal deflector and external adjustable discharge orifice to control leakage or blow-by of liquid.
      31. Provide valves 4 inches and larger with

internal surge check unit ahead of air / vacuum valve to ensure gentle closing upon.

ii. Operation
1. Release air when filling line.
2. Admit air when emptying line.
3. Release accumulated air while pipeline is full and operating under pressure.

iii. Connection
1. Connect air valves 2 inches and smaller to pipeline through ductile iron pipe service saddles with 304 SS straps. Corporation stops may be used of Mueller Company Style H- 10003, H-10013, H-10045 or Engineer approved equal.
2. Connect air valves 3 inches and larger through tapped bosses or flanged outlets as indicated on drawings. Air vacuum valve inlet and outlet shall be provided with ANSI B16.1 125 psi flanged connections. Locate valve and vault either directly over pipeline or off to one side as indicated.
3. Connecting fittings and pipe shall be bronze, brass, or copper rated for 250 psi service.
4. Couplings or unions indicated between pipeline and air valve piping shall be insulated style.
5. Blowoff valves and shutoff valves with backflushing attachments shall be provided for all air valves.

iv. Valve Schedule

As indicated on Drawings.

2.4 Surge Relief Valves

A. Acceptable Manufactures
1. G.A. Industries, Inc.
2. Or approved equal.

B. Operational Requirements
1. Valve shall be normally closed and shall open when the system pressure exceeds 135 psi.

2. Valve shall close at a slow speed to prevent hammer or pipeline shock.

C. Design
1. Valve shall be wye body configuration.
2. Flanges shall be ANSI B16.1, Class 125.

D. Materials and Construction
1. Valve body shall be ASTM A126 cast iron.
2. Valve seats and seat rings shall be renewable. Seats shall be resilient. Seat rings shall be bronze or stainless steel.
3. Disc movement shall be guided for proper alignment throughout its stroke and shall provide for full opening.
4. External springs shall be enclosed in protective casings and shall be in compression.
5. Provide two coats of the manufacturer's standard coating.

E. Valve Schedule
As indicated on Drawings.

2.6 Isolation Valves

A. Isolation valves shall be provided for all air/vacuum valves and pressure switches and shall be bronze gate valve, Crane No. 424 or Engineer-approved equal for sizes 3 inches and smaller unless otherwise noted. Isolation valves 4 inches and larger shall be flanged AWWA C504 butterfly valves.

2.5 Pipe Hangers and Supports

A. Pipe hangers and supports shall meet the requirements of Section 5, Chapter II of ANSI B31.1 and shall be types as given for MSS Standard Practice SP-58 and SP-69.

B. Constant Support, Spring and Rigid Hangers: Bergen, Blaw Knox, Fee and Mason, Grinnell, or NAVCO.

C. Pipe hanger and supports shall be of the types listed in Table 1 "Hanger and Support Selection," MSS Standard Practice SP-69 except that the following figure types given in Fig. 1 will not be acceptable: Types 5, 6, 11, 12, 7, 9, 10, and 25.

D. All hangers shall be stainless steel.

E. All hanger rods shall be stainless steel.

F. Concrete Inserts and Expansion Shields
1. Inserts shall be 316 stainless steel and have a recommended load capacity of 2,000 pounds per foot of length in average good concrete with a safety factor of 3.
2. Inserts shall be continuous and located as required.
3. Provide end caps at each end. End caps shall have attached anchor if spacing from end of insert to next anchor is greater than 2 inches.

2.6 Meters and Gauges

A. General
   1. Provide all instruments, meters, gauges, and thermometers, complete with interconnecting stainless steel tubing, piping, valves, as specified and as indicated.
   2. Provide gauge stainless steel cock in the piping for all instruments, meters, and gauges, both at point of takeoff and at the instruments, meters and gauges. Gauge cock shall be of the same design requirements as the lines they serve.

B. Indicating Pressure Gauges
   1. Ashcroft "Duragauge," Crosby or Marsh.
   2. Bourdon Tube
      a. 160-psi maximum graduation: Stainless steel Grade A phosphor bronze, brazed joints stress relieved.
      b. 200-psi to 800-psi maximum graduation: 316 stainless steel threaded.
   3. Socket and Tip
      a. 160-psi maximum graduation: 316 stainless steel.
      b. 200 psi and over graduation: 316 stainless steel.
   4. Case: High-impact glass-fiber-reinforced polypropylene, weatherproof with safety blowout discs or release back plate.
   5. Ring: Bayonet-locking type.
   6. Movement: All stainless steel mounted on socket with milled teeth on pinion and sector.
   7. Dial: 6 inches, white laminated phenol with black markings.
   8. Pointer: Aluminum with micrometer adjustment.
   9. Accuracy: 1/2 of 1% over full range of scale.
   10. Range: As required for the pressure range to be measured.
   11. Mount all pressure gauges on rigid surfaces. Differential strainer gauges shall be line-mounted. Mount outdoor gauges on pump flange. Install an instrument needle valve with each gauge.
   12. Be solid-front type recalibrated from back without removing dial.
   13. Ashcroft Type 45-2464 with back connection for flush mounting on gauge boards.
   14. Ashcroft Type 45-2462 with lower connection for differential strainer on line or pump-mounted gauges.

2.7 Valve Boxes

A. Acceptable Manufacturers
   1. Clay and Bailey Manufacturing Company.
   2. Dresser Industries, Inc.
   3. Mueller Company.
   4. Neenah Foundry Company.
   5. Tyler Company.

B. Provide for all buried valves.

C. Design
1. Boxes shall be three-piece cast-iron screw type with 5-1/4- inch shaft.
2. Provide extension stem to bring operating nut within 2 feet of valve box top.

2.8 Shop Painting

A. Prepare surfaces and paint or coat all valves, corporation stops, and all related accessories to the standard of the manufacturer unless otherwise specified herein.
B. Paint and coatings shall be suitable for the service intended.
C. Submit type of paint or coating proposed with drawings and data for Engineer approval prior to fabrication.

PART 3 - EXECUTION

3.1 Installation

A. Comply with provisions of AWWA C600 and as specified.
B. Thoroughly clean and remove all shipping materials prior to setting. Operate all valves from fully opened to totally closed.
C. Equip with anchorage where indicated.
D. In accordance with Section 2560, Sewer Line Construction and Section 2550 Water Line Construction.

3.2 Field Painting

A. Manufacturer shall provide adequate coating system equal to shop coating for field touch-up.

3.3 Hangers, Supports and Anchors

A. General
1. The design, selection, spacing, and application of pipe hangers, supports, and anchors shall be in accordance with the codes and standards specified except the ANSI B31.1 - Code for Power Piping shall take precedence over the MSS SP-69 standard.
2. Hanger class and selection of components shall be in accordance with those specified.
3. Furnish and install all rigid and spring supports, whether or not they are shown and detailed, but are required to adequately support the piping systems.
4. Furnish and install for all pipe installed under this Contract.
5. Include all necessary structural aluminum or 316 stainless steel, brackets, concrete inserts, and similar items which are not a part of the building, or specified but required to properly support the piping systems.

6. Include necessary temporary supports, pins, and related items for the hydrostatic testing of any lines that are spring supported.
7. Install piping and provide necessary supports and anchors to prevent the forces and mounting imposed on Equipment from exceeding the limits specified by the Equipment manufacturer.

B. Adjustment

1. Prior to putting the piping systems into service, adjust all solid hangers to correct position and remove all temporary hangers used in erection and testing.
2. After and during the time the piping systems are being put into service, align all hanger rods to the vertical position.

C. Hangers and Related Items not on Drawings: Pipe hanger assemblies, anchors, and sway braces other than those indicated on the Drawings shall be designed, selected, and located by Contractor or hanger manufacturer in accordance with the following:

1. Make accurate weight balance calculations to determine the required supporting force on each hanger and to show the reaction and forces on Equipment on the Shop Drawings. Calculate expansion and movement of all pipe installed under this Contract and select hanger type and components to allow for pipe expansion and movement.
2. Submit detail Shop Drawings of each hanger assembly for review and comments.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment for Utility Valves and Accessories will be made at the contract lump sum price and shall be considered full payment for providing labor and materials to perform this work.

B. Progress payments for valves will be based on the Schedule of Values per valve for each size and type of valve and shall be considered as full payment for the valve in place including any fittings, flexible couplings, anchor and thrust blocks, hydrostatic testing, disinfection, plastic pipe wrap, trench excavation, bedding and backfill. No payment will be made until the hydrostatic testing and disinfection is satisfactorily completed.

** END OF SECTION 2515 **

SECTION 02532
UTILITY STRUCTURES

PART 1 – GENERAL

1.1 Summary

A. Description of the Work

The work shall include the furnishing of all labor, tools, equipment, materials and performing all required operations to provide a complete item in accordance with the project plans and these specifications.

B. This Section includes the following structures and related appurtenances:

Precast concrete manholes
Pump Station wet well and valve vault. Accessory vault.
Concrete anchor and thrust blocks.

C. Related Work Specified Elsewhere:

Trench Excavation and Backfill ..... Section 02300

Sewer Line Construction ..... Section 02560

Concrete ..... Section 03300

1.2 Quality Assurance

A. Applicable Test Standards and Specifications

1. American Society for Testing and Materials (ASTM)

ASTM A48 - Gray Iron Castings
ASTM C76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C270 - Mortar for Unit Masonry
ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C478 - Precast Reinforced Concrete Manhole Sections
ASTM C1107 –Packaged Dry, Hydraulic-Cement Grout, Nonshrink

2. Federal Specification (FS)

FS FF-H-106 - General Hardware, Builder's, Locks and Door Trim
FS SS-S-00210 - Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints

3. American Association of State Highway Transportation Officials (ASSHTO)

AASHTO H20 – Axial Loading

4. American Concrete Institute (ACI)

ACI 350 – Code Requirements for Environmental Engineering Concrete Structures and Commentary

B. Leakage Test

Test all manholes installed under this contract using the vacuum method described below. Provide all equipment necessary to perform the test. Coordinate test schedule with the Owner. Test will not be accepted unless witnessed by the Owner.

1. Plug all pipes entering the manhole, taking care to securely brace the plug from being drawn into the manhole.
2. Place the test head inside of the top of the cone section and inflate seal in accordance with the manufacturer's recommendations.
3. Draw a vacuum of 10 inches of mercury and shut off the vacuum pump. With the valves closed, measure the time for the vacuum to drop to 9 inches. The manhole shall pass if the time for the vacuum to drop is greater than 60 seconds for 48" diameter manhole, 75 seconds for 60" diameter manhole and 90 seconds for 72" diameter manholes. In lieu of vacuum testing, a water tightness test may be performed by filling the manhole with water. The manhole shall pass if the drop in water level does not exceed 0.001% of the manhole volume in one hour.
4. If the manhole fails the initial test, make necessary repairs with a non-shrink grout while the vacuum is still being drawn. Retest until a satisfactory test is obtained.

1.3 Submittals

A. Certificates of Compliance and Descriptions required for Frames and Covers.

B. Provide submittal for precast reinforced manholes per Section 01330, Submittals. The minimum information required for each manhole includes:

1. Top Elevation.
2. Base Elevation.
3. All pipe inverts entering and leaving the manhole.
4. All angles between lines leaving and entering the manhole.

1.4 Product Delivery, Storage And Handling

Take all necessary precautions in handling, storage and placement of manhole components and appurtenances. Replace defective materials.

PART 2 – PRODUCTS

2.1 Precast Manholes

A. Precast concrete manholes shall conform to ASTM C478 with ASTM C443 two-fin serrated flat gasket to concrete joint or with FS SS-S- 00210 preformed plastic concrete joint.

B. Precast manholes shall be 48-inchs in diameter unless otherwise indicated.

C. Provide precast concrete manhole bases for all concrete precast manholes.

D. Manhole cone section shall conform to ASTM C478, 24 inch minmimum inside diameter of similar quality as manhole riser sections.

E. Manhole penetrations for pipes entering the manhole shall be provided with A-lock gaskets or approved equal and shall be included in the precast base section.

2.2 Manhole Frames And Covers

A. Shall conform to ASTM A48, Class 30B.

B. The word "sewer" shall be cast into the top of the lid and the lid shall contain the City's Logo.

C. The cover and frame shall be a locking, nonventilated type for all locations in nonpaved areas, and nonlocking, nonventilated type in paved areas.

D. Provide a concrete collar around the frame. (Minimum 1' wide and 8" thick)

E. Provide one ("T" Handle Type) for 24-inch manhole frame and cover for locking units required for non-paved installations.

F. Acceptable Manufacturers:

1. Neenah Foundry Company Model R-1772 Cast Iron Manhole Frame & Cover with special lid containing the City Logo.
2. Model REXUS D 400 or PAMREX as manufactured by SAINT GOBAIN. (This manufacturer can provide a Ductile Iron Locking Lid as specified to be installed in easements.)
3. East Jordan Iron Works – Product no. 00102214 Catalog No. 1022Z3 with special lid containing the Logo.
4. Engineer approved equal.

G. Machine-bearing surfaces to provide even seating.

2.3 Non Shrink Grout

ASTM C1107, prepackaged.

2.4 Preformed Joint Material For Precast Concrete Manholes

Plastic or mastic as recommended by the barrel section manufacturer. Resistant to sewer environment to provide water tight seal between concrete sections. Preformed joint material shall be Ram-Nek, Kent Seal, or equal.

PART 3 - EXECUTION

3.1 Excavation, Backfill And Compaction

A. Manholes

Prepare subgrade and bedding in accordance with Section 02300, Trench Excavation and Backfill. Provide bedding to depth and density indicated. Place and compact bedding and backfill with the same material and to the same density indicated for the adjacent trench.

1. Extensions

Place each extension plumb. Join sections with a full bed of preformed joint material. Cut off excess joint material to provide space for at least 1/4 inch depth of grout. Grout smooth the interior and exterior of the joint after the mastic has set.

2. Final Adjustment to Grade

Adjust frame and cover to required elevation with manhole extensions. Do not exceed maximum dimensions of 18 inches between the top of the frame and the top of the cone. Use preformed joint material to provide water tight seal between extension sections. Grout smooth the interior surface of sections and extensions.

3. Frame and Cover
Place frame and cover level to the elevation indicated or required to match surface conditions on full bed of mortar. Construct concrete collar as indicated.

4. Connections for precast concrete manholes
Grout around pipes with nonmetallic non-shrink grout. Install all piping using a flexible-rubber, entrance-hole gasket joint of pattern approved by the Engineer. Place pipe stub in manhole wall with bell or coupling outside manhole wall to provide flexible joints as indicated. Make provisions for future connections where indicated. Include plug or stopper capable

of withstanding 4.3 psi of internal or external pressure without leakage for future connections.

5. Manhole Installation: All manholes shall be installed in accordance with manufacturers instructions. A representative of the manufacturer must be present for the installation of all manholes until the manufacturer is satisfied that the Contractor is proficient in the installation of the manhole.

6. Invert Channels: Form invert channel with 4,000 psi Type
II portland cement concrete. Make changes in direction of flow with smooth curves of as large a radius as size of manhole permits. Make changes in size and grade smoothly and uniformly. Slope floor of manhole adjacent to channels as indicated. Finish channel bottom smoothly without roughness, irregularity, or pockets.

B. Accessory Vault
1. Design: Construct to conform to Drawings of reinforced concrete pipe conforming to ASTM C76, Class II
2. Installation:
   a. Install vaults where indicated.
   b. Extend from centerline of pipe to ground surface.
   c. Notch lower section 2 inches greater than pipe OD and include fiberglass batt to prevent transmission of loads to pipe barrel.
3. Manhole Frame and Cover:
   a. Pattern as shown on drawings. Set frame level and to grade in mortar.

C. Air Valve Vault
1. Design:

a. Precast and masonry construction as indicated.
b. Precast concrete footings.
c. Riser of ASTM C76, Class II pipe.
d. Top slab shall be precast as indicated.

2. Manhole Frame and Cover:
   a. Pattern as shown on attached detail.
   b. Set frame level and to grade in mortar.

D. ONCRETE ANCHOR AND THRUST BLOCKS
1. Install at tees, elbows, bends, and dead ends where indicated.
2. Place against undisturbed earth or rock.
3. Of design indicated or specified.

PART 4 – MEASUREMENT AND PAYMENT

4.1 Measurement And Payment

A. Measurement and payment for manholes shall be as specified in Section 01210 – Measurement and Payment.

* END OF SECTION 02532 **

SECTION 02535
PIPE INSTALLATION

PART 1 - GENERAL

1.1 Summary

A. Description of Work

This Section includes handling, installation and testing of pipe, fittings, specials, and appurtenances as indicated or specified.

B. Related Work Specified Elsewhere

Excavation, Filling, and Backfilling for Structures ..... Section 02321
Utility Structures .....Section 02532
Sewer Line Construction .....Section 02560

1.2 Quality Assurance

A. Applicable Standards and Specifications

1. American Society for Testing and Materials (ASTM):
   ASTM D2321 - Underground Installation of Flexible Thermoplastic Sewer Pipe.
   ASTM F1417 - Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.
2. Federal Specifications (FS):
   SS-S-00210 - Sealing Compound, Preformed Plastic, For Expansion Joints and Pipe Joints.

1.3 Delivery, Storage and Handling

A. Handle in a manner to ensure installation in sound and undamaged condition.

1. Do not drop or bump.
2. Use slings, lifting lugs, hooks, and other devices designed to protect pipe, joint elements, linings, and coatings.

B. Ship, move, and store with provisions to prevent movement or shock contact with adjacent units.

C. Handle with equipment capable of work with adequate factor of safety against overturning or other unsafe procedures.

PART 2 - MATERIALS

Specified in Section 02560.

PART 3 - EXECUTION

3.1 Installation

A. Verify all preliminary work has been completed prior to any sewer line construction.

B. Use equipment, methods, and materials ensuring installation to lines and grades indicated.

1. Maintain within tolerances specified or acceptable laying schedule.

a. Alignment: +1 inch per 100 feet in open cut or tunnel.

b. Grade: +1 inch per 100 feet.

2. Do not lay on blocks unless pipe is to receive total concrete encasement.

3. Obtain acceptance of method proposed for transfer of line and grade from control to the Work.

C. Install pipe of size, materials, strength class, and joint type with embedment indicated.

D. Install pipe with spigot or tongue ends in direction of flow. Obtain Engineer approval for deviations there from.

E. Clean interior of all pipe, fittings, and joints prior to installation. Exclude entrance of foreign matter during installation and at discontinuance of installation.

1. Close open ends of pipe with snug-fitting closures.

2. Do not let water fill trench. Include provisions to prevent flotation should water control measures prove inadequate.

3. Remove water, sand, mud, and other undesirable materials from trench before removal of end cap.

F. Brace or anchor as required to prevent displacement after establishing final position.

G. Perform only when weather and trench conditions are suitable. Do not lay in water.

H. Observe extra precaution when hazardous atmospheres might be encountered.

3.2 Jointing

A. General Requirements

1. Locate joint to provide for differential movement at changes in type of pipe embedment, impervious trench checks, and structures.

a. Not more than 8 inches from structure wall, or

b. Support pipe from wall to first joint with concrete cradle structurally continuous with base slab or pipe bedding material.

c. As indicated.

2. Perform conforming to manufacturer's recommendations.
3. Clean and lubricate all joint and gasket surfaces with lubricant recommended.
4. Use methods and equipment capable of fully seating or making up joints without damage.
5. Check joint opening and deflection for specification limits.

3.3 Temporary Plugs:

A. Furnish and install temporary plugs. Temporary plugs are to be installed
In the pipe at the end of each workday and the trench is to be completely backfilled.

3.4 Field Testing:

1. Acceptance Tests for Gravity and Low-Pressure Pipelines:
   a. Alignment:
      (1) Sewer shall be inspected by flashing a light between manholes or by physical passage where space permits.
      (2) Sewer shall be inspected by videotaping entire line, from first to last manhole. During entire video recording, water must be flowing in the invert at a rate of at least one gallon per minute. The footage from the starting manhole must be recorded on the video screen, as well as the pipe run identification.
      (3) Contractor shall clean pipe of excess mortar, joint sealant, and other dirt and debris prior to inspection.
      (4) Determine from Videotaping o r Physical Inspection:
      Presence of any misaligned, displaced, or broken pipe.
      Presence of visible infiltration or other defects.
   b. Correct defects as required prior to conducting leakage tests.Air Testing: Perform air tests per ASTM C828 for clay or F1417 for plastic pipe at Contractor's option in lieu of exfiltration test for pipe sizes up to and including 42 inches in diameter and will include all lateral pipes to the property lines where applicable.
      (1) Furnish all facilities required including:
      Necessary piping connections.
      Test pumping equipment.
      Pressure gauges or manometers. Bulkheads.
      All miscellaneous items required.
      (2) Obtain approval of equipment and acceptance of methods proposed for use.
      (3) Conduct initial test on first run of pipe laid by each crew.
         (a) Include a minimum of 10 lengths of pipe but not to exceed 500 feet.
         (b) Perform before backfilling.
         (c) Satisfactorily complete test before crew is permitted to continue pipe installation.

(4) Test remaining pipe in sections determined by Contractor and approved by Engineer.

(5) A wetted interior pipe surface on clay pipe is desirable and will produce more consistent test results.

(6) Plug ends of line and cap or plug all connections to withstand internal test pressures. Test plugs must be securely braced within the manholes.

(7) Introduce low-pressure air until internal air pressure is 4.0 psi greater than the average back pressure of ground water above the pipe invert.

(8) Allow two to five minutes for internal air pressure and temperature to stabilize. Adjust pressure to 3.5 psi and start test.

(9) Time required for pressure to decrease 1.0 psi from 3.5 to 2.5 psig greater than the average back pressure of any ground water above the pipe invert shall not be less than the minimum test time in the following table for the given diameters:

Minimum Test Times (Minutes) in Plastic Pipe

Nominal Pipe Diameter	Minimum Time (min.)*	Length for Min. Time	Time for Longer Length(s)*
4 in.	3:46	597 ft.	0.380 L
6 in.	5:40	398 ft.	0.854 L
8 in.	7:34	298 ft.	1.520 L
10 in.	9:26	239 ft.	2.374 L
12 in.	11:20	199 ft.	3.418 L
15 in.	14:10	159 ft.	5.342 L
18 in.	17:00	133 ft.	7.692 L
21 in.	19:50	114 ft.	10.470 L
24 in.	22:40	99 ft.	13.674 L
27 in.	25:30	88 ft.	17.306 L
30 in.	28:20	80 ft.	21.366 L
33 in.	31:10	72 ft.	25.852 L
36 in.	34:00	66 ft.	30.768 L

* For 3.5 kPa (0.5 psi) pressure test drop, required test times shall be exactly one-half the values shown.

(10) If the section of line to be tested includes more than one pipe size, calculate the test duration for the length of each size

and add the test durations to arrive at the total duration of the testing period for the section.

(11) Repeat test as necessary after all leaks and defects have been repaired.

2. Acceptance Tests for Pressure Pipelines:

a. `Perform hydrostatic pressure and leakage tests.
   (1) Conform to AWWA C600 procedures. As modified herein.
   (2) Perform after backfilling.

b. `Test separately in segments between sectionalizing valves, between a `sectionalizing valve and a test plug, or between test plugs.
   (1) Select test segments such that adjustable seated valves are isolated for individual checking.
   (2) Contractor shall furnish and install test plugs.
      (a) Including all anchors, braces, and other devices to withstand hydrostatic pressure on plugs.
      (b) Be responsible for any damage to public or private property caused by failure of plugs

c. Limit fill rate of line to available venting capacity. Fill rate shall be regulated to limit velocity in lines when flowing full to not more than 0.05 to 1 fps.

d. Owner shall make water for testing available to Contractor at nearest source.

e. Pressure and Leakage Test:
   (1) Test pressure shall not exceed 1.25 times the working pressure at the highest point along the test section.
   (2) Test shall be at least 2-hour duration. Maintain pressure throughout test within 5 PSI of the test pressure.
   (3) Leakage test shall be conducted concurrently with the pressure test.
   (4) Acceptable when leakage does not exceed that determined by the following formula (in English Units):
      L = 0.0000075SD(P)1/2, in which
      L = allowable leakage, in gallons per hour S =
      length of pipe tested, in feet
      D = nominal diameter of the pipe, in inches
      P = average actual leakage test pressure in psig.
   (5) These formulas are based on an allowable leakage of 11.65 gpd/mile/in of nominal diameter at a pressure of 150 psi.
   (6) When testing against a closed metal-seated valve, an additional leakage per closed valve of 0.0078 gal/hr/in of nominal valve size shall be allowed.
   (7) Repeat test as necessary.
      (a) After location of leaks and repair or replacement of defective joints, pipe, fittings, valves or hydrants. All visible leaks are to be repaired regardless of the amount of leakage.
      (b) Until satisfactory performance of test.
   (8) Engineer will witness pressure and leakage test.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

Measurement and payment will be made in accordance with Section 01210 - Measurement and Payment.

** END OF SECTION 02535 **

SECTION 02550

WATER PIPING SYSTEMS

PART 1 GENERAL

A Description of Work:
This work consists of furnishing and installing water mains, service lines, and appurtenances. This includes all equipment, tools, materials, labor, and other incidentals to provide water mains and service lines complete and ready for immediate and continuous use. The work includes, but is not limited to, all necessary excavation, backfilling, compaction, testing, clean up, and restoration required for a complete installation of water mains, service lines, and appurtenances.

B. Related Work:

Section 02300	-	Trench Excavation and Backfill
Section 02310	-	Flowable Fill
Section 02560	-	Sewer Line Construction
Section 02650	-	Traffic Control
Section 03300	-	Concrete Structures

C. Definitions:

1. Distribution main means a water main that supplies one or more branch mains.
2. Fire Service Line means pipe and appurtenances delivering water from the City water distribution system to a building fire extinguishing system. Fire service lines may be located on private property or in public ROW and are owned, operated, and maintained by the property being served.
3. Fire hydrant assembly means the materials located from the city main to the fire hydrant including the tee or tap, piping, auxiliary valve hydrant and all other equipment constructed for the purpose of providing the fire hydrant.
4. “L” length for Joint restraining devices means the length of pipe from a fitting, valve, or feature that needs to have each pipe joint within that length restrained.
5. Private Fire Protection System means hydrants, valves, water pipes, and appurtenances, sprinkler systems, hose connections, and other equipment constructed for the purpose of providing fire protection for a building or group of buildings and supplied with water from a public water supply system. Private Fire Protection Systems are located on private property, although some components may be located in public ROW, and are owned, operated, and maintained by the property being served.
6. Transmission Main means a water main that supplies many tributary branches, serves a large area, and has few taps.
7. Water mains are those pipes of at least four (4) inches in diameter, which will be installed in public right-of-way or easements and will become a part of the City water distribution system and which will be owned, operated, and maintained by Lake Havasu City.

Water service line shall mean the line from the main to the meter box which is normally entirely located within the right-of-way and is owned and maintained by the City. The water meter is then connected to the property water distributing system and which the property owner is responsible for repair and maintenance.

D. Submittals:

Submittals shall be required per Section 01330 unless otherwise specified in the Plan Notes or Special Provisions. The term "Submittals" includes, but is not necessarily limited to, manufacturer's product data sheets of pipe, appurtenances, and fittings. Submittals shall be submitted for, but not limited to, the following items:

Fire hydrants, pipe, pipe fittings and their appurtenances including T- bolts, joint restraints, polyethylene encasement, and any other pertinent information concerning construction materials that the Engineer deems necessary for the review of the materials used on the project in accordance with the specifications and drawings.

Resubmittals shall be made in the same manner as submittals, with changes clearly shown.

PART 2 MATERIALS

2.0 Pipe:

General: Pipe for water mains shall be Polyvinyl Chloride (PVC) or ductile iron with push on joints as specified on the plans or in the Special Provisions.

A. PVC

PVC pipe shall have bell ends with elastometric gaskets. Pipe joints shall use the Rieber joining system, which has the gasket formed into the pipe during the pipe manufacturing process. Installation procedures shall conform to AWWA C-605 Standards.

1. PVC pressure pipe, 4 inches through 12 inches, shall conform to the requirements of AWWA Specification C-900, Pressure Class 305 DR-14.
2. PVC pressure pipe, 14 inches through 36 inches, shall conform to the requirements of AWWA Specification C-905, Pressure Class 305 DR-14.

B. Ductile Iron Pipe

Ductile iron pipe shall conform to the requirements of AWWA Specifications C-150 and C-151, Pressure Class 350 unless specified otherwise on the plans or Detailed Specifications. Ductile iron pipe shall be coated on the outside with a bituminous coating 1-mil thick, minimum, and shall be cement-mortar lined in accordance with AWWA Specification C-104. Linings shall be full thickness to the end of the spigot and to the seat of the bell, or shall be tapered for a length of not more than two inches.

Rubber gasket joints for all Ductile Iron pipe shall meet the requirements of AWWA C-111. Installation procedures shall conform to AWWA C-600 Standards.

C. Water service

1. 1” diameter service pipe shall be Type “K” soft copper tubing.

   Type “K” soft copper tubing shall be US Government Type K Soft Tubing. Tubing shall be supplied in 100 ft single or double pancake coils. The minimum center coil diameter shall be 16”.

2. 1½”and 2”diameter service pipe shall tbe Polyethylene Plastic tubing.
3. Polyethylene Tubing shall conform to AWWA C901 and have a pressure class of 200 psi.
4. Water service pipe with a diameter greater than 2”
   Shall meet the above listed specifications for PVC or Ductile Iron pipe.

2.1 Fittings:

1. Water main fittings:

General:

All bolts and nuts shall be low-alloy, corrosion-resistant, high-strength steel in conformance with AWWA C111.
Fitting types applicable to this specification consist of bends, crosses, tees, reducers/increasers, plugs, caps, couplings, and sleeves.

Unless specified otherwise on the plans or Detailed Specifications the following fitting joint shall be provided:

- Fittings 8 inches and smaller shall be push-on joint.
- Fittings 10 inch and 12 inch shall be push-on joint or mechanical joint. If the fitting is going to be restrained then it shall be a mechanical joint.
- Fittings 14 inches and larger shall be mechanical joint.

Push-on joint fittings shall be furnished with restraining lugs. The lug pattern for all sizes shall accommodate gripper-type restrainers.

a. Ductile Iron water main fittings: Fittings shall be ductile-iron with 350-psi pressure rating and rubber gasket joints meeting all applicable requirements of the latest edition of AWWA C110, C111, and/or C153 Specifications. All fittings shall be coated on the outside with a bituminous coating 1-mil thick, minimum, and shall be cement-mortar lined in accordance with AWWA Specification C-104.

b. PVC water main fittings: PVC fittings may be used in-lieu of ductile iron fittings for PVC pipe installations 12 inches and smaller. PVC fittings shall meet all applicable requirements of the latest edition of AWWA C900 Pressure Class 305 and AWWA C907. The PVC fitting bell ends shall have elastometric gaskets. Installation procedures shall conform to AWWA C-605 Standards.

c. Couplings: Straight and transition couplings shall be as manufactured by Ford, Romac Industries, Inc., or approved equal and shall have ductile iron center rings and end rings meeting ASTM A536-80, Grade 65-45-12. Center rings shall be epoxy coated. Gaskets shall be SBR compounded for water service. Couplings for 12 inch and larger pipe shall be a minimum 12 inches in length.

d. Tapping Sleeves: Shall be ductile iron or stainless steel, flanged branch ends, with test plugs for pressure testing. The Sleeve shall be approved for use at pressures equaling or exceeding those of the pipe classification being installed. Ductile iron tapping sleeves shall be mechanical joint with totally confined end gaskets. Stainless steel tapping sleeves shall have a 304 stainless steel shell with SBR gaskets compounded for water service, a stainless steel flange, and shall have 304 stainless steel nuts, bolts, and washers.

2.3 Valve Boxes:

1. Gate Valves and Butterfly Valves:
   Valve Boxes shall be Tyler Union 6850/60 series 2-piece screw-type construction, or East Jordan (EJIW) Series 8550 3-piece screw type or approved equal. Drop lids shall be marked "Water" and are to be of all- metal construction.
2. Valve Box Adaptor:
   A valve box adaptor shall be installed on the valve bonnet prior to installing the valve box. The valve box adaptor eliminates shifting of the valve box, protects the coatings, centers the valve box, and seals the valve box with a resilient material. The adaptor shall be incidental to the valve box installation. The valve box adaptor shall be installed per the manufacturer's recommendations. The valve box adaptor shall be a "Valve Box Adaptor II" as manufactured by Adaptor Inc., a "Valve Box Self-Centering Alignment Ring" as manufactured by American Flow Control, or an approved equal.
3. Extension stems shall be included on any valve greater than 3' in depth.

2.4 Fire Hydrants:

A. Fire hydrants shall meet AWWA Standard C-502 and shall be Mueller Centurian, Clow Medallion, East Jordan 5CD250, American AVK Series 2700, or Waterous Pacer.

All hydrants shall be Traffic model with 6 ft. bury and 6-inches mechanical joint inlets. Hydrants shall have 5 ¼ inches minimum valve openings, having O-ring

packings and oil chamber to hold soft oil for stem thread lubrication, and shall have all operating parts, including valve seat, removable through the barrel. Barrel and upper standpipe shall be ductile iron with breaker flange and operating stem at ground level. A steel breakaway coupling shall be installed on the operating stem so that in case of breakage, no damage will result to the fire hydrant other than safety breakers.

B. All internal and external ferrous surfaces shall be coated with a minimum of 6 mils of epoxy coating and at a minimum shall meet the requirements of AWWA C550 and AWWA C116 as applicable.
C. All external ferrous surfaces below the fire hydrant ”bury line” including the fire hydrant riser (barrel) sections and adjoining 90 degree ells shall be coated with HB Fuller IF1947T Red Oxide Powder, Tnemec Series 140 Pota- Pox Epoxy, or equal meeting the requirements of AWWA C550 and AWWA C116 as applicable.
D. Additionally an exterior coating of Polyurea/Polyurethan Hybrid Resin per American AVK Company, or equal may be added to the epoxy coatings required above.
E/ All exposed nuts and bolts below the breakaway (direct bury) shall be 304 stainless steel.
F. Hydrants shall have a minimum extension adjustment capability of 10 inches, in 6 inch increments.
g. Drain valves shall be bronze and shall be positively operated by the main operating rod. All threads shall be National Standard threads. Operating nuts shall be 1 ½ inches point-to-flat, pentagon (National Standard). Valvestem for hydrant outlets shall open in a counter-clockwise direction. Fire Hydrants shall have an internal travel stop nut.

Hydrants are to have two (2), two and one-half (2 1/2) inches nozzles and one (1) four and one-half- (4 1/2) inches steamer nozzle, all with National Standard threads. The minimum distance from the hydrant breaker flange to the centerline of the lower nozzle shall be sixteen (16) inches. Caps shall be nut type and shall be provided with chains. Hydrants shall be enamel Caterpillar yellow.

All Fire Hydrants are to be ordered with barrel lengths of five (5) to eight (8) feet to facilitate their installation per the grades and lines shown on the drawings. Adjustments greater than eight (8) feet shall be accomplished using vertical bends (45, 22½, or 11¼) along the hydrant lead. The use of a Fire Hydrant Extension will not be an acceptable method of adjustment for a new Fire Hydrant. If the hydrant requires adjustment for final grade, then the Contractor shall replace the Fire Hydrant with a new Fire Hydrant with the correct barrel length or install the appropriate vertical bends on the hydrant lead.

In cases where a Fire Hydrant Extension will be installed, the Contractor shall furnish the appropriate extension.

2.5 Service Lines, Valves and Fittings:

General: All fittings used shall meet current safe drinking water guidelines for lead free fittings, solder and flux. All service lines, valves and fittings shall meet AWWA Standard C-800 (ASTM B62 and B-584, UNS No C83600-85-5-5-
5) and NSF/ ANSI 61 Annex F). Shall have a 300 psi min. working pressure. All fittings shall meet the specified manufacturer's minimum material specifications or approved equal.

1. 1 inch services
   1 inch services shall be assembled as shown on the "1 Inch Service Connection Details".

   a. Service connection: the connection to the main shall consist of using a service saddle, corporation stop and un- spliced copper tubing in order to provide water to the meter box per Lake Havasu City Standard Details.
   b. Service Termination: the service termination consists of connections made to the copper tubing that is stubbed out at the property line at the proposed meter box location. At

      the end of the tubing a 1 inch ball valve shall be placed, a short piece of 1 inch tubing (10-12 inches in length) to a service tee (if dual meters are necessary), then a ball meter valve shall be placed at each end of the tee branch. If a single service is to be installed a 1 inch angle meter stop shall be installed after the short piece of tubing.

      The one inch angle meter stop shall be a Ford BA43-342W or equal, the one inch service tee shall be a Ford T884-334-
      9 or equal, the ball meter valve shall be a B13-332W or equal and the 1 inch ball valve shall be a Ford B44-444 or equal.

2. 1 ½ and 2 inch services

   ½ inch & 2" services shall be assembled as shown on the detail named "Service Connection and Termination Details". All fittings shown shall meet the specified manufacturer's minimum material specifications or equal.

   a. Service connection: the connection to the main shall consist of using a brass saddle and corporation stop in order to provide water to the meter box. The brass saddle shall be a Ford 202B Double Band Brass Saddle or equal. The corporation stop shall be a (Ford FB-1100-6 for 1 ½ inch) (Ford FB 1100-7 for 2 inch) or equal. Polyethylene Tubing shall be used and is described in the previous section "Water Service Pipe".
   b. Service Termination: the service termination consists of connections made to the polyethylene tubing that is stubbed out at the property line at the proposed meter box location. At the end of the tubing a Pack Joint Coupling (Ford C84-66 for 1 ½ inch) (Ford C84-77 for 2 inch) or

equal shall be attached, a 1 ½ or 2 inch brass 90 degree street elbow shall then be attached, then a Ball Valve (Ford # B44-666W for 1 ½ inch) (Ford # B44-777W for 2 inch) or equal shall be attached.

3. Meter boxes

   For 1 inch service lines plastic meter boxes shall be Carson/ Brooks or equal. In Traffic areas meter boxes shall be Christy Fiberlite or equal.

   For 1 ½ inch service lines the meter box shall be a Christy Fiberlite box # FL-36T Box 12 w/ lid # FL-36D01.

   For 2 inch service lines (with no bypass) the meter box shall be a Christy Fiberlite box # FL 36T Box 18 w/ lid # FL36D01. For 2 inch service with a bypass the box shall be a NDS Pro Series Box # 126B with a Pro Series Lid with Reader Cover part # 126BCDMCIFB

4. Tapping sleeves and valves shall be used for service lines larger than 2 inches.

2.5 Concrete Thrust Blocks:

Thrust blocks shall be 4000 psi concrete as specified in Section 03300 of these specifications.

2.6 Joint Restraining Devices

1. Joint Restraint Devices at Fittings shall meet the following requirements:

   In general, solid ring restraints shall be used whenever possible. Split restraints may be used when connecting to existing systems, for special cases, and when a solid ring restraint is not available for the application. All joint restraint devices shall be epoxy coated or poly-wrapped.

   a. For DI pipe to DI push-on fittings:
      Fitting Joint Restraints shall be EBAA Series 1100HD, or equal.
   b. For DI pipe to DI MJ fittings:
      Fitting Joint Restraints shall be EBAA MEGALUG Series 1100, Series 1100SD, or equal.
   c. For PVC pipe to DI push-on fittings:
      Fitting Joint Restraints shall be EBAA Series 15PF00, or equal.
   d. For PVC pipe to DI MJ fittings:
      Fitting Joint Restraints shall be EBAA Series 2000PV, Series 2000SV, Series 15PF00, or equal.
   e. For PVC pipe to PVC push-on fittings:
      Fitting Joint Restraints shall be EBAA Series 2500, or equal.

2. Joint Restraint Devices at pipe bells shall meet the following requirements:
   In general, solid ring restraints shall be used whenever possible. Split restraints may be used when connecting to existing systems, for special cases, and when a solid ring restraint is not available for the application. All joint restraint devices shall be epoxy coated or poly-wrapped.
   a. For ductile iron pipe:
      The bell restraint shall be EBAA Series 1700, or equal.
      In lieu of bell restraint devices, push on joints with the American Fastite Joint system with Fast Grip Gasket, or equal may be used when approved by the Engineer.
   b. For PVC C-900 pipe:
      The bell restraint shall be EBAA Series 1600, or equal.
   c. For PVC C-905 pipe:
      The bell restraint shall be EBAA Series 2800, or equal.

2.7 Polyethylene Encasement:

Polyethylene Encasement (poly-wrap) shall meet AWWA C-105.

For ductile iron pipe, the encasement shall be 8-mil thickness, seamless tube, black ASTM D-1248, Type 1, Class C, Grade G-1. Joint tape for encasement shall be 3M Scotch-Wrap 50, or equal.

2.8 Combination Air Release Valves:

Air Release Valves shall be constructed in accordance with the LHC Standard Details. Air release valves shall be the size and style indicated on the drawings.

2.9 Tracer Wire System:

Tracer Wire shall be a direct bury wire that meets or exceeds the following requirements:

a. Conductor: 12 AWG 20 AMP solid strand soft drawn copper per ASTM B-3 soft annealed copper, or B-8 stranded/concentric lay 14 g (15 AMP). The breaking pounds of the wire shall be a minimum of 124 with an O.D. of 0.154". All wire shall be spark tested at 7500 VAC.
b. Insulation: Conductor shall be insulated with low density high molecular weight polyethylene insulation suitable for direct bury applications per ASTM D-1248. The minimum insulation thickness shall be 0.045". The color of the insulation shall be blue with a print line saying "WATER".
c. Splices and or Connectors: Splices and or Connectors should be capable of handling from 2 to 4 wires per connector and designated as "water- proof". PVC adhesives or sealing compounds are not acceptable.
d. Tracer Wire Access Box: Tracer wires shall be terminated using a small terminal box suitable for flush burial with a 2½ inches lockable cast iron top, integral stainless terminals and a minimum 12 in. ABS bottom section or as indicated on the plans.

e. Tracer Wire System Manufactures:

- Tracing Wire – Kris Tech Wire Co. Inc., Paige Electric Corporation, or equal.
- Splice Kit/Connectors -3M epoxy type compounds, fusible heat shrink tubing, 3M DBY connectors, or Snaploc LV 9000 direct bury wire connectors, or equals.
- Tracer Wire Access Box – Valvco Pipe Tracer Wire Terminal Box or equal.

PART 3 EXECUTION

3.1 Materials Handling and Storage:

The Contractor shall be responsible for the safe handling and storage of all materials furnished by them and shall replace, at their expense, all such materials found defective in manufacture or damaged in transportation, handling, or storage.

Pipe, fittings, and accessories shall be loaded and unloaded by lifting with hoists or skidding to avoid shock or damage. Under no circumstances shall such materials be dropped. All material shall be stored in a neat and orderly manner. Pipe shall be stored, to the greatest extent possible, in unit packages or bundles and shall be handled to prevent stress to bell joints and prevent damage to bevel ends. In addition, materials shall be handled and stored in accordance with manufactures' recommendations.

If in the opinion of the Engineer damage or defects to the factory applied external coatings on steel or ductile iron pipe and fittings (including fire hydrants) can not be repaired, the Contractor shall replace the damaged items with new materials.

If approved by the Engineer, the Contractor may make repairs when damage or defects occur in the factory applied external epoxy or "MEGABOND" coatings supplied on steel or ductile iron pipe and fittings (including fire hydrant risers and joint restraint devices). Coating repairs shall be made using a high build, low temperature applicable, fast cure, liquid epoxy coating. This epoxy coating material shall be DENSO Protal 7125 Repair Cartridge in packaged two component tubes with dispensing gun as manufactured by DENSO North America Inc.

When high ambient temperatures (i.e., > 85 degrees F) occur or when metal surface skin temperatures are high (i.e., > 100 degrees F) such that use of the DENSO Protal 7125 Repair Cartridge may be difficult due to the very short handling time of the material, an alternate coating TC 7010 FS-Gray fast setting epoxy coating as manufactured by Tapecoat Co, shall be used.

3.2 Alignment and Grade:

Pipe shall be laid true to the line and grade established on the Drawings. Where the Drawings indicate that the finished ground surface elevations are to be modified from the existing elevations by this or future construction, the

Contractor shall exercise care to ensure that pipe, and appurtenances are placed to the elevations indicated on the drawings.

3.3 Underground Obstructions:

The Contractor shall expose existing underground obstructions shown on the plans or located in the field and shall determine their elevations far enough in advance of pipe laying that the proposed water main can be installed without the use of fittings at or near the points of crossing. Wherever obstructions are encountered during the progress of the work and interfere with the proposed horizontal or vertical alignment of the pipeline, the contractor shall consult with the Engineer who may change the plans and order a deviation in the line and/or grade, or may arrange for the removal or relocation of the obstructions. The Contractor shall not deviate from plan line or grade without the Engineer's approval.

3.4 Water Main and Sewer Main/Storm Sewer Separation:

1. Vertical Separation at Crossings:
   Water mains may cross above sanitary and storm sewers with a minimum vertical distance of twenty four (24) inches between the invert of the water main and the top of the sewer. In these cases where the water main is above the sewer and there is at least 24 in. of separation, then at the crossing no extra protection is required.

   At all other crossings the sewer shall be encased in concrete a minimum of 6 inches thick per LHC standard details.
2. Water Main and Sewer Main/Storm Sewer Horizontal Separation:

   Water mains shall be constructed with a minimum of 6 feet of horizontal separation from any existing sanitary or storm sewer or proposed sanitary or storm sewer. The 6 feet horizontal separation shall be the clear distance (water pipe sidewall to sewer pipe sidewall) and not the centerline distance between the utilities.
3. Unusual Conditions:

   Where conditions prevent a minimum horizontal and vertical separation as set forth above, both water and sewer shall be protected 10’ in both directions. Where a water main must cross under a sewer, a vertical separation of at least 18 inches between the bottom of the sewer and the top of the water main shall be maintained, under all conditions, with adequate support provided for the sewer lines to prevent them from settling on and breaking the water main.

4. 4/Sewer Manholes:

   No water pipe shall pass through, or come in contact with any part of the sewer manhole.

3.5 Installation:

1. Trenching shall comply with the requirements of Section 02300 Trench Excavation and Backfill.
2. Minimum Cover depth from top of pipe to finished grade shall be 3 ft.
3. Cleaning shall be done as necessary so that the interior of all water pipe and fittings are free from all dirt, cement, or other foreign material before installation. Contact surfaces shall be wire brushed immediately prior to jointing.
4. Pipe Cutting shall be done without damage to the pipe with saw or abrasive wheel and shall be smooth, straight, and at right angles to the pipe axis. Ends of pipe shall be dressed and beveled to remove roughness and sharp corners.
5. Laying and Joining of PVC pipe shall be in accordance with AWWA C-900, AWWA C905, and AWWA C605, and with the pipe manufacturer's instructions. Laying and joining of ductile iron pipe shall be in accordance with AWWA C-600, Installation of Ductile-Iron Water Mains and their Appurtenances, and with the pipe manufacturer's instructions, unless specifically required otherwise by these Specifications. All Ductile Iron Water Mains shall be constructed with a Polyethylene Encasement tube as specified herein. The polyethylene encasement tube shall be secured circumferentially at 2 feet horizontal intervals with tape during installation.

   Pipe shall be laid with bell ends facing in the direction of laying. Each pipe length shall be inspected for defects prior to being lowered into the trench. All pipe and fittings shall be carefully lowered into the trench piece by piece by means of pipe slings to prevent damage to the pipe and/or coating. Full lengths of pipe shall be installed except where connecting to appurtenances and fittings. The Contractor shall leave an appurtenance or fitting with a full length of pipe whenever possible.

   During construction, prior to filling and testing, no water shall be allowed to run into or through the pipe.

   During the course of construction, a suitable stopper shall be kept in the end of the pipe so as to prevent any dirt and or water from entering during the progress of the work at all times. Any dirt, loose material or cement mortar, which may accumulate in the pipe, shall be removed prior to installation.

   a. Push-on Joints: The spigot end of field cut piping shall be cut square and then beveled. Joint surfaces shall be cleaned and lubricated immediately before completing the joint.

   b. Mechanical Joints: Joints shall not be over-tightened; if an effective seal is not obtained the joint shall be disassembled, cleaned thoroughly and reassembled. Where joint restraint devices are used with a mechanical joint, the holes shall be carefully aligned to permit installation of harness bolts. At mechanical

joints, a beveled PVC spigot may not be used. Rather a non-beveled spigot shall be used for insertion into mechanical joint.

6. Protection of the Work: Once in place, the pipe shall have its open end plugged to prevent soil, water, or other matter from entering the pipe.
7. Pipe Deflection: Deflection or bending of the pipe or deflection of the pipe joint (bell and spigot) shall not be permitted except as approved by the Engineer.
8. Fittings: Bends and tees shall be placed on a stable foundation, which may require the use of concrete pads of equal size or larger than specified for valves. Fittings may require thrust blocks and/or joint restraining devices. All fittings not epoxy-coated shall be poly-wrapped.
9. Couplings: Couplings shall be placed on a stable foundation and shall be wrapped in polyethylene encasement as specified herein. Couplings shall be approved by the pipe manufacturer for the use with the pipe and shall be installed according to the coupling manufacturer's recommendations.
10. Thrust Blocks: concrete thrust blocks may be required in lieu of restraints as approved by the Engineer at tees, crosses, horizontal bends, plugs, caps, fire hydrants, and similar locations as indicated. Refer to the subsection "Joint Restraining Device Installations" for situations and fittings that require the use of joint restraints in-lieu of concrete thrust blocks.

    Concrete thrust blocks shall have a thickness at the fitting equal to at least half the diameter of the pipe being installed but shall not be less than six (6) inches thick under any circumstances. They shall extend from the fitting to the undisturbed wall of the excavation. The Contractor shall insure that the concrete does not cover or render inoperable nuts or bolts on the fittings. All metal fittings, valves, or appurtenances shall be wrapped in polyethylene prior to pouring thrust blocks.

    Concrete Thrust blocks shall be allowed to cure for 48 hours prior to activating the water main. If the water main needs to be activated prior to the concrete curing (48 hours) then the water main shall be restrained using joint restraining devices. Prior to backfilling, thrust blocks shall cure for a minimum of four hours.

    Thrust Blocks shall be installed as shown on the drawings and shall meet or exceed the minimum volume or bearing area requirements as specified on the drawings or specifications for the water pressures and soil conditions.

    In muck, peat, or similar weak soils, thrust loads shall be resisted by using joint restraining devices or by removal of the soil and replacement with a material of sufficient stability to resist thrust loads as determined by the Engineer.

    Where prior approval of the Engineer is obtained, the Contractor may be able to substitute acceptable joint restraining devices for concrete thrust blocking. A condition of approval will be to address the potential corrosion issues associated with the use of joint restraints. The approval to substitute joint restraints is the Engineer's decision and approval may or may not necessarily be granted even if the potential corrosion issues are addressed.

11. Joint Restraining Device Installations: Joint Restraining Devices are required for the following installations: Refer to the plans for the definition of "L" length for Joint restraining devices.
    a. All Valves 12 inches and larger and pipe joints within their corresponding "L" lengths shall be restrained.
    b. All High Pressure Valves (working pressures greater than 110 psi) and pipe joints within their corresponding "L" lengths shall be restrained.
    c. All Reducers/Increasers and their corresponding "L" lengths shall be restrained.
    d. All Vertical Bends and pipe joints within their corresponding "L" lengths shall be restrained.
    e. All Water Main Lowering and pipe joints shall be restrained. Water Main Lowering restraint shall include restraining all joints within the fitting's corresponding "L" length plus restraining all pipe joints which lie between the start of the lowering and the end of the lowering, regardless whether or not the pipe joint is located within the fitting's "L" length.

    All Joint Restraint Devices shall be double poly wrapped and taped per the specifications for polyethylene encasement. If cathodic protection anodes are used, double poly wrap shall not be required. The polyethylene encasement ends shall be taped around the entire pipe diameter.

    Joint Restraining Devices shall be installed per the manufactures' recommendations and for the appropriate water pressures and soil conditions as shown on the drawings or specifications.

12. Tracer Wire: Tracer wire shall be installed along with all water pipes as described below:

    The tracer wire shall be extended along with the water main. The wire shall be installed along the top of the pipe and shall be securely anchored to the pipe every 4 feet horizontally with an adhesive tape. The tracer wire shall be extended along all water main branches and hydrant leads as well. At fire hydrant leads two (2) tracer wires (the upstream tracer wire and the downstream tracer wire) shall be brought along the lead and brought to the surface at the fire hydrant. The upstream and downstream tracer wire at fire hydrants shall not be tied together as this is intended to allow independent tracing of the downstream and upstream main.

    Tracer wire shall not be installed with copper water service lines.

    Tracer wire shall be installed with PVC water services. Tracer wire installed with PVC service lines shall be installed in accordance with water main requirements except that the tracer wire shall be brought to the surface at a service line valve location. Do not connect the water service tracer wire to the tracer wire on the main. Tracer wire installed along service lines shall be independent of the

tracer wire installed along the main. This allows for only tracing the service line.At locations where the PVC water service is not being replaced entirely, the contractor shall splice the new tracer wire to the existing tracer wire at the point of reconnection. In instances where a PVC water service is not being replaced entirely and an existing tracer wire is not encountered, the Contractor shall coil approximately five (5) feet of wire at the reconnection location(s) to facilitate a future splice.

All tracer wire connections shall be accomplished through the use of "pig- tails". All splices and "pig-tails" shall be accomplished by stripping the wires to be connected, twisting the wires together, securing the connection by using an appropriately sized wire nut, and then preserving the splice or "pig-tail by using a direct bury splice kit.

The main line tracer wire shall run continuous along the main(s) from fire hydrant to fire hydrant but shall not be continuous at fire hydrants. At fire hydrants two tracer wires shall be installed, one wire is the main line wire from downstream of the fire hydrant and the second wire is the main line wire going upstream of the fire hydrant. The main line tracer wire shall not be interconnected at the fire hydrant or at the main. This is intended to allow independent tracing of the downstream main from the upstream main and vise a versa. Service line tracer wire shall not be connected to the main line tracer wire.

As a condition of project acceptance, Water Division personnel shall be able to successfully electronically trace all newly installed tracer wire/water mains. Utility maintenance personnel should be able to connect to tracing wires at every Fire Hydrant location and energize all water mains between that fire hydrant and the surrounding fire hydrants. The contractor is responsible for coordinating conductivity testing with Water Division personnel prior to finish surfacing activities. If the tracer wire does not function as intended, the contractor shall repair the system to the satisfaction of the Engineer.
The Engineer shall inspect all underground splices and "pig tails" prior to backfilling.

13. Fire Hydrants and Auxiliary Valves: Fire Hydrants shall stand plumb and shall have their nozzles parallel with or at right angles to the street, with the pumper nozzle facing the street. At intersections, the pumper nozzle shall face the higher classification street. Hydrants shall be set with the bottom of the breaker flange 2 inches above the finished ground elevation as shown on the Standard Details, resulting in the centerline of the lowest nozzle being at least 18 inches above finished grade. In no case shall hydrants be set closer than 4 feet from curb or edge of pavement; measured from outside of hydrant barrel to back of curb or edge of pavement.

    The Contractor shall set each fire hydrant on a 8 inch x 12 inch precast concrete pad with a 4 inch thickness and shall place a minimum of 1/3 cubic yard of Aggregate Base around the lower part of the hydrant to at least six (6) in. above the drain port to provide a drainage area for the hydrant barrel. The Contractor

shall insure that the drain port at the base of the hydrant is open to allow for the hydrant to drain properly when closed. Cast in place concrete may be used in lieu of the pre-cast pad if the hydrant lead is not charged for at least 48 hours and the drainage ports are maintained.

The hydrant barrel shall be poly wrapped to the ground surface and the poly wrap shall not cover up the weep holes.

A thrust block shall be installed between the hydrant valve chamber and the undisturbed trench wall. The thrust block shall meet the thrust block specifications herein.

An auxiliary valve matching the size of the fire hydrant lead and a valve box shall be installed on the fire hydrant lead. Auxiliary valves shall be installed as shown on the standard detail and shall be placed on a precast concrete block, or shall be fitted with a joint restraining device as approved by the Engineer. Cast in place concrete may be used in lieu of the pre-cast block if the hydrant and hydrant lead are not charged for 48 hours, and 4 hours cure time is allowed before backfilling.

Tracer wire shall be attached to the fire hydrant barrel section prior to backfill per LHC Standard Details.

14. Valves: Valve interiors and adjacent piping shall be cleaned of foreign material prior to making valve to pipe connection. Pipe/valve joints shall be straight and without deflection. All valves shall be encased in polyethylene per AWWA Standard C105 and as specified herein. Valves shall be placed and centered on a precast concrete anchor block. The trench surrounding valves shall be backfilled with Bedding Sand to one (1) foot above the valve. The Contractor shall check all operating mechanisms for proper functioning; valves which do not operate easily or are otherwise defective, shall be replaced by the Contractor at their expense.

    Valves placed on dead-ends of mains with less than the required "L" length of pipe extending beyond the valve shall be restrained using the appropriate "joint restraining devices".

15. Valve Boxes: Valve boxes shall be installed straight and plumb directly over the valve stem and shall not be placed in direct contact with the valve. The top of the valve box shall be placed flush to ¼ inch below flush with the surfacing in paved or graveled areas and 1 inch - 2 inches above finished grade in non-paved surfaced areas. Where the Drawings indicate that the future grade at the valve location will be higher or lower than the existing grade at the time of valve installation, the Contractor shall provide the correct combination of extension pieces so that the valve box can be adjusted to the future finished grade without replacing the valve box.

    A Valve Box Adaptor shall be installed on the valve bonnet prior to installing the valve box.
    When shown on the drawings or specified, tracer wire shall be secured to the valve box section prior to backfill.

16. Tapping Tees for taps 4 inches and larger: Where new 4 inch or larger service

lines or mains are to be connected to an existing main, the Contractor shall furnish all material necessary for connection to the water main, as specified herein. The tapping tee shall be assembled in accordance with the manufacturer's instructions. Tapping sleeves shall be supported independently from the pipe prior to tapping and shall be provided with thrust restraint as specified for other fittings. All tapping tees shall be poly wrapped.

17. Polyethylene Encasement: All buried metallic items including fittings, service lines, valves, valve boxes, fire hydrants, pipe, and accessories, shall be encased in 8-mil thickness sheet polyethylene per AWWA Standard C105. The polyethylene sheet shall be installed per AWWA C105 and taped using 3M Scotchwrap 50 or equal. The polyethylene shall fully encase the fitting and appurtenances. Excess material shall be neatly trimmed away and all seams shall be tapped. The transition between Ductile Iron and PVC shall be accomplished by sealing the ends of the polyethylene sheet and taping the material fully around the circumference of the pipe twice.
    Polyethylene encasement shall NOT be used when the metallic piping is cathodically protected by the use of an anode.
18. Dewatering: If necessary, dewatering shall be accomplished as identified in the special provisions.

3.6 Disinfection:

1. General:
    Disinfection shall comply with the requirements of AWWA Standard C651, C605, C600, and ADEQ Engineering Bulletin #8. All new water mains and appurtenances shall be disinfected before they are placed into service. All water mains taken out of service for inspecting, repairing, or other activity that might lead to contamination shall be disinfected before they are returned to service.
2. Preventative Methods:
    The Contractor shall take precautions to protect the interiors of pipes, fittings, and valves against contamination. Pipe delivered for construction shall be strung so as to minimize the entrance of foreign material.
    If dirt enters the pipe, it shall be removed and the interior of the pipe surface swabbed with a 1%-5% hypochlorite disinfecting solution. If, in the opinion of the Engineer, the dirt remaining in the pipe will not be removed by flushing, the Contractor shall clean the interior of the pipe by mechanical means, such as a hydraulically propelled foam pig. Following mechanical cleaning the Contractor shall flush the line achieving minimum flushing velocities of at least 30 ft/s and shall then disinfect the pipe using either the continuous-feed or the slug method. Flushing a completed main will not be allowed as a method of cleaning sediment allowed to enter the pipe during construction.
    All openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped for any length of time. If water accumulates in the trench, the plugs shall remain in place until the trench is dry. If, for any reason, the water main is flooded during construction, it shall be cleared of the floodwater by draining and flushing with potable water until the main is clean. The section exposed to floodwater shall then be filled with chlorinated potable water that, at

the end of a 24-hour holding period, will have a free chlorine residual of not less than 25 mg/l. The chlorinated water shall then be flushed from the main and after construction is completed, the main shall be disinfected using the continuous-feed or slug method.

3. Disinfectant:
   Unless specified otherwise in the Detailed Specifications or on the Drawings, or required by other provisions of this specification, disinfection shall be accomplished by the tablet method. The Contractor shall obtain the Engineer's approval prior to using a method other than the tablet method.

   This method requires that the pipes and appurtenances be kept clean and dry. This method may not be used if the pipes and appurtenances are not kept clean and dry and in the event this happens, the Engineer must be contacted.

   Tablets shall be 5-gram calcium hypochlorite tablets conforming to AWWA Standard B300 and shall contain between 65 and 70 per cent available chlorine. Tablets shall be fresh and shall be stored in a cool, dry, and dark environment to prevent loss of strength, which occurs upon exposure to the atmosphere.

   Do not use calcium hypochlorite intended for swimming pool disinfection, as this material has been sequestered and is extremely difficult to eliminate from the pipe after the desired contact time has been achieved.

4. Dosage:
   Unless otherwise specified, the Contractor shall place hypochlorite tablets in each section of water pipe installed, including the hydrant branch, according to the Table 1 below.

Table 1

NUMBER OF 5-GRAM CALCIUM HYPOCHLORITE TABLETS REQUIRED

(25 mg/l Dose)

Length of Pipe Section (Ft.)	4	6	8	10	12	16
13 or less	1	1	1	2	3	4
13 - 18	1	1	2	3	4	6
18 - 20	1	1	2	3	4	7
20 - 30	1	2	3	4	6	10
30 - 40	1	2	4	5	7	13

For Pipes 18 inches and larger refer to drawings or detailed specifications for disinfection requirements. The Engineer of Record is responsible for establishing the disinfection requirements for pipes 18 inches and larger.

5. Placing Tablets:

Tablets shall be adhered to the inside top section of each pipe length using a food-grade adhesive, such as Permatex Form-A-Gasket No. 2 or Permatex Clear RTV Silicon Adhesive Sealant as manufactured by Loctite Corporation. Adhesives shall meet the requirements of a food-grade adhesive per either NSF/ANSI 51-2005: Food Equipment Materials or NSF/ANSI 61-2005: Drinking Water System Components – Health Effects. NSF/ANSI 61 lists several adhesives that are approved for drinking water contact. It is recommended to use an adhesive that sets quickly and isn't reactive with the water main's composition or with the disinfectant tablet. There shall be no adhesive on the tablet except on the broad side attached to the surface of the pipe. If the tablets are attached before the pipe section is placed in the trench, their position shall be marked on the pipe section to indicate the pipe has been installed with the tablets at the top.

6. Filling and Contact:

   The water main shall be filled slowly so that the water velocity is no greater than one foot per second. Precautions shall be taken to assure that air pockets are eliminated. The water shall be allowed to stand in the pipe for at least 24 hours. Valves shall be positioned so that the strong chlorine solution in the treated main will not flow into water mains in active service. The chlorinated water shall remain in the pipe for at least 24 hours. The Contractor shall notify the Engineer at the end of the 24- hour retention period prior to flushing to allow the Engineer to check the chlorine residual in the pipe. If the chlorine residual is less than 25 mg/l, the Contractor shall, at his expense, disinfect the water main again by the continuous-feed method or the slug method, as approved by the Engineer.

7. Flushing:

   Within 48 hours of the end of the 24-hour retention period, the Contractor shall flush the heavily-chlorinated water from the main until the chlorine concentration in the water leaving the main is no higher than that prevailing in the system or is less than 1 ppm as determined by the Engineer. In addition to the above requirements, a minimum flushing velocity of 3 feet per second and flushing duration of one minute per 100 feet of pipe being flushed shall be achieved per Table 2.

   Flushing shall be done in accordance with AWWA C651. Flushing shall be accomplished through use of hydrants or temporary fittings installed for the purpose; flushing through corporation stops and/or water service lines is prohibited. The Contractor shall obtain the Engineer's approval prior to installing special fittings for flushing.

   Flushing shall be conducted in such a way as to prevent contamination of existing water mains and/or water service lines and to minimize traffic and pedestrian hazards and nuisance conditions. When possible, flushing shall be to the nearest storm sewer or drainage way. Flushing to the sanitary sewer is prohibited.

   The Contractor will be responsible for any damage to fish and/or aquatic life caused by the chlorine residual. If Chlorine reaches or is detected in a stream, river, or other waterway the Contractor will be in violation for that discharge. For more information, contact ADEQ (602) 771-2300. Refer to section below, “Disposal of Chlorinated Water” for additional information regarding neutralizing chlorine residual.

Table 2

REQUIRED FLOW AND MINIMUM FLOW DURATION TO FLUSH PIPELINES

Pipe Diameter	Flow required to produce 2.5 fps Velocity in Main*	Fire Hydrants		Minimum Flushing Duration
(In.)	Gpm	Number of Fire Hydrants	Outlet Size (In.)	(minutes per 100 feet of pipe)
4	100	1	2-1/2	1
6	200	1	2-1/2	1
8	400	1	2-1/2	1
10	600	1	2-1/2	1
12	900	2	2-1/2	1**
16	1600	2	2-1/2	1**

Table 2 shows the rates of flow required to produce a velocity of 3.0 fps in pipes of various sizes and the minimum flushing duration per 100 feet of pipe length

For pipes 18 inches and larger refer to drawings or detailed specifications for flushing requirements.

* Requires a minimum 40-psi pressure in the main and the hydrant flowing to atmosphere.

** Assumes that the corresponding flow rate is being met.

After the water lines have been flushed, the contractor shall sample the lines. Two consecutive samples of water from the end of the disinfected/flushed line must be collected at least 24 hours apart.

8. Bacteria Testing:

Per AWWA C651, the Contractor shall coordinate with Engineering to schedule sampling for coliform bacteria contamination. The samples must show the absence of coliform bacteria contamination before any taps may be made to the main or the main is activated and placed into service. Copies of all sample results shall be submitted to the Engineer within 48 hours of receipt thereof.

9. Disposal of Chlorinated Water:

   When, in the opinion of the Engineer or Contractor, the potential exists for chlorinated water to reach a stream, river, or waterway, the Contractor shall apply a neutralizing chemical to the water to be wasted to neutralize thoroughly the chlorine residual remaining in the water as listed in Appendix B of AWWA Standard C651. The Contractor will be responsible for any damage to fish and/or aquatic life caused by the chlorine residual. If Chlorine reaches or is detected in a stream, river, or other waterway the Contractor will be in violation for that discharge. For more information, contact ADEQ (602) 771-2300

3.7 Pressure and Leakage Test for Mains and service lines 4 inches or larger:

1. General:
   Pressure and leakage tests shall be performed on all newly installed water mains. The "Simultaneous Pressure and Leakage Tests" will be used unless otherwise specified. The testing methods specified in this section are specific for water pressure testing only; air pressure testing is prohibited due to the catastrophic nature of potential failure.
2. Test Restrictions:
   Per AWWA C605 the pressure shall be a minimum of 150% of the working pressure at the point of test, but not less than 125% (or 150 psi, whichever is greater) of normal working pressure at the highest elevation, whichever is greater. Test pressure shall not exceed pipe, valve, or thrust-restraint design pressures and shall not vary by more than 5 percent (plus or minus) for the duration of the test. The duration of the hydrostatic test shall be a minimum of two (2) hours.

   The Contractor shall anticipate the need to conduct multiple tests in areas of varying topography and shall conduct testing in such a manner and sequence that the pressure requirements indicated above are achieved.
3. Pressurization:
   Before applying the specified test pressure, each valved section of pipe to be tested shall be slowly filled with potable water and all air expelled from the pipe, valves, fittings, and hydrants. Where City water is not available, the Contractor shall furnish sufficient potable water to fill and test the pipe. The specified test pressure, based on the elevation of the lowest point of the section under test and corrected to the elevation of the test gauge, shall then be applied by means of a suitable pump connected to the pipe in a manner satisfactory to the Engineer and shall be sustained for the specified time.

   The test pump shall be equipped with two (2) accurate pressure gauges, between the pump shut-off valve and water main being tested, both to show the line pressure reading during testing. Pressure gauges shall have graduation marks, at minimum, for every 2 psi, and be capable of interpreting pressure readings within 1 psi. The pressure reading deviation between the two pressure gauges shall not be greater than 2.0 psi. During the pressure test the pressure loss indicated between the two gauges shall not deviate more than 0.5 psi between the two gauges.

4. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within five (5) psi of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by the drop in pressure for a test section over a period of time.

5. Allowable Leakage for PVC Pipe and Ductile Iron Pipe:
   The PVC pipe shall be pressure and leakage tested in accordance with AWWA C605. The Ductile Iron pipe shall be pressure and leakage tested in accordance with AWWA C600.

   No pipe installation, PVC pipe or ductile iron pipe will be accepted if the leakage is greater than that indicated in Table 3.

Table 3
ALLOWABLE LEAKAGE IN GALLONS
PER HOUR PER 1000 FT OF PIPE (GPH)

Pipe.	Average Test Pressure (PSI)					
Dia. (in.)	50 psi (gph)	100 psi (gph)	150 psi (gph)	200 psi (gph)	250 psi (gph)	300 psi (gph)
4	0.19	0.27	0.33	0.38	0.43	0.47
6	0.29	0.41	0.50	0.57	0.64	0.70
8	0.38	0.54	0.66	0.76	0.85	0.94
10	0.48	0.68	0.83	0.96	1.07	1.17
12	0.57	0.81	0.99	1.15	1.28	1.40
14	0.67	0.95	1.16	1.34	1.50	1.64
16	0.76	1.08	1.32	1.53	1.71	1.87
18	0.86	1.22	1.49	1.72	1.92	2.11
20	0.96	1.35	1.66	1.91	2.14	2.34
24	1.15	1.62	1.99	2.29	2.56	2.81
30	1.43	2.03	2.48	2.87	3.21	3.51
36	1.72	2.43	2.98	3.44	3.85	4.21

The above table is based on the equation $L = SD(P).5 /148,000$ where
L= allowable make up water in gallons
D= nominal diameter of pipe in inches
P= average mainline test pressure (lb/ sq in) during mainline hydrostatic test S= length of pipe tested

6. Acceptance shall be determined on the basis of allowable leakage. If any test of installed pipe discloses leakage greater than that specified in Table 3, the Contractor shall, at his own expense, locate and make approved repairs as necessary until the leakage is within the specified allowance. All visible leaks shall be repaired, regardless of the amount of leakage.

   Any damaged or defective pipe, or appurtenances discovered following the pressure test shall be repaired or replaced with approved material at the Contractor's expense, and the test shall be repeated until it is within the specified allowance.

   Example - A pipe segment is required to be tested at 140 psi. At the start of the test, pressure gauge #1 indicates an initial pressure of 141 psi and pressure gauge #2 indicates an initial pressure of 143 psi. Both gauges are recording the test pressure within 2 psi and therefore

   the test may proceed. After completing the two-hour test duration, pressure gauge #1 indicates a pressure of 134 psi and pressure gauge #2 indicates a pressure of 136.5 psi. The pressure drop for pressure gauge #1 is 7 psi and the drop for pressure gauge #2 is 6.5 psi. The two gauges record a pressure drop within 0.5 psi of each other therefore the deviation of the pressure reading between the two gauges is acceptable.

   If the pressure test had indicated a pressure loss of less than 5 psi then the "Pressure and Leakage Test" would have been considered as passing. Because in this example, the pressure loss is more than 5 psi, the Contractor may elect to re-pressurize the system and repeat the two-hour test or the Contractor may elect to measure the quantity of water required to pressurize the pipe segment so that the pressure loss is less than 5 psi. For this example if the quantity of water required to pressurize the pipe segment so that pressure gauge #1 indicates a pressure of 137 psi (loss of 4 psi) and pressure gauge #2 indicates a pressure of 137.5 psi (loss of 4.5 psi), is within the quantity of water allowed per Table 3 then the test would be considered as passing without having to repeat pressure test for two-hours.

3.8 Water Main Closures and Temporary Service:

1. Water Main Closures shall be scheduled to minimize the inconvenience to the public. Consequently, water main closures shall be scheduled, between 9:00 A.M. and 4:00 P.M. Monday through Friday, when possible. Water main closures scheduled to begin prior to or continue beyond those times listed above, will require approval from the Engineer. In any case, water main closures will not be allowed until the Engineer gives his approval.

   The Contractor shall provide notification of a proposed closure to the Water Division and any affected residents at least 48 hours prior to closure of any water main, unless a shorter time of notice is approved by the Engineer.

2. Operation of Valves: Only City personnel shall operate valves on existing water mains. The Contractor may operate valves on newly installed water mains that are under his control or closed valves with permission from Water Division.

3 Temporary water service for private residences affected shall be provided by the Contractor when the water main closure will exceed eight (8) hours. The Contractor shall provide temporary water service for businesses upon request, regardless of the length of closure. When temporary service is to be provided to businesses, the Contractor shall obtain the name and phone number of a responsible contact person at each affected business and submit the information to the Engineer at least 48 hours prior to closure.

3.9 Abandonment and/or Salvage of Water Main and Appurtenances:

1. Water Mains:
   The Contractor shall seal all open ends of water mains to be abandoned with a concrete plug having a length equal to the diameter of the pipe being plugged.
2. Fire Hydrants:
   Fire hydrants and auxiliary valves are to be removed and salvaged, unless indicated otherwise on the drawings or Detailed Specifications, and shall be delivered by the Contractor to the City Utility Maintenance Shop in good working condition. Any damage to the hydrant and/or appurtenances as a result of removing, salvaging, and delivering, shall be repaired by the Contractor at no cost to the City.
3. Valves:

   Unless indicated otherwise on the drawings or Detailed Specifications, valves are to be removed, salvaged, and delivered by the Contractor to the City Utility Maintenance Shop without further damage.
4. Valve Boxes:

   The Contractor shall close the valve, remove and salvage the top sections of those water main valve boxes marked on the plans to be abandoned and shall deliver them to the City Utility Maintenance Shop. The resulting holes shall be backfilled and compacted to meet the requirements of these specifications and shall be resurfaced with the appropriate material; i.e. seed, gravel, asphalt, concrete, etc.
5. Others:
   When the drawings indicate items are to be removed or salvaged, the Contractor shall deliver the items to the City Utility Maintenance Shop in good working condition. Any damage to the items as a result ofremoving, salvaging, and delivering, shall be repaired by the Contractor at no cost to the City.

   Unless an item is indicated as salvaged, the item will be considered a Contractor obligation to remove and dispose of.

3.10 Service Lines and Fittings:

1. Service pipe: Copper pipe shall be laid with sufficient waving as to prevent rupture in settlement. A "goose-neck" shape shall be constructed in the copper pipe leading from the corporation stop. Polyethylene, PVC and ductile iron service pipe shall be laid as specified herein for water mains. Minimum cover depth for water service lines shall be four (4) feet. A minimum six (6) foot horizontal separation (outside diameter to outside diameter) shall be maintained between water service and sewer service lines. Tracer Wire shall be installed along with all Polyethylene and PVC service lines, as described in the specification section relating to tracer wire. Tracer Wire shall not be installed with copper service lines.
2. Service saddles shall be installed for all connections to water mains 2 inch and smaller. Unless specified otherwise on the Drawings or Detailed Specifications, the Contractor shall furnish and install all service saddles.
3. Corporation stops shall be provided by the Contractor. Corporation stops that are used to connect metal water services to metallic water mains shall be the isolator style. If a Contractor is installing a copper water service on private property but is not replacing the service to the main and the copper water service connects to a metallic water main then an insulating union for copper water services shall be installed near the curb stop or at the location where the new copper connects to the existing copper. This is only required for copper water services connecting to metallic mains.
4. Service lines larger than 2 inches diameter shall be connected to the main with either an appropriately sized tapping sleeve and valve or a ductile iron tee as specified for water main fittings elsewhere in these specifications.
5. Meter boxes *shall be installed on all service lines and shall be located entirely within the public Right of Way*. The top of the box shall be placed flush to ¼ inch below flush with the surfacing in paved or graveled areas and 1 - 2 inches above finished grade in non-traffic areas.
6. Water Services: Where service lines are to be installed for undeveloped property or future buildings or additional services added to an existing building, the Contractor shall furnish all materials necessary for connection of new service lines to the water main.

   The termination point shall be at a meter box.

7. Water Service Reconnections: The Contractor shall furnish all materials necessary for reconnecting service lines existing prior to construction of a water main. On City projects, all permits and tapping fees will be waived.
8. Inspection: All water service installations shall be inspected by the City prior to the Contractor backfilling the trench. The Contractor shall notify the City a minimum of four (4) hours prior to the time he needs the inspection. Any trench backfilled without being inspected and approved by authorized City personnel shall be re-excavated by the Contractor to expose the work for the required inspection. Discrepancies shall be corrected by the Contractor and re-inspected by City personnel.

3.11 Acceptance of Meter Valves and Main Valves:

As a condition for project acceptance, all meter valves and water main valves within the project boundaries shall be in proper operating condition. City personnel will inspect and operate each valve as part of the final inspection. The Contractor shall correct any deficiencies discovered during the inspection

PART 4 Measurement & Payment

A. Water Main and Service Line Pipe:
Installed pipe quantities shall be determined by measuring from centerline to centerline of all pipe and fittings. Measurements shall be to the nearest whole linear foot.

B. Water Main Fittings and Couplings:
Fittings furnished and installed shall be counted on a per each basis unless otherwise specified by contract. Measurement for concrete thrust blocks, cable and rods, and other thrust restraint will not be made; such work shall be incidental to the respective work item.

C. Valves:

Valves shall be counted on a per each basis. Valve boxes shall be included with the valves as a complete unit.

D. Fire Hydrant Assembly:
Fire Hydrant Assemblies will be counted on a per each basis. Hydrant, auxiliary valve, valve box and pipe between the auxiliary valve and hydrant shall be included with the assembly as a complete unit; no separate measurement and payment will be made for pipe between the auxiliary valve and the hydrant or for auxiliary valves and boxes.

E. Fire Hydrant Lead:
The water main pipe for the hydrant lead (branch) from the main to the Auxiliary Valve shall be paid for at the unit price bid for the appropriate size pipe.

F. Fire Hydrant Extensions:
Fire hydrant extensions are not allowed. Contractor shall verify grade prior to installation.

G. Water Service Reconnection:
Water service reconnections and new water service connections will be counted on a per each basis.

H. New Water Service Connections:
Water service consists of service saddle, corp stop, copper tubing, ball valve and meter box, counted on a per each basis.Meter Boxes & Service Termination Fittings Installed, Adjusted or Abandoned:

Meter Boxes & Service Termination fittings furnished and installed, adjusted, or abandoned will be counted on a per each basis.

I. Water Main Encasement:

Measurement for water main encasement will be made on a per each basis, furnished and

installed, for each encased crossing with lengths as noted on the Drawings.

J. Polyethylene Encasement:
No separate measurement will be made for polyethylene encasement such work will be incidental to the pipe and fittings.

K. Water Air Release or Blow Off Valves:
Valve assembly per standard detail, furnished and installed, will be counted on a per each basis.

L. Tapping Tee (Includes sleeve and valve):
Tapping tees furnished and installed will be counted on a per each basis unless otherwise specified.

M. Tracer Wire
Tracer wire access boxes and all accessory items necessary for the installation of tracer wire shall be considered as incidental to the pipe installed.

N. Water Main Lowering:
Water main lowerings including, all materials, restraints, and Flowable Fill for the complete installation shall be included in the bid item for water main lowering. Water main lowerings shall be counted on a per each basis.

O. Abandon valve:
Abandon valve shall be incidental.

P. Adjust Valve Box:
Adjust valve box shall be incidental.

Q. New Water Main Connections:

New water main connections shall be counted on a per each basis. The bid item, New Water Main Connections, is intended for use where a tapping tee cannot be used and where an in-line tee must be cut into an existing main or where a cap/plug with thrust block must be removed prior to connecting.

R. Measurement and payment will be made in accordance with Section 01210 - Measurement and Payment.

END OF SECTION

SECTION 2600

SUBGRADE PREPARATION

PART 1 - GENERAL

1.1 Description

A. Description of the Work

The work to be performed in accordance with this section includes the preparation of native or excavated soils prior to the placement of subbase, base course, pavement, curb, gutter, driveways, sidewalks or other structures.

The work shall include the furnishing of all labor, tools, equipment, materials and performing all required operations to provide a complete item in accordance with the project plans and these specifications.

B. Related Work Specified Elsewhere

Clearing and Grubbing	Section 2100
Earthwork	Section 2200
Trench Excavation and Backfill	Section 2300

1.2 Quality Assurance

A. Reference Test Standards and Specifications

ASTM D1556, Density of Soil in Place by the Sand-Cone Method.

ASTM 1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

ASTM D6938-08a, Density of Soil and Soil-Aggregate in Place by Nuclear Methods.

ASTM D6938-08a, Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods.

Rock Correction Procedure for Maximum Density Determination, ARIZ 227.

B. Frequency of Testing

1. Maximum Dry Density and Optimum Moisture Content, ASTM D1557.
   a. One test for each different class or type of material shall be provided by the prior to beginning construction.
   b. CONTRACTOR shall provide additional test when previous test is suspect, due to subtle changes in the material, as determined by the OWNER.

2. Density of In-Place Soil by the Sand Cone or by Nuclear Methods, ASTM D1556 or D6938-08a
   a. CONTRACTOR will perform a minimum of one test per lift per 2,000 square yard per type of material.
   b. CONTRACTOR will perform additional test as required to ensure proper compaction.

C. Testing Tolerances
1. Percent Relative Compaction
   Not less than as specified on plans or in these specifications.
2. In-Place Moisture Content
   As required to achieve minimum relative compaction.
3. Soft or Yielding Surfaces
   Regardless of the percent compaction obtained by test, areas which are soft and yield under the load of construction equipment are to be removed and replaced at no additional cost.

1.3 Submittals

A. Materials Test Report
1. Report on maximum dry density and optimum moisture content prior to beginning of construction.

1.4 Job Conditions

A. Soils Report
This section does not apply to this project.

PART 2 - MATERIALS

2.1 General

A. Unsuitable materials not to be incorporated in the work.
1. Organic matter such as peat, mulch, organic silt or sod
2. Soil containing expansive clays
3. Material containing excessive moisture
4. Poorly graded coarse material
5. Material with particle sizes in excess of 6 inches
6. Material which will not achieve density and/or bearing requirements

2.2 Earthwork Balance

No attempt has been made to estimate cut and fill earthwork quantities. The CONTRACTOR is solely responsible for an estimation of quantities of earthwork materials to construct the project as shown.

PART 3 - EXECUTION

3.1 Preliminary Investigation of the Work

The CONTRACTOR is to satisfy himself that all preliminary work including clearing, grubbing and staking has been performed in accordance with these specifications prior to subgrade preparation.

3.2 Subgrade Preparation

A. Scarification

Scarify and loosen to a minimum depth of 6 inches. Remove any particles larger than 6 inches.

B. Moisture Conditioning

Condition the soil by aerating or wetting to the moisture content required to obtain the minimum compaction requirements. Mix the soil such that the moisture content is uniform throughout the lift. No payment will be made for conditioning of the soil, wetting, or drying.

C. Compaction

Construct subgrade cut and fill areas to achieve a uniform soil structure. Compact the subgrade to the percent relative compaction indicated on the plans. When not shown on the plan, compact as indicated herein.

Major streets, other streets and traffic ways	95%
Curbs, gutters and sidewalks	95%
Area to receive Engineered fill	95%

D. Subgrade Tolerances

Below pavement, sidewalk, curb and gutter	+1/4 inch
Below base course	+3/4 inch

Variations from the plan grade and cross section shall be compensating so that the average grade and cross section are obtained.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

No measurement will be made for this item.

4.2 Payment

No payment will be made for subgrade preparation. This item shall be considered incidental to Section 2630, Asphalt Concrete Pavement.

SECTION 2610

AGGREGATE BASE COURSE

PART 1 - GENERAL

1.1 Description

A. Description of Work

The work to be performed in accordance with this section includes furnishing and placing an aggregate base course to plan grades and cross sections.

This work shall include the furnishing of all labor, tools, equipment, materials and performing all operations required to provide a complete item in accordance with the project plans and specifications.

B. Related Work Specified Elsewhere

Earthwork	Section 2200
Subgrade Preparation	Section 2600

C. Definitions

1. Crushed Rock

Crushed rock shall consist of the product obtained by crushing rock, stone, or gravel so that at least 50 percent by weight of aggregate is retained on the No. 4 sieve for 3/4 inch or larger maximum sizes, and 50 percent is retained on the No. 8 for maximum sizes less than 3/4 inch. All crushed rock particles shall have at least one rough, angular surface produced by crushing.

2. Gravel

Material designated herein as gravel shall be composed entirely of particles that are either fully or partially rounded and water- worn. The quality and gradation requirements shall be as specified herein.

3. Sand

Sand shall consist of fine granular material produced by the crushing of rock or gravel or naturally produced by disintegration of rock and shall be sufficiently free of organic material, mica, loam, clay, and other deleterious substances to be thoroughly suitable for the purpose for which it is intended.

1.2 Quality Assurance

A. Reference Test Standards and Specifications

ASTM C117, Test Method for Material Finer Than 75-um (No. 200) Sieve in Mineral Aggregates by Washing.

ASTM C131, Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

ASTM C136, Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM D1556, Density of Soil in Place by the Sand-Cone Method.
ASTM D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.
ASTM D6938-08a, Density of Soil and Soil-Aggregate in Place by Nuclear Methods.
ASTM D6938-08a, Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods.
ASTM D4318, Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
Rock Correction Procedure for Maximum Density Determination, ARIZ 227.

B. Frequency of Testing

1. Maximum Dry Density and Optimum Moisture Content, ASTM D1557.
   a. One test for each different class to type of material shall be provided by the CONTRACTOR prior to placing aggregate base.
   b. CONTRACTOR shall provide additional test when previous test is suspect, due to subtle changes in the material, as determined by the OWNER.
2. Density of Soil In-Place by the Sand Cone or by Nuclear Methods, ASTM D1556 or D6938-08a.
   a. CONTRACTOR will perform a minimum of one test per lift per 2,000 square yards per type of material.
   b. CONTRACTOR will perform additional test as required to ensure proper compaction.
3. Method for Sieve Analysis of Fine and Coarse Aggregates, ASTM C136.
   a. OWNER may perform sampling of Aggregate Base in place to check conformance with gradation requirements.

C. Testing Tolerances

1. Percent Relative Compaction
   Not less than as specified on plans or in these specifications.
2. In-Place Moisture Content
   As required to achieve minimum relative compaction.
3. Soft or Yielding Surfaces
   Regardless of the percent compaction obtained by test, areas which are soft or yield under the load of construction equipment are to be removed and replaced at no additional cost.

1.3 Submittals

A. Materials Test Report
Report on maximum dry density and optimum moisture content, as well as gradation prior to beginning of construction.

1.4 Job Conditions

A. Soils Report
This section does not apply to this project.

PART 2 - MATERIALS

2.1 Aggregate Base

Crushed aggregate or processed natural mineral shall be clean, hard, sound and free of any detrimental quantity of soft, friable elongated or laminated pieces, organic matter or other deleterious substances. Aggregate base shall meet the following requirements:

A. Grading

ASTM C136 and ASTM C117

Sieve Size	Percent by Weight Passing
1-1/8"	100
No. 4	38-65
No. 8	25-60
No. 30	10-40
No. 200	3-12

B. Percentage of Wear

ASTM C131, maximum percentage of wear of 40 after 500 revolutions.

C. Plasticity Index and Liquid Limit

ASTM D4318, maximum plasticity index of 5, maximum liquid limit of 25 percent.

D. Fractured Faces

1. Maximum aggregate size of 3/4 inch or greater, at least 50 percent of aggregate retained on the No. 4 sieve, at least one fractured face.
2. Maximum aggregate size less than 3/4 inch, at least 50 percent of aggregate retained on the No.8 sieve, at least one fractured face.

PART 3 - EXECUTION

3.1 Preliminary Investigation of the Work

Verify that all of the preliminary work including clearing, grubbing, subgrade preparation and staking has been performed in accordance with the plans and specifications prior to placing aggregate base.

3.2 Base Course Placement and Compaction

A. Moisture Conditioning

Condition the base by aerating or wetting to the moisture content required to obtain the minimum percent compaction. Mix the soil such that the moisture content is uniform throughout the lift. Take care so as not to damage the subgrade below.

B. Lift Thickness

Place and compact base course lifts, 6 inches or less, in a single lift. For lifts in excess of 6 inches thick, place and compact in successive equal layers not to exceed a maximum of 6 inches.

C. Compaction

Construct base course to achieve a uniform soil structure. Compact the base course to a relative density of not less than 100 percent.

D. Base Course Tolerances

Place and compact the base course to the grade and cross sections indicated. The base course shall not vary from plan grade and cross sections by more than 1/4 inch.

E. Deficiencies

Remove and replace deficiencies prior to placement of the pavement. Deficiencies in the base course, covered by paving will be removed and replaced at no additional to the OWNER.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

The quantity of aggregate base course to be paid for will be determined by measurement of the number of square yards of each thickness placed and accepted by the OWNER as complying with the drawings and specifications. The quantity shall be based on plan dimensions.

4.2 Payment

Payment will be made at the contract unit price per square yard for each thickness of aggregate base course. This price shall be full compensation for furnishing all materials, for preparing and placing these materials, and for all the labor, equipment, tools and incidentals necessary to complete the item.

See Section 00310 Bid Schedule for Bid Items.

SECTION 02810

TEMPORARY CONSTRUCTION FENCING

PART 1 - GENERAL

1.1 Summary

A. Description

This Section includes temporary construction fencing and related components.

1.2 Submittals

A. Submit as specified in Section 01330.

B. Includes, but not limited to, the following:

1. Product data: Manufacturer's technical data, specifications, and installation instructions for fence material and accessories.
2. Shop drawings showing layout and location of fence, posts, and including details illustrating fence height, sizes of posts, hardware list, and accessories.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Subject to compliance with requirements, provide products of one of the following.

1. Roxford Fordell, Greenville, SC
2. BF Products, Inc., Harrisburg, PA
3. Naltex Plastics, Inc, Austin, TX
4. Seton Identification Products, Branford, CT

2.2 General

A. Fence height shall be 4 feet located from top of ground to top of fence.

B. Fence shall extend from the top of ground. No gaps between the fence and the top of ground shall be permitted.

2.3 Fabric

A. Fence material shall be plastic.

B. Fence material shall be orange in color.

C. Fence material shall be resistant to temperature change and shall be UV protected.

2.4 Framing and Accessories

A. Provide posts and accessories necessary to erect fence in location desired.

B. Posts shall be either fiberglass or steel, specifically made for the installation of fencing.

C. Fencing shall be secured to the posts through the use of nylon ties or nylon wire (minimum 12 gauge). Steel wire shall not be used.

PART 3 - EXECUTION

3.1 Installation

A. Follow the existing general contour of ground and properly align.
B. Posts
   1. Posts shall be installed plumb and in straight alignment.
   2. Posts shall be spaced every 6.5 feet maximum, unless otherwise approved by the Engineer.
C. Fabric
   1. Fabric shall be stretched taut between fence posts. Equal tension shall be applied so that fence remains straight and taut between posts.
   2. Install fabric on security side of fence and anchor to posts so that fabric remains in tension after pulling force is released.
   3. Fasten fabric to posts with nylon ties or nylon wire spaced 12 inches maximum.

3.2 Maintenance

A. Fence shall not be allowed to be in disrepair. All breaks or tears in the fence fabric will be repaired immediately.
B. All posts shall remain plumb and in straight alignment. All fallen posts shall be reset immediately.
C. Contractor shall maintain temporary construction fencing in such a manner as to protect Work from damage and to protect the safety of the general public.
D. No Contractor personnel or equipment shall be allowed outside of the fenced construction easement area.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

No measurement will be made for this item.

4.2 Payment

No payment will be made for temporary construction fencing. This item will be considered incidental to the other items of Work.

** END OF SECTION 02810 **

DIVISION 3

CONCRETE

SECTION 03100

CONCRETE FORMWORK

PART 1 - GENERAL

1.1 Summary

A. This Section includes formwork for cast-in-place concrete.

B. Related Work Specified Elsewhere

Concrete Reinforcement.....Section 03200
Concrete. .....Section 03300
Concrete Curb, Gutter, Sidewalk, and Driveways.....Section 03310

1.2 Quality Assurance

A. Reference Standards and Specifications

1. American Concrete Institute (ACI)
   ACI 301 - Specifications for Structural Concrete for Buildings.
   ACI 318 - Building Code Requirements for Reinforced Concrete.
   ACI 347 - Recommended Practice for Concrete Formwork.
2. American Society for Testing and Materials (ASTM)
   ASTM C31 - Making and Curing Concrete Test Specimens in the Field.

PART 2 - MATERIALS

2.1 Materials for Facing

A. Where concrete will be exposed to view after construction:

1. Smooth finish, Exterior grade plywood at least 5/8 inch thick.
2. Steel.

B. Where concrete will not be exposed to view after construction:

1. Exterior grade plywood at least 5/8 inch thick.
2. Steel.
3. Wood fiberboard.
4. Dressed lumber free of loose knots.

C. Treat forms with lacquer, form oil, or other acceptable material to prevent bonding to concrete. Material shall not stain, cause injury to exposed concrete surfaces, or affect bonding of specified surface finishes. Bond breaker shall be VOC compliant with maximum 600 g/L (5 lbs/gal) or less where area restrictions are more stringent.

D. Clean forms of sawdust, dust, dirt, and other foreign materials.

2.2 Form Ties

A. Break-back, coil, or screw-type, except where otherwise specified.
B. Water-seal coil type or break-back water-seal type in walls below grade and walls of water-bearing structures.
C. All types shall leave conical depression in concrete.
D. Removable tapered tie system shall not be used.
E. Space as required against pressure of fresh concrete.

2.3 Chamfer Strips

A. Chamfer: 3/4-inch except where otherwise indicated.
B. Place in all forms to provide chamfer where concrete will have exposed projecting corners.

PART 3 - EXECUTION

3.1 Form Construction

A. Conform to ACI 301, 318, and 347, except Shop Drawings for formwork, shoring, and reshoring shall not be submitted to the Engineer for approval.
B. Adequately brace, stiffen, and support forms to prevent perceptible deflection or settlement, and to hold plumb, level, and true to line.
C. Construct and maintain forms to the tolerances given in ACI 301, Section 4.
D. Construct sufficiently tight to prevent mortar leakage.
E. Avoid offsets between adjacent forms and construct so that shores, braces, and stiffening members are in line with those below.
F. Space studs and stringers as required to support facing against concrete pressure, but not more than 12 inches for 5/8-inch plywood or 16 inches for 3/4-inch plywood.
G. Use wales, strongbacks, shores, and bracing as required.
H. Form all necessary openings where indicated or as required for the Work.
I. Construct forms to be removable in sections without marring concrete surface.
J. Surface of forms shall provide smooth, dense, plane surface to finished concrete where exposed to view.
K. Contractor shall be responsible for structural adequacy, design, engineering, and construction of the formwork.

3.2 Time-in-Place for Forms

A. No shores, bracing, supports, or other formwork shall be loosened or removed until the concrete members supported thereby have acquired sufficient strength to support safely their own weight and any other possible loads.
B. The minimum time between concrete placement and form removal shall be determined either by field-cured, test-cylinder specimens or in accordance with the time specified for the member involved.

C. If CONTRACTOR elects to determine the required time by means of test specimens, all costs in connection therewith shall be his responsibility.

D. Test specimens shall be made, field-cured, and tested as specified in ASTM C31. No forms or supports shall be loosened or removed until tests indicate strength of members as follows:

Structural Member	Percent of Design Compressive Strength
Unshored slab and beam forms or forms which can be removed without disturbing shores	70
Slab or beam shoring	85
Wall, column, and beam side forms	40

E. If field-cured test cylinders are not used as the basis for determination of time-in-place for formwork, the following criteria shall apply:

Structural Member	Time-in-Place for Forms*
Slab or beam shoring	12 days
Slab forms or beam soffits	7 days
Wall, column, and beam side forms	18 hours

*These periods are a cumulative number of days or fractions thereof, not necessarily consecutive, during which the temperature of the concrete surface is above 50°F.

3.3 Removal of Forms: Remove forms in a manner to avoid damage to the structure, with particular care for corners and edges.

PART 4 - MEASUREMENT AND PAYMENT – Not Applicable

END OF SECTION

SECTION 03200
CONCRETE

PART 1 - GENERAL

1.1 Summary

1.2 REINFORCEMENT

A. This Section includes steel reinforcement bars, ties, welded wire fabric, bolsters, chair supports, and accessories.

B. Related Work Specified Elsewhere

Concrete Formwork..... Section 03100
Concrete ..... Section 03300
Concrete Curb, Gutter, Sidewalk, and Driveways.....Section 03310

1.3 Quality Assurance

A. Reference Standards and Specifications

1. American Concrete Institute (ACI)
ACI 301 - Specifications for Structural Concrete for Buildings.
ACI SP-66 - Detailing Manual.
ACI 318 - Building Code Requirements for Reinforced Concrete.
2. American Society for Testing and Materials (ASTM) ASTM 82 - Steel Wire, Plain, for Concrete Reinforcement.
ASTM A185 - Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement.
ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
ASTM A706/A706M – Low-Alloy Steel. Deformed and Plain Bars for Concrete Reinforcement.
3. American Welding Society (AWS)
A5.5 – Low-Alloy Steel Covered Arc Welding Electrodes.
B2.2 – Standard for Welding Procedure and Performance Qualification.
D1.4 – Structural Welding Code – Reinforcing Steel.
4. Concrete Reinforcing Steel Institute (CRSI)
Manual of Standard Practice.

1.4 Submittals

A. Submit as specified in Section 1330.

B. Include, but not limited to, the following:

1. Complete bar schedule, bar details, and erection drawings to conform to ACI SP-66.
2. Drawing with each type of bent bar marked with identification mark. Straight bars shall have mark number or be identified by size and length.

3. Erection drawings shall be clear, easily legible, and to a minimum scale of:
   a. 1/4 inch = 1 foot.
   b. 1/8 inch = 1 foot if bars in each face are shown in separate views.
4. Size and location of all openings.
5. Concrete protective cover.
6. Grade of steel.
7. Lap splice lengths.
8. Mechanical splice product specification and data.

1.5 Delivery, Storage and Handling

A. Store steel reinforcement blocked-up off the ground and in orderly stacks.
B. Store only bars with the same identifying label in the same stack.

1.6 Testing

A. Perform at the mill for each heat.
B. Submit certified test results to Engineer upon request.

PART 2 - MATERIALS

2.1 Reinforcement Bars, Ties, and Stirrups

A. Materials
   1. Conform to ASTM A615, Grade 60, except as otherwise specified.
B. Fabrication of Bars
   1. Fabricate with cold bends conforming to the recommended dimensions shown in ACI 318.
   2. Fabricate bars according to the tolerances given in ACI 301, Chapter 5.
   3. Field fabrication will not be allowed.
   4. Attach metal or plastic tags with identifying mark or length corresponding to mark number or length on Drawing. Straight bars shall have mark number or size and length. Bent bars shall have mark number.
   5. CONTRACTOR may, at his option, continue steel reinforcement through openings in walls and slabs, then field-cut the opening so that there will be the required concrete cover between ends of bars and edge of opening.

2.2 Welded Wire Fabric

A. Conform to ASTM A185 using bright basic wire conforming to ASTM A82.
B. Wire sizes W 1.4 and smaller shall be galvanized.

2.3 Bolsters, Chairs, and Accessories

A. Conform to ACI SP-66 and the CRSI Manual of Standard Practice.
B. Provide all spacers, bolsters, chairs, ties, and other devices necessary to properly space, place, support, and fasten steel reinforcement in place during the concrete placement.
C. Metal accessories shall be plastic-coated where legs will be exposed in finished concrete surfaces.
D. Do not use rocks, broken bricks, wood blocks, or concrete fragments for support of steel reinforcement.

2.4 Precast Concrete Block Bar Supports

A. May be used only for bar supports in slabs on ground.
B. Blocks shall be made with a minimum of nine sacks of cement per cubic yard and have a minimum compressive strength of 6,000 psi in 28 days.
C. Each block shall have a minimum of 9 square inches of bearing area. Space as required by the particular condition of weight, bearing surface, and rigidity of the steel reinforcement.

PART 3 - EXECUTION

3.1 Placement of Steel Reinforcement

A. Place in accordance with Chapter 5 of ACI 301, Chapters 7 and 12 of ACI 318, and the CRSI Manual of Standard Practice.
B. Tie securely with 16-gauge or larger annealed iron wire.
C. Place to maintain concrete cover to conform to Chapter 5 of ACI 301 and Chapter 7 of ACI 318, unless otherwise indicated.
D. Splice steel to conform to Chapter 12 of ACI 318.
    1. Unless otherwise indicated, lap splices shall be Class B as defined by ACI 318.
    2. Mechanical Splices
        a. Lenten mechanical splices shall be used where indicated.
        b. The Lenten mechanical splices shall develop in tension and compression at least 125% of the yield strength (Fy) of the bar spliced.

3. Any additional Contractor-proposed splice shall be approved by the Engineer for location and splice length.

E. Lap welded wire fabric in accordance with Section 12.19 of ACI 318, but not less than the length of one mesh plus 2 inches.

PART 4 - MEASUREMENT AND PAYMENT – Not Applicable

END OF SECTION

SECTION 03300

CONCRETE

PART 1 - GENERAL

1.1 Summary

A. This Section includes concrete and related items.

B. Related Work Specified Elsewhere

Concrete Formwork..... Section 03100
Concrete Reinforcement..... Section 03200
Concrete Curb, Gutter, Sidewalk, and Driveways ..... Section 03310

1.2 Quality Assurance

A. Reference Standards and Specifications

1. American Concrete Institute (ACI)

ACI 211.1 - Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete.

ACI 301 - Specifications for Structural Concrete for Buildings.

ACI 304 - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.

ACI 305 - Committee Report on Hot-Weather Concreting. ACI 306 -

Committee Report on Cold-Weather Concreting. ACI 308 -

Recommended Practice for Curing Concrete.

ACI 309 - Recommended Practice for Consolidation of Concrete.

ACI 318 - Building Code Requirements for Reinforced Concrete.

ACI 350 – Code Requirements for Environmental Engineering Concrete Structures and Commentary

2. American Society for Testing and Materials (ASTM)

ASTM C31 - Making and Curing Concrete Test Specimens in the Field.

ASTM C33 - Concrete Aggregates.

ASTM C39 - Compressive Strength of Cylindrical Concrete Specimens.

ASTM C40 - Organic Impurities in Fine Aggregates for Concrete.

ASTM C42 - Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

ASTM C88 - Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

ASTM C94 - Ready-Mixed Concrete.

ASTM C114 - Methods for Chemical Analysis of Hydraulic Cement.

ASTM C117 - Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing.

ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.

ASTM C142 - Clay Lumps and Friable Particles in Aggregates. ASTM

C143 - Slump of Portland Cement Concrete.

ASTM C150 - Portland Cement.

ASTM C172 - Sampling Freshly Mixed Concrete.

ASTM C192 - Making and Curing Concrete Test Specimens in the Laboratory.

ASTM C231 - Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

ASTM C233 - Testing Air-Entraining Admixtures for Concrete. ASTM

C260 - Air-Entraining Admixtures for Concrete.

ASTM C289 - Potential Reactivity of Aggregates (Chemical Method).

ASTM C295 - Petrographic Examination of Aggregates for Concrete.

ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.

ASTM C430 - Fineness of Hydraulic Cement by the No. 325 (45-□m) Sieve.

ASTM C494 - Chemical Admixtures for Concrete.

ASTM C566 - Total Moisture Content of Aggregate by Drying.

ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction. (Nonextruding and Resilient Bituminous Types.)

ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

2. Concrete Plant Mixer Standards of the Plant Mixer Manufacturers Division Concrete Plant Manufacturers Bureau.
3. Concrete Plant Standards of the Concrete Plant Manufacturers Bureau.
4. Corps of Engineers Specification for Nonshrink Grout, CRD-C621.
5. Federal Specification (FS)
   TT-S-227E - Sealing Compound: Elastomeric Type, Multicomponent (for Caulking, Sealing, and Glazing in Buildings and Other Structures).
6. National Bureau of Standards (NBS) Specifications for Scales.
7. National Ready-Mix Concrete Association, "Truck Mixer, and Agitator Standards of the Truck Mixer Manufacturers Bureau."

B. Acceptance Testing of Concrete During Construction

1. A testing laboratory will be selected and paid by the Owner to perform the required compressive strength tests and statistical evaluations of concrete being used in the Work.
2. The Laboratory will sample, cure and test concrete cylinders in accordance with ASTM C31, C192 and C39, testing two cylinders at 7 days of age and two at 28 days of age.
3. The Laboratory will sample a minimum of one set of concrete cylinders per day's placement or one for each 50 cubic yards for larger placements.

1.3 Submittals

A. Submit as specified in Section 1330.

B. Include, but not limited to, product data and Shop Drawings of the following:

1. Nonshrink grouts.
2. Admixtures.
3. Bonding agents.
4. Curing agents.
5. Concrete floor hardeners, sealers, and coloring compounds.
6. Expansion joint materials.
7. Expansion joint sealants.
8. Waterstops.

C. Mill Certificates

1. Submit to Engineer a minimum of one copy for each cement shipment.

D. Concrete Mix Design Proportions
   1. Submit as specified in PART 2, paragraph 2.1.D - Mix Proportions, this Section.
   2. Submit for each mix design.
   3. Resubmit for any change in each mix design.

E. Production Test Reports: Submit as specified in DIVISION 1 and PART 2, paragraph 2.1.E - Measurement of Materials, this Section.

F. Concrete Plant Certificate: Submit current plant certification showing the concrete plant is certified by the Nationl Ready Mixed Concrete Association (NRMCA).

PART 2 - MATERIALS

2.1 Concrete

A. Materials
   1. Portland cement Type V. Conform to ASTM C150.
   2. Fine Aggregate
      a. Conform to ASTM C33.
      b. Approved service record of 3 years with a history indicating that the fine aggregate is not chemically reactive.
      c. For a new fine aggregate source, or when 3 years' approved service records are not available, or when the service records are unacceptable; the aggregate shall be evaluated for potential reactivity. Aggregate must be considered innocuous in accordance with petrographic examination by ASTM C295 and tests conforming to ASTM C289.
      d. Fine aggregate considered deleterious or potentially deleterious shall not be used without approval.
      e. Maintain fine aggregate free of ice and frozen lumps.
   3. Coarse Aggregate
      a. Conform to ASTM C33
         1. Limits for deleterious substances and physical property requirements shall conform to Table 3 and applicable class designation 5S, 5M or 1N.
      b. Approved service record of 3 years with a history indicating that the coarse aggregate is not chemically reactive.
      c. For a new coarse-aggregate source, when 3 years' approved service records are not available, or when the service records are unacceptable; the aggregate shall be evaluated for potential reactivity. Aggregate must be considered innocuous in accordance with petrographic examination by ASTM C295 and tests conforming to ASTM C289.
      d. Coarse aggregate considered deleterious or potentially deleterious shall not be used without approval.
      e. Blast furnace slag will not be permitted.
      f. Maintain coarse aggregate free of ice and frozen lumps.

g. Grading Requirements
1. From 1 inch to No. 4 for all concrete unless otherwise specified.

4. Mixing Water
a. Only potable water will be acceptable.

5. Admixtures
a. Water-Reducing Type
1. Conform to ASTM C494, Type A.
2. Conform to manufacturer's recommendations for use.
3. Technical assistance of the manufacturer's field representative shall be furnished upon request.

b. Air-Entraining Type
1. Conform to ASTM C260.
2. Conform to manufacturer's recommendations for use.
3. Technical assistance of the manufacturer's field representative shall be furnished upon request.
4. Testing of air-entraining admixtures shall conform to STM C233.

c. Other Admixtures: Used only with Engineer's written concurrence.
1. Water-Reducing, Retarding Type: Conform to ASTM C494, Type D, and shall not contain any chloride ions added during manufacture.

d. Storage
1. Admixtures shall be stored in such a manner as to avoid contamination, evaporation, freezing, temperature changes, settling, or any damage, which would adversely affect their characteristics.

B. Laboratory Testing of Materials for Use in Concrete
1. An approved independent testing laboratory shall be selected and paid by Contractor to perform all required quality control tests of materials proposed for use in the production of concrete and to determine mix proportions when laboratory trial batches are required.
2. If requested by the Owner, Contractor shall deliver representative Samples of all proposed concrete materials to the laboratory for the following testing:
a. Fine Aggregate
1. ASTM C33.
2. ASTM C40.
3. ASTM C88.

b. Coarse Aggregate
1. ASTM C33.
2. ASTM C88.

c. Air-entraining admixture shall be tested conforming to ASTM C233.

3. The laboratory test results shall be part of the design mix as specified in this PART 2, paragraph 2.1.D. - Mix Proportions, this Section.

C. Concrete Qualities Required

1. Compressive Strength

a. Minimum 28-day compressive strength = 4,000 psi for all construction.

b. Compressive-strength determinations shall be made from 4" diameter x 8" long concrete cylinders tested in accordance with ASTM C39.

2. Slump of concrete shall be 4 inches, ±1 inch as tested in accordance with ASTM C143.

3. Air Content: 4% to 6% as tested in accordance with ASTM C231.

4. Minimum Cement Content: 600 pounds per cubic yard.

5. Water-Cement Ratio: 0.45.

D. Mix Proportions

1. Concrete shall be homogeneous, readily placeable, and uniformly workable; proportioned to conform to ACI 211.1.

2. Mix proportions for all concrete, unless otherwise specified, shall be selected on the basis of laboratory trial mix design, or historical records of compressive strength.

a. Laboratory Trial Batch: All such Work shall be performed by the laboratory as specified in PART 2, paragraph 2.01.B. - Laboratory Testing of Materials for Use in Concrete, this Section.

1. Laboratory trial batches shall be used to establish a water-cement ratio, compression- strength curve with at least three points, each representing the strength of a separate trial batch. At least one point shall be above and one below the strength required. Each point on the curve shall represent the average of at least three cylinders tested at 28 days or an earlier age when approved by Engineer. The slump and air content shall be at the maximum limits specified in PART 2, paragraph 2.01.C. - Concrete Qualities Required, this Section.

2. A point on the water-cement ratio, compressive- strength curve shall be selected that will provide an average strength at least 1,200 psi greater than the specified minimum strength.

3. Submit the following test data to Engineer for approval prior to placing concrete.
   a. Fine Aggregate
      1. ASTM C33.
      2. ASTM C40.
      3. ASTM C88.
      4. ASTM C117.
      5. ASTM C136.
      6. ASTM C142.
      7. Fineness modulus.
      8. ASTM C295 and ASTM 289 or approved service records.
   b. Coarse Aggregate
      1. ASTM C33.
      2. ASTM C88.
      3. ASTM C136.
      4. ASTM C142.
      5. ASTM C295 and ASTM C289 or approved service records.
   c. Cement
      1. Mill certificate.
   d. Concrete
      1. Fine and coarse aggregate, water and cement sources.
      2. Laboratory mix proportions, slump and air content.
      3. Water-cement ratio, compressive-strength curve.

b. Historical Records: In lieu of laboratory trial batches, the Contractor shall submit historical compressive strength data which demonstrates the mixture meets the strength criteria for proportioning presented in ACI 318-5.2.

3. Prior to placing any concrete, the laboratory selected by the Contractor shall report the results of the testing and mix designs to the following:
   a. Resident Project Representative, Field Office (one copy).
   b. Contractor (copies as required).
   c. Concrete Supplier (copies as required).

E. Measurement of Materials

1. General Requirements
   a. Conform to ACI 304.
   b. Beam or springless dial-type scale conforming with NBS - "Specifications for Scales."
   c. Volumetric measurement of water shall be performed with an approved automatic valve.

2. Concrete Plant Scale Accuracy and Calibration Frequency
   a. The concrete plant scales shall be accurate to +0.4% of the capacity of the scale.
   b. The scales shall be calibrated at intervals as specified in PART 3, paragraph 3.09 - Testing, this Section.

3. Individual Batch Accuracy
   a. Cement: +1.0%.
   b. Water: +1.0% by volume or weight.
   c. Aggregates: +2.0%.
   d. Admixtures: +3.0% by volume or weight.

F. Mixing and Delivery

1. Conform to ACI 304.
2. Cement temperature, when added to mix, shall not exceed 170ºF.
3. Adjust the amount of mix water to compensate for the moisture content of the aggregates.
4. Concrete Plant
   a. Conform to "Concrete Plant Mixer Standards of the Plant Mixer Manufacturers Division Concrete Plant Manufacturers Bureau" and "Concrete Plant Standards of the Concrete Plant Manufacturers Bureau."
   b. Charge with 5% to 10% of the mixing water both in advance and after the addition of aggregates and cement.
   c. Charge with remaining water uniformly with the other materials. Avoid charging in excess of manufacturer's rating.
   d. Discharge mixed concrete completely prior to recharging.
   e. Mixing Time
      1. Start immediately when all ingredients, except the last of the water, are in the mixer.

2. Minimum mixing time shall conform with mixer manufacturer's instructions, but not be less than the following:

Capacity of Mixer Cubic Yards	Minimum Time of Mixing
1 or less	1 minute
2	1 minute, 15 seconds
3	1 minute, 30 seconds
4	1 minute, 45 seconds
5	2 minutes
6	2 minutes, 15 seconds

Add 15 seconds' mixing time for each additional cubic yard of concrete.

5. Mixing of Concrete at Plant Off Jobsite
   a. Mix concrete in central mixer or truck mixer. Transport in truck mixer turning at agitation speeds only.
   b. Water added to concrete having a slump below the specified minimum shall be at Contractor's risk. If the water added produces a slump greater than the specified maximum, the concrete will be rejected. If water is added, the concrete shall be remixed for a minimum of 25 revolutions.
   c. Truck mixer shall conform to "Truck Mixer and Agitator Standards of the Truck Mixer Manufacturers Bureau" of the National Ready-Mix Concrete Association.
   d. Ready-mixed concrete shall be produced and delivered conforming to ASTM C94 as applicable.
   e. Contractor shall furnish Owner with a concrete delivery ticket for each load of concrete. The ticket shall have the following information recorded:
      1. Ticket number.
      2. Time batched.
      3. Time arrived on jobsite.
      4. Time discharge started.
      5. Time completed delivery.
      6. Mix number.
      7. Amount of all water added at jobsite by Contractor.
6. Plant and truck mixer uniformity shall be tested according to ASTM C94. Frequency of tests shall be as specified in PART 3, this Section.

2.2 Grout

A. Grout for Dry Packing

1. Volume: 1 part portland cement to 2 parts sand.
2. Keep water to a minimum as required for placing by the dry packing method.
3. Place after the mixed grout has been allowed to stand for 2 hours.

B. The sand and cement shall be as specified for concrete.

C. Flowable Nonshrinking Grout

1. Required for setting handrail posts, for setting equipment recommended by the manufacturer to be set with nonshrinking grout, and in other places indicated.
2. Grout shall conform to Corps of Engineers specification for Nonshrink Grout, CRD-C621.
3. Grout shall be nonmetallic, as manufactured by one of the following:
   a. L and M Construction Chemicals, Inc. - Crystex.
   b. U. S. Grout Corporation - Five Star Grout.
   c. Master Builder's Company - Masterflow 713 Grout.
   d. Sauereisen Cements Company - Sauereisen F-100.
   e. Gifford-Hill & Company - Supreme Grout.
4. Prepare and place conforming to manufacturer's printed instructions.
5. For equipment bases, the concrete surfaces shall be sandblasted or roughened with a chipping hammer prior to grouting. The foundation plates shall be cleaned of any grease, oil, paint, primers, or epoxy coatings.

D. Grout for Bonding

1. Proportion (by weight): 1 part cement to 1-1/2 parts sand.
2. Keep water to a minimum.

2.3 Bonding Agent

A. Provide moisture-insensitive, epoxy-resin bonding agent as manufactured by one of the following:

1. A. C. Horn, Inc. - Epoxtite.
2. Euclid Chemical Company - Euco Epoxy.
3. Sika Chemical Company - Sikastix 370.
4. L&M Construction Chemicals, Inc. - Epobond.

2.4 Concrete Accessories

A. Water Stops

1. Serrated virgin polyvinyl chloride equal to one of the following:
   a. Four Seasons, Inc. - Horn Durajoint Type 3.
   b. Vulcan Metal Products Company - Vulco 8013.
   c. Greenstreak – Model No. 732

B. Expansion Joints

1. Expansion Joint Filler: Premolded cork of thickness indicated and conforming to ASTM D1752, Type III, self- expanding cork. Unless indicated to be asphalt-impregnated fiber.
2. Expansion Joint Filler: Preformed asphalt-impregnated fiber of thickness indicated and conforming to ASTM D1751. Use where indicated.
3. Bond Breaker: Polyethylene strip.
4. Joint Sealant:
   a. Use 2-component, self-leveling urethane conforming to FS TT-S-227E as manufactured by one of the following:
      1. A. C. Horn Inc. - Duraseal-U.
      2. Pecora Inc. - Urexpan NR-200.
      3. Sonneborn - SL-2 Sealant.
   b. Prime joints with manufacturer's primer.

C. Dovetail Anchor Slots

1. 24-gage zinc alloy, 1" (25 mm) wide back x 1" deep x 5/8" throat as manufactured by one of the following:
   a. Gateway Products.
   b. Heckmann Building Products, Inc.
   c. Hohmann & Barnard, Inc.

2.5 Curing Agent

A. Liquid membrane-forming compound conforming to ASTM C309, Type
1. Curing agent shall be VOC compliant with maximum 2.9 lbs/gal (350 g/l), or less where area regulations are more stringent. ASTM C309, Type 2 shall be used as specified in PART 3, paragraph 3.05 - HOT WEATHER CONCRETING, this Section.

PART 3 - EXECUTION

3.1 Preparation for Concrete Placement

A. Openings Through Concrete: Provide openings through concrete as indicated and for the proper installation of all equipment, piping, wiring and similar items, installed under this Contract.

B. Installation of Embedded Items

1. Provide for accurate installation of embedded items installed under this Contract.
2. Embedded items shall be as indicated or specified, or as selected by Contractor and approved by Engineer.
3. During cold weather, protect pipe sleeves from moisture, which may freeze, expand, and crack the sleeve and concrete structure.
4. Grease or tape anchor bolt threads to protect from concrete splatter.

C. Installation of Joints

1. Construction Joints

a. Location

1. Locate joints, which are not indicated or specified, in conformance with ACI 318.
2. Obtain Engineer's approval of joints located by Contractor prior to preparation of reinforcing steel drawings.

b. Preparation and Installation

1. Clean and break laitance or other foreign material from bonding surface.
2. Tighten forms remaining in place (where applicable) to prevent seepage between forms and hardened concrete.
3. Provide water stops and shear keys as indicated or specified and as required in any new construction joint requested by Contractor.

c. Waterstops

1. Install in all construction joints where indicated.
2. Install conforming to manufacturer's printed instructions.
3. All joints and splices of PVC waterstop shall be 100% fused.

2. Expansion Joints

a. Install as indicated.
b. Reinforcement bars will not extend through expansion joints unless otherwise indicated.
c. Where joint sealant is indicated, completely cover the top surface of the joint filler with a polyethylene strip bond breaker prior to sealing joint.
d. Seal top of expansion joint with joint sealant applied conforming to manufacturer's instructions. Depth of sealant shall be one-half the joint width unless otherwise indicated. During cold weather, protect joint from moisture prior to installation of joint sealant.

3. Dovetail Anchor Slots: Install as indicated or specified.

D. Cutting and Bonding to Existing Concrete

1. Cutting Existing Concrete

a. Use methods and equipment that will avoid damage to adjacent parts of the structure from heavy blows or vibration.
b. Cut existing concrete with power concrete saw where possible to prevent spalling and chipping and to form neat, straight edge.

c. Remove all loose or cracked pieces resulting from cutting existing concrete, leaving only sound, undamaged concrete adjacent to new Work.

d. Leave access opening edges with a neat, true grout surface to the opening size indicated.

e. Cut reinforcing steel with sufficient length remaining (approximately 30-bar diameters) for bending and lapping into new construction.

2. Bonding to Existing Concrete

a. Roughen concrete by use of a pneumatic chipping hammer or other approved means.

b. Thoroughly clean the concrete surface and apply the bonding agent. Place the fresh concrete after the bonding agent becomes tacky.

3.2 Placing of Concrete

A. Conventional Placing

1. General Requirements

a. Conform to ACI 304.

b. Bonding surfaces shall be clean, free of laitance and foreign materials.

c. Face horizontal bonding surfaces with 1-inch-thick coat of fresh "grout for bonding." Wet all other surfaces.

d. Place concrete on properly prepared and unfrozen subgrade and only in dewatered excavation and forms.

e. Use forms for all concrete except where otherwise indicated or specified.

f. Do not place concrete that has partially hardened or has been contaminated by foreign materials.

g. Prevent mud or foreign materials from entering the concrete or forms during placement operations.

2. Conveying

a. Convey concrete from the mixer and deposit in place by methods, which will prevent the segregation or loss of materials.

b. Equipment for chuting, pumping, and pneumatically conveying concrete shall be of such size and design as to provide a practically continuous flow of concrete at the delivery end.

c. Aluminum conveying equipment shall not be used.

3. Depositing

a. Place concrete in continuous horizontal lifts not to exceed 2 feet, and place concrete against bulkheads and keyways at vertical joints.

b. Maximum free drop of concrete shall be 5 feet, in walls 10 inches or less in thickness, with 1-foot additional drop allowed for each inch of wall thickness over 10 inches, with a maximum drop of 10 feet.

4. Consolidation of Concrete

a. Consolidate concrete in conformance with ACI 309. Characteristics and application of concrete vibrators shall be as set forth in Table 5.1.4.

b. Provide an adequate number of vibrators of sufficient capacity to keep up with the maximum rate of concrete placement. Keep on hand adequate standby equipment in good operating condition.

c. Vibrate concrete only until the concrete is thoroughly consolidated and the voids filled, as evidenced by the leveled appearance of the concrete at the exposed surface and the embedment of the surface aggregate.

d. Insert internal vibrators vertically to the full depth of the layer being placed and into the previous layer. Do not drag vibrators through the concrete. Insert and withdraw vibrator slowly with the vibrator running continuously so that no hole will be left in the concrete. Do not flow concrete from one location to another by use of a vibrator.

e. Consolidate concrete layer to full depth when using a surface vibrator. Use thinner layers or a more powerful vibrator if necessary to achieve complete consolidation.

f. Use form vibrators only where sections are too thin or where sections are inaccessible for internal vibrators.

5. Time Requirements

a. Place concrete at a sufficient rate to assure that lifts below have not taken initial set before fresh concrete is deposited.

b. Place concrete within 45 minutes after mixing. This period may be extended to 1 hour and 30 minutes provided that the combined air temperature, relative humidity, and wind velocity are such that the plasticity of the fresh concrete is satisfactory for placement and consolidation, and that the specified mixing water is not exceeded. Concrete, which has partially set, shall not be retempered but shall be discarded.

6. Placing Concrete at Joints

a. Bed horizontal joints with 1 inch of grout for bonding.

b. Take precautions to ensure tight, well-bonded construction joints with no air pockets or voids.

c. Take special precautions to avoid bending or displacing waterstop while placing concrete around it.

d. Delay construction at a joint a minimum of 16 hours where placement is continued past joint, except where otherwise indicated.

3.3 Finishing

A. Unformed Surfaces

1. Screed Finish

a. Use as first stage for all concrete finishes.

b. Use as final finish on surfaces that will be covered by additional concrete, grout placement, or mortar setting bed except as otherwise specified.

c. Immediately after screeding, use a wood float, darby, or bullfloat to eliminate high and low spots and to embed large aggregate. This shall be done in a manner to produce even, uniform surfaces so that surface irregularities do not exceed 3/8 inch in 10 feet when used as final finish.

2. Floated Finish

a. Use as second stage of broomed or troweled finish.

b. Float with mechanical float. Hand floating will be permitted only in areas inaccessible to mechanical float.

c. On surfaces not to receive troweled finish, finish with wood or cork float after mechanical floating to a true uniform surface so that surface irregularities do not exceed 1/8 inch in 10 feet, except at floor drains.

3. Broomed Finish

a. Use as final finish on all outdoor concrete surfaces subject to pedestrian and/or vehicle traffic.

b. After floated finish, draw a stiff bristle broom across the surface making uniform corrugations, perpendicular to the direction of traffic, not more than 1/16 inch deep.

4. Troweled Finish

a. Use as final finish on all other unformed surfaces not otherwise indicated or specified.

b. Trowel with steel trowel, mechanical or hand, to obtain a smooth, dense finish. The final troweling shall be done after the concrete has become hard enough so that no mortar adheres to the edge of trowel and a ringing sound is produced as the trowel passes over the surface.

c. Do not trowel before surface water has evaporated or has been removed with a squeegee.

d. Finish to a true uniform surface so that surface irregularities do not exceed 1/8 inch in 10 feet, except at floor drains.

e. Do not add sand or cement to the floor surface.

B. Formed Surfaces

1. Repair surface defects as specified in PART 3, paragraph 3.03.C. - Repair of Defective Surfaces, this Section.

C. Repair of Defective Surfaces

1. Defined as any concrete surface showing misalignment, rock pockets, poor joints, holes from ties, voids, honeycomb, or any other defective area.

2. Repairing
   a. Repair as soon as forms have been removed.
   b. Chip surface back to minimum depth of 1/2 inch, chip edges perpendicular to surface, prewet depression and brush with neat cement immediately before patching.
   c. Patch surfaces using stiff mortar with same sand- cement ratio as original concrete and with minimum water for placing. Blend with white cement to match concrete color.
   d. Compact mortar into depressions so that after curing, hole is filled and mortar is flush with surface. Use hammer and ramming rod for compacting the holes.
   e. Moist-cure for 3 days or use curing compound.
   f. Engineer shall be notified of areas containing defects or where reinforcing steel is exposed, prior to determination of repair method.

3.4 Curing

A. Cure all concrete by one of the following methods in accordance with ACI 308:
   1. Leaving in forms for a minimum of 7 days. Keep formwork wet to prevent drying of concrete surfaces.
   2. Use of saturated bats, soaker hoses, or sprinkler for a minimum of 7 days. Keep concrete continuously wet.
   3. Using one coat of a liquid membrane forming compound conforming to ASTM C309, Type 1. Apply immediately after removal of forms (which have been continuously wet); or in case of a slab, after the concrete has been finished and is hardened sufficiently to walk on.
   4. Using polyethylene sheets applied in full contact with surfaces.
   5. Curing of concrete during hot or cold weather shall conform to PART 3 - HOT WEATHER CONCRETING and COLD WEATHER CONCRETING, this Section.

3.5 Hot Weather Concreting

A. Follow the recommendations of ACI 305 if any of the following conditions occur:
   1. When the temperature is 90°F or above.
   2. When the temperature is likely to rise above 90°F within the 24-hour period after concrete placement.
   3. When there is any combination of high air temperature, low relative humidity, and wind velocity which would impair either concrete strength or quality.

B. Concrete shall have a maximum temperature of 100°F during placement.

C. Dampen subgrade and forms with cool water immediately prior to placement of concrete.

D. Protect freshly placed concrete immediately after placement so that the rate of evaporation as determined by ACI 305 (Figure 2.1.5) does not exceed 0.2 pound per square foot per hour.

E. Protect concrete with suitable insulation if rapidly decreasing nighttime temperatures occur, which would cause thermal shock to concrete placed during warm daytime temperatures.

F. Protect the concrete with temporary wet covering during any appreciable delay between placement and finishing.

G. Begin curing unformed surfaces immediately after finishing and continue for 24 hours. Curing shall consist of application and maintenance of water-saturated material to all exposed surfaces; horizontal, vertical, and otherwise. After the 24-hour interval, continue curing using one of the following methods:

1. Moist curing for 6 days.
2. Application of one coat of curing compound conforming to ASTM C309, Type 2.
3. Application and maintenance of curing paper or heat-reflecting plastic sheets for 6 more days.

H. Begin curing formed concrete immediately after placing. Curing shall consist of keeping forms continuously wet for 24 hours. Thereafter, continue curing using one of the following methods:

1. Loosen forms and position soaker hose so that water runs down along concrete surfaces. Continue for 6 days.
2. Strip forms and apply curing compound conforming to ASTM C309, Type 2. Do not allow concrete surfaces to dry prior to application of curing compound.

3.6 Cold Weather Concreting

A. When the temperature is 40°F or is likely to fall below 40°F during the 24-hour period after concrete placement, follow the recommendations of ACI 306 to prevent loss of concrete strength or quality.

B. Minimum temperature for concrete as mixed shall be as indicated on lines 2, 3, and 4 of Table 1.4.1 of ACI 306. Maximum temperature for concrete as mixed shall be 10°F greater than the corresponding minimum temperature.

C. Place and maintain concrete so that its temperature is never less than the temperature indicated on line 1 of Table 1.4.1 of ACI 306. Maintain the required temperature for the time duration indicated on Table 1.4.2 of ACI 306.

D. Monitor temperature of concrete in place at corners or edges of formwork as applicable.

E. Air Heaters

1. Do not expose concrete to carbon monoxide or carbon dioxide fumes from heaters or engines.
2. Oil- or coke-burning salamanders will not be permitted.
3. Heaters shall be ultramatic portable heaters made by the Union Chill Mat Company or approved equal.
4. Personnel shall be present at all times to maintain safe, continuous operation of heating system.

F. Control temperature and humidity of protected concrete so that excessive drying of concrete surfaces does not occur.

G. Calcium chloride will not be permitted as a concrete accelerator or to thaw frozen subgrade prior to concrete placement.

H. The maximum allowable temperature drop during the first 24-hour period after protection is discontinued shall be as indicated on line 5 of Table 1.4.1 of ACI 306.

I. Cure the concrete in accordance with Chapter 5 of ACI 306.

3.7 Low-Strength Concrete

A. Low-Strength Concrete

1. Defined as either
   a. Concrete whose average, of any sets of three consecutive 28-day strength tests, is below the required 28-day strength.
   b. Concrete whose individual 28-day strength test (average of two cylinders) is more than 500 psi below the required 28-day strength.
2. Should concrete meet either definition of low-strength concrete as a minimum, the Contractor shall take the following steps:
   a. Increase the cement content. The increase shall be based on a statistical evaluation of the strength data, the design water-cement ratio, compressive-strength curve, and acceptable mix-design literature as follows:
      1. If sufficient concrete has been furnished to accumulate 30 tests, these should be used to establish a new target average strength in accordance with ACI 318, Section 4.3.1.
   b. If less than 30 tests have been made, the new target average strength should be at least as great as the average strength used in the initial selection of the mix proportions. Increase the target average strength based on a statistical evaluation of the available strength data, the design water-cement ratio, compressive-strength curve, and acceptable mix-design literature. If the statistical average equals or exceeds the initial mix-design level, a further increase in the average level is required.
   c. Remove and replace with acceptable concrete when the quality and location of the low-strength concrete is such that Engineer considers the strength or durability of the structure is impaired and so orders.
3. Low-strength concrete shall be considered defective Work as defined in DOCUMENT 00700 - GENERAL CONDITIONS.

B. Potentially Low-Strength Concrete: Defined as concrete whose 7-day test (average of two cylinders) is less than 70% of the specified minimum 28-day compressive strength.

C. Construction delays caused by low-strength or potentially low-strength concrete shall not relieve Contractor from responsibility for late completion even though extensions of time may be granted.

3.8 Miscellaneous Concrete Items

A. Concrete Seal Coat

1. Apply to the ground surface immediately beneath all "on- grade" slabs and footings where indicated or specified.
2. Seal coat shall consist of a concrete slab of the thickness indicated.
3. Accurately screed so that the top of the seal coat will not be higher than the bottom elevation of structural slabs or footings to be placed thereon.
4. Do not place seal coat until after all excavating in the area has been completed and all drain lines, conduits, and other items under the area are completed and properly backfilled and compacted.

B. Equipment Bases

1. Construct equipment bases, pads, and foundations as indicated or, when not indicated, conforming to equipment manufacturer's requirements.
2. Reinforce conforming to typical detail unless otherwise indicated.
3. Equipment bases shall include concrete, reinforcing steel, form work as required, and anchor bolts. Place grout for equipment installed under this Contract.
4. Finish top area of bases between anchor bolts and forms with a troweled finish.

3.9 Testing

A. Field Testing of Concrete Plant and Mixing Trucks

1. The concrete plant shall be inspected and tested to ensure conformance with ACI 304 and the "Concrete Plant Standards of the Concrete Plant Manufacturers Bureau." The scales shall be calibrated at the initial setup and at 3-month intervals thereafter.
2. Mixing trucks shall be inspected and tested to ensure conformance with ACI 304 and "Truck Mixer and Agitator Standards of the Truck Mixer Manufacturers Bureau" of the National Ready-Mix Concrete Association. Tests shall be done at initial setup and every 3 months thereafter.
3. Submit test reports when requested.

B. Field Testing of Concrete and Making of Concrete Test Cylinders

1. Contractor shall furnish test equipment, test cylinder molds, and trained personnel to perform all required field tests, make the required concrete test cylinders, and deliver test cylinders to the testing laboratory. The prescribed tests shall be made in the presence of or with the concurrence of the Owner.
2. Concrete sampling for tests and cylinder making shall be done conforming to ASTM C172. Samples shall be taken at random and at the point of truck discharge.

3. Perform the following tests
   a. Moisture content, ASTM C566. Perform this test a minimum of twice a day and adjust the amount of mix water to compensate for the moisture content of the aggregates.
   b. Prepare test cylinders conforming to ASTM C31, with not less than one set of cylinders (four cylinders) from each day's placement for each 50 cubic yards or fraction thereof. Test cylinders for compressive strength in accordance with ASTM C39.
   c. Slump test conforming to ASTM C143. Perform tests on the first batch produced each day, for every 50 cubic yards or fraction thereafter, and with every set of test cylinders. Additional tests shall be run when directed by the Engineer.
   d. Air content test conforming to ASTM C231. Perform for first batch of day and with each set of test cylinders.
   e. The batch of concrete being tested for slump or air content shall not be placed until acceptable results are obtained.
   f. Discard concrete used for slump and air tests.
   g. Perform concrete and air temperature tests for first batch of day and with each set of test cylinders. Additional readings shall be taken when directed by the Engineer.
   h. Any batch of concrete with slump or air content not in conformance with Specifications shall be rejected.
   i. Furnish slump, air content, and temperature test results to the testing laboratory for inclusion in the cylinder test reports.

C. Laboratory Testing of Aggregates and Concrete During Construction
   1. An independent testing laboratory will be selected and paid by the Owner to perform the required laboratory tests and statistical evaluations of concrete being used in the Work.
   2. Laboratory will sample, cure and test concrete cylinders in accordance with ASTM C31, C192 and C39, testing two cylinders at 7 days of age and two at 28 days of age.
   3. Contractor shall have the right to observe all phases of concrete cylinder curing and testing. Should Contractor observe any deviations from the prescribed testing procedures that he considers detrimental to concrete strength test results, he shall immediately notify Owner in writing.
   4. Contractor shall assist laboratory in obtaining Samples of fine and coarse aggregate for periodic testing.
   5. The Contractor shall make arrangements with the testing laboratory to receive copies of test reports. The cost of providing a maximum of two copies of each report to the Contractor will be paid by the Owner.

6. Should the test results indicate low strength concrete as defined in PART 3, paragraph 3.07 - LOW-STRENGTH CONCRETE, this Section, Contractor shall take immediate corrective action.
7. Should the statistical data indicate an excessive margin of safety, the concrete mix may be modified subject to Engineer's approval.
8. Should the material tests taken during construction indicate nonconformance with the Specifications, the Contractor shall take immediate corrective action.

PART 4 - MEASUREMENT AND PAYMENT – Not Applicable

** END OF SECTION 03300 **

SECTION 03301
EPOXIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Epoxy.
2. Epoxy gel.
3. Epoxy bonding agent.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. D 638 - Standard Test Method for Tensile Properties of Plastics.
2. D 695 - Standard Test Method for Compressive Properties of Rigid Plastics.
3. D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

1.03 SYSTEM DESCRIPTION

A. Performance Requirements:

1. Provide epoxy materials that are new and use them within shelf life limitations set forth by manufacturer.
2. Perform and conduct work of this Section in neat orderly manner.

1.04 SUBMITTALS

A. Not Used.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Epoxy: Water-insensitive two-part type low viscosity epoxy adhesive material containing 100 percent solids and meeting or exceeding following characteristics when tested in accordance with standards specified: Manufacturers: One of the following or equal:

1. Master Builders, Inc., Concressive Standard LVI.
2. Sika Chemical Corp.'s, Sikadur 35 Hi-Mod LV.

Physical Characteristic	Test Method	Required Results
Tensile Strength	ASTM D 638	8,000 pounds per square inch at 14 days and 77 deg. F cure.
Flexure Strength	ASTM D 790	11,000 pounds per square inch at 14 days and 77 deg. F cure.
Compressive Strength	ASTM D 695	16,000 pounds per square inch at 24 hours and 77 deg. F cure.
Bond Strength	N/A	Concrete shall fail before failure of epoxy.
Gel Time in 5-Mil Film	N/A	Four hours maximum at 77 deg. F
Elongation	ASTM D 638	1 percent minimum at 14 days and 77 deg. F

B. Epoxy Gel: Manufactures: One of the following or pre-approved equal:
   1. Sika Chemical Corp.'s, Sikadur 31 Hi-Mod Gel.

C. Epoxy Bonding Agent: Manufacturers: One of the following or pre-approved equal:
   1. Master Builders, Inc., Concressive 1001 Liquid LPL.
   2. Sika Chemical Corp.'s, Sikadur 32 Hi-Mod.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install and cure epoxy materials in accordance with manufacturer's installation instructions.

B. Epoxy:
   1. Apply in accordance with manufacturer's installation instructions.

C. Epoxy Gel:
   1. Apply in accordance with manufacturer's installation instructions.
   2. Use for vertical or overhead work, or where high viscosity epoxy is required.
   3. Epoxy gel used for vertical or overhead work may be used for horizontal work.

D. Epoxy Bonding Agent:
   1. Apply in accordance with manufacturer's installation instructions.
   2. Bonding agent will not be required for filling form tie hole or for normal finishing and patching of similar sizes small defects.

*** END OF SECTION ***

SECTION 03310

CONCRETE CURB, GUTTER, SIDEWALK AND DRIVEWAYS

PART 1 - GENERAL

1.1 Summary

A. Description of Work

The work to be performed in accordance with this section includes the furnishing and placement of Portland cement concrete curb, gutter, sidewalk and driveways.

The work shall include the furnishing of all labor, tools, equipment, materials and performing all required operations to provide a complete item in accordance with the project plans and specifications.

B. Related Work Specified Elsewhere

Aggregate Base Course	Section 02610
Concrete Formwork	Section 03100
Concrete Reinforcement	Section 03200
Concrete	Section 03300

1.2 Quality Assurance

Provide all laboratory and field testing of material and workmanship in accordance with Specification Section 3300, Concrete.

A. Applicable Test Standards and Specifications

1. American Society for Testing and Materials (ASTM)

ASTM D-1751, Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.

B. Tolerances

1. Sidewalk

Test the surface of concrete sidewalk with a 5-foot straightedge. Correct any deviation in excess of 1/8-inch at no additional cost to the Owner.

2. Water Test

Water test gutters having a slope of 0.8 foot per hundred feet or less, or where unusual or special conditions cast doubt on the capability of the gutters to drain. Establish flow in the length of gutter to be tested by supplying water from a hydrant, tank truck or other source. One hour after the supply of water is shut off, inspect the gutter for evidence of ponding or improper shape. In event water is found ponded in the gutter to a depth greater than 1/2-inch, or on the adjacent asphalt pavement, the defect or defects

shall be corrected in a manner acceptable to the Owner at no additional cost.

PART 2 - MATERIALS

2.1 Portland Cement Concrete

Provide concrete conforming to Specification Section 3300, Concrete Structures unless indicated otherwise.

2.2 Preformed Joint Filler

According to ASTM D 1751.

PART 3 - EXECUTION

3.1 Matching Existing Concrete

Sawcut and remove existing concrete to the lines indicated on the plan in accordance with Specification Section 2110, Removal of Existing Improvements. Sawcut, remove and replace sections damaged by construction in accordance with these specifications.

3.2 Base Preparation

According to Section 2610, Aggregate Base Course.

3.3 Form Work

Unless otherwise approved, use conventional forms to construct concrete curb, gutter, sidewalk and drives. Secure formwork to line and grade.
Thoroughly clean forms before each use and apply a light coat of release agent, which will not discolor the concrete.

Do not remove front face form before the concrete has taken the initial set and has sufficient strength to carry its own weight. Do not remove gutter forms or rear forms until concrete has reached sufficient strength to prevent damage. Sawcut, remove and replace damaged sections.

3.4 Machine Formed

Machines shall be designed specifically for such work and approved by the Owner. Machines shall be capable of producing results equal to or better than that produced with forms. If the results are not satisfactory to the Owner, discontinue the use of the machine and make necessary repairs no additional cost to the Owner. All applicable requirements of construction with forms shall apply to the use of machines.

3.5 Densification

Thoroughly spade concrete away from the forms so there will be no rock pockets next to the forms. The concrete may be compacted by mechanical vibrators approved by the Owner. Tamp or vibrate the concrete until the mortar rises to the surface and the coarse aggregate is not exposed.

3.6 Finish

Finish all concrete surfaces smooth, straight and defect free. Provide a light broom finish as approved by Owner on all surfaces.

3.7 Concrete Curing

Concrete curing shall be required according to the MAG Standard Specifications, Section 726. No diesel fuel is to be used.

3.8 Joints

A. Expansion Joints

Construct expansion joints in a straight line and vertical plane perpendicular to the longitudinal of the sidewalk or curb and gutter, except in cases of curved alignment, when joints will be constructed along the radial lines of the curve. Construct to the full depth and width of the concrete. Match the joints in the adjacent pavement sidewalk or curb and gutter. Joints shall be constructed at all radius points, driveways, alley entrances, adjoining structures, and at a maximum interval of 100 feet between joints.

B. Contraction Joints

Construct in a straight line and vertical plane perpendicular to the longitudinal line of the sidewalk or curb and gutter, except in cases of curved alignment when joints will be constructed along the radical lines of the curb. Construct to a depth of 1-inch and at 10- foot intervals on sidewalk widths of 5 feet and 12-foot intervals on sidewalks of 4-foot and 6-foot widths.

C. Edges

Shape with a suitable tool so formed as to round the edges to the radius indicated.

3.9 Sidewalks

Sidewalks shall have a cross-slope of 1/4-inch per foot or as indicated on the Plans.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

A. Curb With And Without Gutter

Curb and gutter will be measured in linear feet, to the nearest one linear foot, along the gutter flow line horizontally from end of curb to end of curb, including the street frontage of driveways, sidewalk ramps, and all curb returns. The measurement shall be per plan dimensions.

B. Sidewalk

Sidewalk will be measured in square feet, to the nearest one square foot, along the sidewalk centerline horizontally, from end of sidewalk to end of sidewalk. Sidewalk ramps will be included in the sidewalk quantity.Driveways will not be included in the sidewalk quantity. The measurement shall be per plan dimensions.

C. Residential and Commercial Driveways

Residential and commercial driveways will be measured in square feet, to the nearest one square foot, horizontally from edge of driveway to edge to driveway and back of curb to the end of the driveway. The measurement shall be per plan dimensions.

D. Valley Gutter

Valley gutter will be measured in linear feet, to the nearest one linear foot, horizontally along the longest flow line of valley gutter, parallel to the street, from end of curb return to end of curb return. The curb and gutter around the curb returns shall not be considered as a portion of the valley gutter. The measurement shall be per plan dimension.

4.2 Payment

If no item is listed in the bid tab or the measurement and payment section, this item is to be considered incidental.

Payment for concrete curb with and without gutter, valley gutter,sidewalk, residential driveways and commercial driveways will be made at the full contract price per linear foot, square foot or per each. Payment shall include, but not be limited to subgrade preparation, base preparation, base course, form materials and placement of steel and concrete materials.

See Section 00310 Bid Schedule for Bid Items.

** END OF SECTION 03310 **

SECTION 03356

TOOLED CONCRETE FINISHES

PART 1 - GENERAL

1.01 SUMMARY
Section Includes: Tooled concrete finishes.

1.02 DELIVERY, STORAGE, AND HANDLING
A. Packing and Shipping:
1. Deliver and store packages materials in original containers until ready for use.

PART 2 - RODUCTS

2.01 MIXES
A. Mortar Mix for F4 Finish: Consist of one part cement and 1-1/2 parts of fine sand passing Number 100 screen, mixed with enough water emulsified bonding agent to have consistency of thick cream.

PART 3 - EXECUTION

3.01 CONCRETE FINISHING
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 (use F4 finish if not otherwise indicated on drawings):
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 ½ 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 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 are uniform in 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 an 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 50 grit 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 indicated on the Drawings (Use finish S4 unless otherwise indicated on Drawings):
   1. S1 Finish: Screened 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 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.
   5. S5 Finish: Nonslip abrasive: After concrete has been screened level and hardened enough to support man standing on a board, sprinkle abrasive

from shake screen into surface at 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 nonslip surface.

D. Concrete Floor Surfaces to Which Surfacing Material is Applied: Finish smooth with tolerance within 1/8 inch in 10 feet in any direction from lines indicated on the Drawings.

END OF SECTION

SECTION 03600

GROUT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Concrete mortar, grout, drypack mortar, nonshrink grout, and epoxy grout.

B. Related Sections:

1. Section 03301 - Epoxies.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. C 109 - Standard Test Method for Comprehensive Strength of Hydraulic Cement Mortars.
2. C 157 - Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
3. C 191 - Standard Test Method for Time of Setting of Hydraulic Cement by Vicat Needle.
4. C 827 - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures.

B. U. S. Corps of Engineers (USCE):

1. CRD C-621 - Corps of Engineers Specification for Non-Shrink Grout.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Concrete Mortar:

1. General: Consist of concrete mixture with coarse aggregate removed and water quantity adjusted as required.
2. At Exposed Concrete Surfaces not to be Painted or Submerged in Water: White cement.

B. Grout:

1. Consist of mixture of Portland Cement and sand.

C. Dry-Pack Mortar:

1. Consist of mixture of Portland cement and sand.

D. Non-Shrink Grout:

1. Consist of hydraulic cement, which when mixed with water hardens rapidly to produce permanent high strength material suitable for exterior use.
2. Nonmetallic and not contain calcium chloride or other chemicals which accelerate corrosion of embedded steel.
3. Physical Characteristics:
   a. When Tested in Accordance with ASTM C 827: Show no shrinkage prior to initial setting.

b. When Tested in Accordance with ASTM C 157 and Corps of Engineers CRD C-621: Show no shrinkage in hardened state.

4. Manufacturers: One of the following or pre-approved equal:
   a. Master Builders, Inc., Masterflow 928 Grout.

E. Epoxy Grout:
   1. Consist of mixture of epoxy and sand.
   2. Sand: Clean, bagged, graded, and kiln dried silica sand.

2.02 MIXES

A. Concrete Mortar Mix:
   1. Use water-cement ratio that is no more than that specified for concrete being repaired.
   2. At Exposed Concrete Surfaces not to be Painted or Submerged in Water: Use sufficient white cement to make color of finished patch match that of surrounding concrete.

B. Grout Mix:
   1. For Concrete Repair: Mix in same proportions used for concrete being repaired, with only sufficient water to give required consistency for spreading.
   2. For Spreading over the Surfaces of Construction or Cold Joints: Mix with no more water used than allowed by water-cement ratio specified for concrete.
   3. For grout not specified in subparagraph 2.02B1 or 2.02B2, mix in proportions by weight of one part cement to four part of concrete sand.

C. Dry-Pack Mortar Mix: Use only enough water so that resulting mortar will crumble to touch after being formed into ball by hand.

D. Non-Shrink Grout: Mix accordance with manufacturer's installation instructions such that resulting mix has semi-fluid, flowable consistency and is suitable for placing by pouring.

E. Epoxy Grout:
   1. Mix in accordance with manufacturer's installation instructions for mixing.
   2. Proportioning:
      a. For horizontal work, consist of mixture of one part epoxy as specified in Section 03301 with not more than 2 parts sand.
      b. For vertical or overhead work, consist of 1 part epoxy gel as specified in Section 03301 with not more than 2 parts sand.

PART 3 - EXECUTION

3.01 PREPARATION

A. Surface Preparation:
   1. Concrete Surfaces: Clean and roughen by heavy sandblasting. For portland cement based mortars and grouts, concrete shall be saturated and surface damp before mortar or grout is placed.
   2. Epoxy Grout:
      a. Wet contact surface with prepared grout as required to provide proper adhesion.
      b. Where required to wet the concrete surfaces, apply coat of epoxy for horizontal work or epoxy gel for vertical or overhead work prior to placing epoxy grout.

3.02 APPLICATION

A. Cement Mortar and Grout:
   1. For Imperfect Concrete Repair:
      a. Filling: Filling of voids around items through the concrete.
      b. Grout Spreading: Spread over construction joints, cold joints, and similar type items.
   2. Concrete Surfaces:
      a. Apply epoxy bonding agent to clean, roughened, and dry surface before placing mortar or grout.
   3. Placing:
      a. Exercise particular care in placing portland cement mortar or grout since they are required to furnish structural strength or impermeable water seal or both.
      b. Do not use cement mortar or grout that has not been placed within 30 minutes after mixing.

B. Epoxy Grout:
   1. Apply in accordance with manufacturer's installation instructions.
   2. Use where specified herein or where indicated on the Drawings.

3.03 FIELD QUALITY CONTROL

A. Tests:
   1. Non-Shrink Grout:
      a. A set of three specimens shall be made for testing. One at seven days, one at 25 days, and the third of a later date if needed.
      b. Compression test specimens shall be taken during construction from the first day of placement of grout.
      c. The costs of all laboratory tests shall be borne by the CONTRACTOR.
      d. Compressive Strength When Tested In Accordance With ASTM C 109:

1) At One Day: Not less than 3,000 pounds per square inch. At 28 days: Not less than 6,000 pounds per square inch.

e. Setting Time when Tested In Accordance with ASTM C 191: Not less than 30 minutes.

*** END OF SECTION ***

SECTION 03605

EPOXY BONDING REINFORCING BARS AND RODS IN CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Bonding reinforcing bars and all thread rods in concrete using epoxy adhesive.

1.02 REFERENCES

A. American National Standards Institute (ANSI):
   1. Standard B212.15 - Cutting Tools - Carbide Tipped Masonry Drills and Blanks for Carbide Tipped Masonry Drills.

B. American Society for Testing and Materials (ASTM):
   1. C 881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

C. Steel Structures Painting Council (SSPC):
   1. SP-10 Near White Blast Cleaning.

1.03 SUBMITTALS

A. Product Data: Furnish technical data for epoxy adhesives, including installation instructions, independent laboratory test results, and handling and storage instructions.

B. Quality Control Submittals:
   1. Special Inspection: Provide detailed step-by-step instructions for the special inspection procedure as required by International Building Code.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Storage of Epoxy Components:
   1. Store epoxy components on pallets or shelving in a covered-storage area.
   2. Control temperature above 60 degrees Fahrenheit and dispose of product if shelf life has expired.
   3. If stored at temperatures below 60 degrees Fahrenheit, test components prior to use to determine if they still meet specified requirements.

PRODUCTS

1.05 GENERAL

A. Compatibility of Materials: Use end products of one manufacturer in order to achieve structural compatibility and singular responsibility.

1.06 EPOXY ADHESIVE FOR SELF-CONTAINED CARTRIDGE SYSTEM

A. Meet ASTM C 881, Type IV, Grade 3, Class B or C depending on site conditions.

B. Two-component, 100 percent solids, insensitive to moisture, and gray in color.

C. Cure Temperature, Pot Life, and Workability: Compatible for intended use and environmental conditions.

D. Container Markings: Include manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

E. Manufacturers: One of the following or equal:

1. Covert Operations, Long Beach, CA, CIA-Gel 7000 System.
2. Hilti, Tulsa, OK, RE 500 High Strength Epoxy Doweling System.

1.07 EPOXY ADHESIVE FOR METER AND MIXING PUMP SYSTEM

A. Meet ASTM C 881, Type IV, Grade 3, Class B or C depending on site conditions.

B. Two-component, 100 percent solids, insensitive to moisture, and gray in color.

C. Cure Temperature, Pot Life, and Workability: Compatible for intended use and environmental conditions.

D. Container Markings: Include manufacturer's name, product name, batch number, mix ration by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

E. Manufacturers: One of the following or equal:

1. Sika, Sante Fe Springs, CA, Sikadur 31 Hi-Mod Gel.

1.08 ALL THREAD BARS

A. As specified in Section 05052.

1.09 REINFORCING BARS

A. As specified in Section 03200.

PART 2 - EXECUTION

2.01 GENERAL

A. Dispensing, Metering, or Mixing Epoxy Adhesive Components: Use portable, automatic metering and mixing device or machine capable of maintaining prescribed mix ratio within deviation of 5 percent or less, by volume.

B. Dispense epoxy components through specially designed static mixing nozzle that thoroughly mixes epoxy components and places mixed epoxy at base of predrilled hole.

C. Mixing Nozzles: Disposable and manufactured in several sizes to accommodate different size and depth of holes.

D. Where large meter and mixing pumps are impractical, provide epoxy adhesive packaged as follows:

1. Disposable, self-contained cartridges system capable of dispensing both epoxy components in the proper mixing ratio, and fit into a manually or pneumatically operated caulking gun.

2. Dispense components through a mixing nozzle that thoroughly mixes components.

2.02 TESTING OF AUTOMATIC METERING AND MIXING PUMP SYSTEMS

A. Tests For Proper Ratio:
   1. Retain small amount of dispensed adhesive for inspection after each time the pump is refilled.
   2. Operator shall check these samples for color change.
   3. Should change in color occur, operator shall follow manufacturer's service instructions to obtain proper operation.

B. Frequency of Tests: Make full ratio check after each 10 gallons of adhesive is dispensed or if color of mixed adhesive becomes noticeably darker or lighter.

C. Ratio Check Procedure:
   1. Disconnect dispensing head behind ON/OFF valve.
   2. Place a 1 cup volume container and a 2 cup volume container under the "B" and "A" component hose ends.
   3. Actuate the pump until both cups are filled to proper proportion as recommended by epoxy manufacturer.

2.03 HOLE SIZING AND INSTALLATION

A. Drilling Holes:
   1. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the existing concrete without acceptance by OWNER.
   2. The location of reinforcing bars, or other obstructions shall be determined with a non-destructive indicator device.

B. Hole Drilling Equipment:
   1. Electric or pneumatic rotary impact type with medium or light impact.
   2. Drill Bits: Carbide-tipped in accordance with ANSI B212-15.
   3. Hollow drills with flushing air systems are preferred. Air shall be free of oil, water, or other contaminants which will reduce bond.
   4. Where edge distances are less than 2 inches, use lighter impact equipment to prevent microcracking and concrete spalling during drilling process.

C. Hole Diameter:
   1. Reinforcing bar diameter or all thread rod diameter plus 1/8 inch.

D. Obstructions in Drill Path:
   1. If the drill hits an existing reinforcing bar or other obstruction, stop drilling and fill the hole with drypack mortar. Relocate the hole to miss the obstruction and drill another hole. Repeat the above until the hole has been drilled to the required depth.
   2. Avoid drilling an excessive number of holes in an area which would excessively weaken the structural member being drilled and endanger the stability of the structure. When required, drypack holes which hit obstructions and allow drypack to reach strength equal to the existing

concrete being drilled before drilling adjacent holes. Epoxy grout may be substituted for drypack when acceptable to ENGINEER.

3. When existing reinforcing steel is encountered during drilling and when acceptable to ENGINEER, enlarge the hole by 1/8 inch, core through the existing reinforcing steel at the larger diameter, and resume drilling at original hole diameter.
4. Bent Bar Dowels: Where edge distances are critical, and striking reinforcing steel is likely, and if acceptable to ENGINEER, drill hole at 10 degree angle or less from axis of reinforcing bar or all thread rod being installed.

E. Install reinforcing bars and all thread rods to depth, spacings, and locations as indicated on the Drawings.

F. Cleaning Holes:
1. Insert long air nozzle into hole and blow out loose dust. Use air which is free of oil, water, or other contaminants which will reduce bond.
2. Use a stiff bristle brush to vigorously brush hole to dislodge compacted drilling dust.
3. Repeat step 1.
4. Repeat above steps as required to remove drilling dust or other material which will reduce bond. The hole shall be clean and dry.

G. Cleaning Reinforcing Bars and All Thread Rods:
1. Degrease and sandblast reinforcing bars or all thread rods over embedment length to near-white metal in accordance with Steel Structures Painting Council, SP-10 finish. The reinforcing bar or all thread rod shall be free of oil, grease, paint, dirt, mill scale, rust, or other coatings that will reduce

H. Filling Hole with Epoxy:
1. Fill the hole with epoxy before inserting the reinforcing bar or all thread rod. Fill hole with epoxy starting from back of the hole. Fill hole without creating air voids.
2. Fill the hole with sufficient epoxy so that excess epoxy is extruded out of the hole when the reinforcing bar or all thread rod is inserted into the hole.

*** END OF SECTION ***

DIVISION 5

ANCHORS, BOLTS, AND CONCRETE INSERTS

SECTION 05052

ANCHOR BOLTS, TOGGLE BOLTS
AND CONCRETE INSERTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown on the Drawings, specified, and required to furnish and install anchor bolts, toggle bolts and concrete inserts.

B. This Section includes all anchor bolts, toggles and inserts required for the Work, but not specified under other Sections.

C. The types of Work using the anchor bolts, toggles and inserts include, but are not limited to the following:

1. Hangers and brackets.
2. Equipment.
3. Piping.
4. Electrical and Plumbing Work.
5. Metal and plastic fabrications.
6. Structural members and accessories.

D. Related Sections: CONTRACTOR shall coordinate the requirements of the Work in this Section along with the requirements of the Sections listed below which includes, but is not necessary limited to, Work that is directly related to this Section.

1.02 QUALITY ASSURANCE

A. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown and specified.

1. ASTM A36M-14 - Standard Specification for Carbon Structural Steel.
2. ASTM A123M-17 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A153M-16a - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4. ASTM A307-14e1 - Standard Specification for Carbon Steel Bolts, Studs and Threaded Rod 60,000 psi Tensile Strength.
5. ASTM A484M-18a - Standard Specification for General Requirements for Stainless Bars, Billets and Forgings.
6. ASTM A536-84(2019)e1 - Standard Specification for Ductile Iron Castings.
7. ASTM B633-19 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
8. ASTM F593-17 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
9. Federal Specification FF-S-325 - Shield Expansion; Nail Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry).

10. Federal Specifications WW-H-171E - Hangars and Support, Pipe.
11. ICBO, International Conference of Building Officials.
12. International Building Code.

B. Inserts shall be ICBO, UL or FM approved.

C. Toggle Bolts: Federal Specification FF-B-588C - Type I, Class A, Style 1.

1.03 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Copies of manufacturer's specifications, load tables, dimension diagrams and installation instructions for the devices.
2. Copies of ICBO, UL or FM Reports certifying load carrying capacities and installation requirements for the anchorage devices.

PART 2 - PRODUCTS

2.01 DESIGN CRITERIA

A. When the size, length or load carrying capacity of an anchor bolt, toggle bolt, or concrete insert is not shown on the Drawings, provide the following:

1. For anchor bolts (cast-in-place), provide the size, length and capacity required to carry the design load based on the values and requirements given in the International Building Code.
2. For concrete anchors (epoxy adhesive types), stud type expansion anchors, and concrete inserts, provide the size, length, type, and capacity required to carry the design load based on the values and requirements given in the ICBO Evaluation Report, or similar certifications by UL or FM, for the anchor to be used. Alternately the capacity may be based on independent testing lab capacities for tension and shear strength using a minimum safety factor of four. Consideration of reduced capacity ue to spacing and edge distance shall be made.

B. Determine design loads as follows:

1. For equipment anchors, use the design load recommended by the equipment manufacturer.
2. For pipe hangers and supports, use the total weight of: pipe, fittings, and water contained in pipe, plus the full weight of valves and accessories located between the hanger or support in question.
3. Allowances for vibration shall be included.
4. Concrete anchors shall develop ultimate shear and pull-out loads of not less than the following values in 4,000 psi concrete:

Bolt Diameter (Inches)	Min. Shear (Pounds)	Min. Pull-Out Load (Pounds)
½	5,000	7,600
5/8	8,000	12,000
3/4	11,500	17,000
7/8	15,700	20,400
1	20,500	28,400

2.02 APPLICATION

A. n masonry, only anchor bolts shall be used.

B. Anchor Bolts (cast-in-place):

1. Shall be used where indicated and may be used where concrete anchors are indicated.
2. Where an anchor bolt is indicated, only a cast-in-place anchor bolt shall be used, unless another anchor type is accepted by the ENGINEER.
3. Provide anchor bolts as shown on the Drawings or as required to secure structural steel to concrete or masonry.

C. Epoxy Adhesive Anchors:

1. Use where subject to vibration or where buried or submerged.
2. Use for pipe supports.
3. Use in concrete.
4. Shall not be used for pipe hangers.

D. Concrete Inserts:

1. Use only where indicated on the Drawings.
2. Use for pipe hangers and supports for the pipe size and loading recommended by the insert manufacturer.

E. Toggle Bolts:

1. Use for fastening brackets and other elements onto masonry units.

F. Stud Type Expansion Anchors:

1. Use only when indicted on the Drawings.

2.03 MATERIALS

A. nchor Bolts:

1. Provide carbon steel bolts complying with ASTM A 307 - headed or non-headed type where indicated.
2. In buried or submerged locations, provide stainless steel bolts complete with washers complying with ASTM F 593 - AISI Type 316 and with nitronic 60 stainless steel nuts and locknuts.
3. For equipment, provide anchor bolts, which meet the equipment manufacturer's recommendations for size, material, and strength.
4. Provide anchor bolts as shown on the Drawings or as required to secure structural steel to concrete or masonry.

5. Locate and accurately set the anchor bolts using templates or other devices as required.
6. Protect threads and shank from damage during installation of equipment and structural steel.
7. Comply with manufacturer's required embedment length and necessary anchor bolt projection.

B. Epoxy Adhesive Anchors:
1. Provide stainless steel adhesive anchors complying with ASTM F 593 - AISI Type 316 with nitronic 60 stainless steel nuts and locknuts.
2. In buried or submerged locations, provide stainless steel adhesive anchors complying with ASTM F 593 - AISI Type 316 with nitronic 60 stainless steel nuts and locknuts.
   Anchors shall be of the size required for the concrete strength specified.
3. Adhesive anchors shall consist of threaded rods or bolts anchored with an adhesive system into hardened concrete or grout-filled masonry. The adhesive system shall use a two-component adhesive mix and shall be injected with a static mixing nozzle following manufacturer's instructions. The embedment depth of the rod/bolt shall provide a minimum allowable bond strength that is equal to the allowable tensile capacity of the rod/bolt, unless noted otherwise on the Drawings.
4. Product and Manufacturer: Provide one of the following:
   a. RE 500 Epoxy Injection Adhesive Anchor System, as manufactured by Hilti.
   b. Or equal.

C. Concrete Inserts:
1. For piping, grating and floor plate, provide malleable iron inserts. Comply with Federal Specification WW-H-171E (Type 18). Provide those recommended by the manufacturer for the required loading.
2. Finish shall be black.
3. Product and Manufacturer: Provide inserts by one of the following:
   a. Figure 282, as manufactured by ITT Grinnell.
   b. No. 380, as manufactured by Hohmann and Barnard, Incorporated.
   c. Or equal.

D. Toggle Bolts:
1. Provide spring-wing toggle bolts, with two-piece wings.
2. Provide carbon steel bolts with zinc coating in accordance with Federal Specification FF-S-325.
3. Product and Manufacturer: Provide toggle bolts by one of the following:
   a. The Rawlplug Company, Incorporated.
   b. Haydon Bolts, Incorporated.
   c. Or equal.

E. Stud Type Expansion Anchors:
1. Product and manufacturer
   a. Kwik-Bolt 3.
   b. Or equal.

F. Powder activated fasteners and other types of bolts and fasteners not specified herein shall not be used.

PART 3 - EXECUTION

3.01 INSPECTION

A. CONTRACTOR shall examine areas and conditions under which anchor bolts, toggle bolts and concrete insert Work is to be installed.

3.02 INSTALLATION

A. Assure that embedded items are protected from damage and are not filled in with concrete.

B. Use concrete inserts for pipe hangers and supports for the pipe size and loading recommended by the insert manufacturer.

C. Use toggle bolts for fastening brackets and other elements onto masonry units. For the epoxy adhesive anchors and adhesive material, CONTRACTOR shall comply with the manufacturer's installation instructions on the hole diameter and depth required to fully develop the tensile strength of the adhesive anchor or reinforcing bar. Contractor shall properly clean out the hole utilizing a wire brush and compressed air to remove all loose material from the hole, prior to installing adhesive capsules or material.

3.03 CLEANING

A. After embedding concrete is placed, remove protection and clean bolts and inserts.

END OF SECTION

SECTION 05120

MISCELLANEOUS STEEL

PART 1 - GENERAL

1.1 Summary

A. This Section includes fabrication and erection of the structural steel and other steel or metal items as defined in AISC Manual, Code of Standard Practice.

B. Structural Steel Repair and Improvement Requirements

1. Interior Structural Steel Repair Work

a. Replace a total of one column and top cap plate. The replacement column and cap plate shall be equal or greater in size and material properties to those being replaced. The existing column base plates shall remain in place. Grind the top of the existing column base plate surfaces smooth for column to fully bear against the top of the plate. Install the columns plumb. At the Contractor's option the `columns may be repaired by welding new cover plates of sufficient cross sectional area to restore the load carrying capacity of the existing members to their original condition. Prior to the start of work, the Contractor shall submit a detailed report with recommendations and drawings for the replacement or repair of the structural steel columns to the Engineer for approval. The Contractor shall submit the report and drawings sealed by a registered professional Engineer licensed in the state of Arizona.

b. Replace roof purlins at locations directed by the Engineer. Inspect all structural steel surfaces following abrasive blasting operations. Notify the Engineer in writing where the loss of material exceeds fifteen (15) percent of the original material thickness. At the Contractor's option the roof beams may be repaired by welding new cover plates of sufficient cross sectional area to restore the load carrying

capacity of the existing members to their original condition. Prior to the start of work, the Contractor shall submit a detailed report with recommendations and drawings for the replacement of repair of the structural steel roof beams to the Engineer for approval. The Contractor shall submit the report and drawings sealed by a registered professional Engineer licensed in the state of Arizona.

c. Perform Ultra Sonic Floor Thickness Survey and vacuum test on all floor seams prior to application of the new protective coating system. Locate any leaks in the floor plate or welded joint using vacuum testing in accordance with AWWA D100, Section 11.12.
Leaks observed in welds shall be repaired by gouging- out the defective area and rewelding. Leaks observed at surfaces of plates shall be repaired by seal welding a ¼ inch thick plate (minimum) to the existing floor plate. Prior to the start of the repair work, the Contractor shall submit a detailed report with recommendations and drawings for the repair of the floor, to the Engineer for approval. The Contractor shall submit the report and drawings and sealed by a registered professional engineer licensed in the State of Arizona.

2. Exterior Structural Steel Modifications:
   a. Install new safety handrail and chain as indicated in Sketches SK-1 and SK-3.
   b. Install new gauge board numbers, float and target per Sketch SK-7.
   c. Remove and replace the existing roof vent located at the center of the roof per Sketch SK-4. Install new side vents through the shell wall of reservoir per Sketch SK-5 and SK-6. Eight side vents shall be equally spaced around the perimeter of the shell wall of each 1.0 mg tank above maximum overflow inlet pipe elevation and shall avoid interference with existing ladders, piping, level indicators, etc.
   d. Furnish and install 30” access door on shell at location determined by the Engineer. Access door to be installed per AWWA D100-*Welded Steel Tanks for Water Storage* and shall be constructed with a side hinge assemble. Shop drawings to be submitted with a structural engineer stamp prior to installation.

C. Related Work Specified Elsewhere
Protective Coatings..... Section 09900

1.2 References

A. Applicable Standards
1. American Institute of Steel Construction (AISC) Manual of Steel Construction – Allowable Stress Design. Quality Criteria and Inspection Standards.
2. American Welding Society (AWS)
A5.4 – Stainless Steel Electrodes for Shielded Metal Arc Welding.
D1.1 – Structural Welding Code – Steel.
QC1 – Standard for AWS Certification of Welding Inspectors. QC3 – Standard for AWS Certified Welders.
3. American Society for Testing and Materials (ASTM)
A6 – General Requirements for Rolled Steel Plates, Shapes Sheet Piling, and Bars for Structural Use.
A36 – Structural Steel.
A53 – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
A106 – Seamless Carbon Steel Pipe for High-Temperature Service.
A108 – Steel Bars, Carbon, Cold-Finished, Standard Quality. A307 – Carbon Steel Bolts and Studs, 60,000 psi Tensile.
A563 – Carbon and Alloy Steel Nuts.
A569 – Steel, Carbon (0.15 Maximum, Percent) Hot-Rolled Sheet and Strip Commercial Quality.
F436 – Hardened Steel Washers.
4. American Water Works Association (AWWA)
D100 – Welded Steel Tanks for Water Storage

1.3 Submittals
A. Submit as specified in DIVISION 1.
B. Includes, but not limited to, the following:
1. Fabrication and erection drawings for all Work. The Contractor may use a reproduction of the Engineer prepared Contract Drawings for erection drawings such as to indicate information on erection or to identify detail drawing references. Where the drawings are revised to show this additional Contractor information, the Engineer's title block is to be replaced with a Contractor's title block and the Engineer's professional seal will be removed from the drawing. The Contractor shall revise these erection drawings for subsequent Engineer revisions to the Contract Drawings.
2. All necessary information for the fabrication, including filler

metal for welds, of the component part of the structure, presented on drawings to conform to recognized standard practice, AISC Manual Part 5, and AWS Code.

3. Drawings showing each piece marked for identification to correspond to erection drawings.

4. Manufacturer's literature on products including, but not limited to hardware and protective coatings.

1.4 Quality Assurance

A. Welder Qualifications

1. Welders shall be previously qualified by passing the tests prescribed in the AWS Standard Qualification Procedure.

2. Welders shall have been tested within the past 12 months and their qualification shall be considered as remaining in effect unless the welder is not engaged in a given process of welding for a period exceeding 6 months.

B. Inspection: Material or workmanship may be subject to inspection in the shop and field.

1.5 Delivery, Storage and Handling

A. Handle and store all steel and appurtenances as specified in DIVISION 1.

B. Store all steel and appurtenances blocked-up off the ground and in orderly stacks.

C. Protect all items with shop applied protective coatings from corrosion. Store in an environment and manner consistent with type of coating.

PART 2 – MATERIALS

2.1 Basic Materials

A. Steel: Conform to ASTM A36, as designated in the AISC Manual, Part 1, unless otherwise indicated or specified.

B. Connection Bolts, Nuts, and Washers

1. Conform to ASTM A307.

2. Be galvanized when connecting galvanized steel.

C. Handrail: Conform to ASTM A53, Type E or S, Grade B or ASTM A106, Grade B.

D. Pipe for Structural Uses: Conform to ASTM A53, Type E or S, Grade B, or ASTM A106, Grade B.

E. Welding

1. For ASTM A36 steel, use E70 electrodes for shielded metal arc welding, F7 series electrodes for submerged arc, E70T series electrodes for flux-cored arc welding, and ER70S series electrodes for gas metal arc welding.

2. Select "matching" filler metal in accordance with Table 4.1, AWS D1.1.
3. Select "matching" electrodes in accordance with AWS A5.4 for welding of stainless steel.

2.2 Steel Fabrication

A. Fabricate all steel to conform to AISC specifications, codes, and standards.

B. Permissible variations for sweep, camber, length, and cross section of all steel members shall conform to ASTM A6, AISC "Manual of Steel Construction, Part 1", AISI "Code of Standard Practice", and AISC "Quality Criteria and Inspection Standards" unless indicated otherwise.

C. Welding

1. All welding shall be shielded metal arc, submerged arc, or flux cored arc, or gas metal arc. For gas metal arc welding, the short-circuiting mode of filler metal transfer is not permitted.
2. Conform to AWS Code, AISC Manual, Part 4, and the AISC Quality Criteria and Inspection Standards.
3. The Contractor shall perform fabrication welding inspection in accordance with AWS D1.1. This welding inspection shall be performed by AWS Certified Welding Inspector(s) (CWI). Defective welds shall be corrected.

D. Shop Connections

1. Weld or bolt as indicated or specified.

E. Provisions for Field Connections

1. Provide with bolted connections as indicated or specified.

2.3 Shop-Protective Coating

A. Prepare surface and apply primer (first coat) as specified in SECTION 9900.

B. Apply primer in shop to all steel including connections, except for the following surfaces:

1. Within 3 inches adjacent to field welds.
2. On faying surfaces of bolted connections when using alkyd primer.

2.6 Handrail

A. 1-1/2-inch nominal (1.9-inch od) round, black standard-weight pipe.

B. Post spacing shall not exceed 5 feet from center-to-center.

C. Form and weld all handrail. Grind all welds smooth and even with the surface of the pipe, including field welds required for erection.

D. Carefully form all handrail where change of direction or elevation occurs.

E. Handrail posts shall be vertical (plumb) unless otherwise indicated.

PART 3 - EXECUTION

3.1 Preparation

A. Contractor shall submit the method and sequence of erection for acceptance.

3.2 Steel Erection

A. Erect all steel to conform to AISC specifications, codes, and standards; AISC Quality Criteria and Inspection Standard; or any local, state or federal codes which may exceed such requirements.

B. Erection Shoring and Bracing

1. Contractor shall be responsible for structural adequacy, design, engineering, and construction of all erection shoring and bracing.
2. Provide all necessary temporary struts, ties, cables, temporary flooring, planking, and scaffolding in connection with the erection of the structural steel or support of erection machinery.
3. Locate shoring and bracing as required to maintain proper position against loads from erection equipment, construction material, and wind.
4. Leave bracing in place until sufficient steel connections to ensure stability of the structure.

C. Connections

1. Make bolted connections as indicated.
2. Where required for connection fit-up, bolt holes may be adjusted in one of the following manners (flame cutting or flame enlargement of holes is not allowed):
   a. Reamed to AISC allowable maximum size for oversized holes.
   b. Holes may be filled with weld metal, ground smooth, and field-drilled.
3. Welded Connections
   a. Make welded connections as indicated and leave all erection bolts in place after completion of welding unless otherwise indicated.
   b. Reinforce connections when members requiring fillet welds are not in contact.
   c. Use backup bars or spacer bars on all butt welds where root opening exceeds 3/16-inch.
   d. Remove all run-out tabs.

D. Welding and Welders
   1. The requirements for erection welding and welders shall be the same as specified for steel fabrication.
   2. The Contractor shall perform erection-welding inspection in accordance with AWS D1.1. This welding inspection shall be performed by AWS Certified Welding Inspector(s) (CWI). Defective welds shall be corrected.

E. Protect pipe sleeves and other anchorage members from deleterious materials at all times.

F. Handrail
   1. Form and weld all handrail. Grind all welds smooth and even with the surface of the pipe.
   2. Carefully fit all handrail where change of direction or elevation occurs.
   3. Install all rails and posts plumb, level, straight and true, and in alignment.
   4. Top rail shall clear all fixed objects by at least 3 inches vertically and horizontally.
   5. Furnish and install plates, bolts, and additional items as indicated or required for fastening to supporting members.

3.3 Field-Protective Coatings

A. Surface preparation, priming, and finish coating are specified in Section 9900.

PART 4 – MEASUREMENT AND PAYMENT

4.1 Measurement: No measurement will be made for this item, Miscellaneous Steel.

4.2 Payment: Payment will be made at the Contract Lump Sum Price Bid and the "Schedule of Adjustment Unit Prices" and shall be considered full payment for providing all labor, equipment, tools and materials to perform this Work.

END OF SECTION

DIVISION VII

THERMAL MOISTURE PROTECTION

SECTION 07900
JOINT SEALERS

PART 1 - GENERAL

1.01 SECTION INCLUDES
- A. Sealants and joint backing.
- B. Precompressed foam sealers.

1.02 REFERENCES
- A. ASTM C834-17 - Standard Specification for Latex Sealants.
- B. ASTM C920-18 - Standard Specification for Elastomeric Joint Sealants.
- C. ASTM C1193-16 - Standard Guide for Use of Joint Sealants.
- D. ASTM D1667-17 - Standard Specification for Flexible Cellular Materials--Poly (Vinyl Chloride) Foam (Closed-Cell).

1.03 SUBMITTALS
- A. See Section 01340 for submittal procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.
- C. Product Schedule: Provide schedule indicating manufacturer's products matched to the same Sealant Types (Type ES-1 and Type ES-2, etc.) listed in Part 2 of this Section.
  1. Failure to provide product schedule will result in immediate rejection of the submittal.
- D. Manufacturer's Installation Instructions: Indicate special procedures, surface preparation, and perimeter conditions requiring special attention.

1.04 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum five years' experience.

1.05 ENVIRONMENTAL REQUIREMENTS
- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.06 COORDINATION
- A. Coordinate the work with all sections referencing this section.

1.07 WARRANTY
- A. Correct defective work within a one year period after Date of Substantial Completion.
- 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.

PRODUCTS

1.08 SEALANTS

A. Type ES-1: General Purpose Exterior Sealant: Polyurethane; ASTM C 920, Grade NS, Class 25, Uses NT, M, G, A and O; multi-component.
   1. Color: Standard colors matching finished surfaces.
   2. Product: Sonolastic NP 2 manufactured by Sonneborn Building Products Div., ChemRex, Inc: www.chemrex.com or equal.

B. Type ES-2: Self-leveling polyurethane; ASTM C 920, Grade P, Class 25, Uses T and M; multi-component.
   1. Color: Standard colors matching finished surfaces.
   2. Product: Sonolastic SL2 manufactured by Sonneborn Building Products Div., ChemRex, Inc: www.chemrex.com or equal.

C. Type ES-4: Butyl sealant, single component, non-hardening with no asbestos.
   1. Product and Manufacturer:
      a. CRL 777 Butyl Rubber.
      b. AP-77 manufactured by Adco Products, Inc: www.adcoglobal.com or equal.

D. Type AE-1 - General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C 834, Type OP, Grade NF single component, paintable.
   1. Color: Standard colors matching finished surfaces.
   2. Product: AC-20 manufactured by Pecora Corporation: www.pecora.com or equal.

E. Type SIL-1: White silicone; ASTM C 920, Type S, Grade NS, Class 25, Uses G and A; single component, mildew resistant.
   1. Product: 786 Mildew Resistant Silicone Sealant manufactured by Dow Corning Corp: www.dowcorning.com or equal.

1.09 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: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.

D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 2 - EXECUTION

2.01 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.

2.02 PREPARATION

A. Remove loose materials and foreign matter which might impair adhesion of sealant.
B. Clean and prime joints in accordance with manufacturer's instructions.
C. Perform preparation in accordance with manufacturer's instructions and ASTM C 1193.
D. Protect elements surrounding the work of this section from damage or disfigurement.

2.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
B. Completely seal joints indicated on Drawings and as required to render weathertightness, close openings, and allow movement of materials.
C. Perform installation in accordance with ASTM C 1193.
D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
E. Install bond breaker where joint backing is not used.
F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
G. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
H. Tool joints in accordance with manufacturer's instructions.
I. Do not lap or feather onto adjacent surfaces.
J. Joint Backing: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.

2.04 CLEANING

A. Clean adjacent soiled surfaces.
B. Repair or replace defaced or disfigured finishes caused by work of this Section.

2.05 PROTECTION OF FINISHED WORK

A. Protect sealants until cured.

2.06 SCHEDULE

A. Exterior Joint Sealants:
    1. Exterior Joints for Which No Other Sealant Type is Indicated: Type ES-1; colors as selected.
    2. Expansion Joints in Paving Sloped 1:50 or Less: Type ES-2.
    3. Expansion Joints in Paving Sloped More than 1:50: Type ES-1.
    4. Joints Between Light Fixtures and Walls: Type ES-1.
    5. Joints Between Piping and Walls: Type ES-1.
    6. Joints Between Ductwork and Walls: Type ES-1.
    7. Joints Between Exterior Metal Frames and Adjacent Work: Type ES-1.
    8. Under Exterior Door Thresholds: Type ES-4.

B. Interior Joint Sealants:
   1. Interior Joints for Which No Other Sealant is Indicated: Type ES-1; colors as selected.
   2. Joints Between Metal Frames and Adjacent Work: Type AE-1.
   3. Exposed Control and Expansion Joints in Concrete Slabs and Floors: Type ES-2.
   4. Joints Between Plumbing Fixtures and Walls: Type SIL-1.
   5. Joints Between Plumbing Fixtures and Concrete Floors: Type ES-1.
   6. Concealed Joints Between Ductwork and Walls: Type ES-1.
   7. Joints Between Piping and Walls: Type ES-1.

Colors: Except for interior sealants to be painted and as may otherwise be indicated, provide colors that match adjacent surfaces.

**** END OF SECTION ****

DIVISION 9

PROTECTIVE COATINGS

SECTION 09900
PROTECTIVE COATINGS

PART 1 - GENERAL

1.1 Summary

A. This Section includes coating of exterior and interior surfaces throughout the Project and which are listed in PART 2 with systems specified in PART 2.

B. Coating systems include surface preparation, prime coat (first coat), finish coats (second and third coats), inspection, cleaning, and touch-up of surfaces and equipment. Shop preparation, prime coat, and finish coats to be shop-applied, may be specified elsewhere or referenced to this Section so that a complete system is specified and coordinated.

1. Where surface preparation and first (prime) coat are specified in other Sections to be shop-applied, such as for structural steel, or equipment, only the touch-up and finish coats are a part of field painting. Surface preparation is the required degree of preparation prior to application of first (prime) coat regardless if done in shop or field.
2. If materials are provided without shop primer then surface preparation, first, second, and third coats are a part of field painting.
3. Concealed surfaces are generally not required to have finish- coats unless otherwise specified, but prime coat should be applied and touched up prior to concealment.
4. Where Equipment and Materials are provided with shop- applied finished coating system, only touch-up is a part of field painting.
5. Refer to applicable Sections to determine whether surface preparation and first coat, or complete coating system, is to be shop-applied.

C. Related Work Specified Elsewhere

1. Shop Painting and Coatings: All applicable Divisions.
2. Factory Prefinished Items: All applicable Divisions.

D. Colors

1. Color of finish coatings shall match accepted color Samples.
2. When second and finish coats of a system are of same type, tint or use an alternate color on second coat to enable visual coverage inspection of the third coat. When first and second coats only are specified and are of same or different types, tint or use an alternate color on first coat to enable visual coverage inspection of the second coat.
3. Contract Price shall include the following approximate number of finish coat colors to form a basis for bidding:
   a. Epoxy: Eight colors, with 50% deep tone colors.
   b. Ceramic: Two colors, with 50% deep tone colors.

1.2 Quality Assurance

A. Reference Standards and Specifications

1. American National Standards Institute (ANSI)
   ANSI A 13.1 - Scheme for the Identification of Piping Systems.
   ANSI Z 53.1 - Safety Color Code for Marking Physical Hazards.

2. American Society for Testing and Mateirals (ASTM)
ASTM D4258 - Surface Cleaning Concrete for Coating.

ASTM D4261 - Surface Cleaning Concrete Unit Masonry for Coating.

3. Society for Protective Coatings (SSPC) Surface Preparation Specifications
SP1 - Solvent Cleaning: Removes oil, grease, soil, drawing and cutting compounds, and other soluble contaminants.

SP2 - Hand Tool Cleaning: Remove loose material. Not intended to remove adherent mill scale, rust, and paint.

SP3 - Power Tool Cleaning: Removes loose material. Not intended to remove all scale or rust.

SP5 - White Metal Blast Cleaning: Removes all scale, rust, foreign matter. Leaves surface gray-white uniform metallic color.

SP6 - Commercial Blast Cleaning: Two-thirds of each square inch free of all visible residues; remainder only light discoloration.

SP10 - Near-White Metal Blast Cleaning. SP11 -
Power Tool Cleaning to Bare Metal.

4. American Waterworks Association (AWWA)
Standard for Painting and Repainting Steel Tanks, Stand- Pipes, Reservoirs, and Elevated Tanks for Water Storage, D- 102.

5. American Concrete Institute (ACI)
ACI 515.1R Guide to the Use of Waterproofing, Damp- proofing, Protective and Decorative Barrier Systems for Concrete

B. Include on label of container:
1. Manufacturer's name, product name, and number.
2. Type of paint and generic name.
3. Color name and number.
4. Storage and temperature limits.
5. Mixing and application instructions, including requirements for precautions which must be taken.
6. Drying, recoat, or curing time.

C. Prepainting Conference
1. Before Project field painting starts, representatives for the Owner, Contractor, coating applicator, and coating manufacturer’s technical representative shall meet with Engineer.
2. Agenda for the meeting will include details of surface preparations and coating systems to ensure understanding and agreement by all parties for compliance.

D. Warranty
   1. The coating manufacturers and applicators shall warrant their products and applications respectively against defects for a period of five (5) years under normal use. The warranty shall be in printed form.

E. In the event a problem occurs with coating system, surface preparation, or application, coating applicator and coating manufacturer's technical representative shall promptly investigate the problem and submit results to Engineer.

F. Stated VOC shall be unthinned maximum VOC certified by manufacturer.

G. A coating report shall be completed daily by Contractor at each phase of the coating system starting with surface preparation. These shall be submitted on the form attached at the end of this Section.

1.3 Submittals

A. Submit as specified in Section 1330.

B. Includes, but not limited to, the following:
   1. Schedule of products and paint systems to be used. Schedule shall include the following information:
      a. Surfaces for system to be applied.
      b. Surface preparation method and degree of cleanliness.
      c. Product manufacturer, name, and number.
      d. Method of application.
      e. Dry-film mil thickness per coat of coating to be applied.
   2. Color charts for selection and acceptance.
   3. Technical and material safety data sheets.
   4. Certification by coating manufacturer(s) that all coatings are suitable for service intended as stated on each coating system sheet. If manufacturer has an equivalent product as that specified, but it is not suitable for the intended purpose, he shall submit the recommended product for approval at no increase in cost, and state reasons for substitution.
   5. Contractor shall certify in writing to the Engineer that applicators have previously applied all the systems in this Specification and have the ability and equipment to prepare the surfaces and apply the coatings correctly.

1.4 Delivery, Storage, and Handling

A. Delivery of Materials
   1. Deliver in original unbroken sealed containers with labels and information legible and intact. Containers shall also have correct labels with required information.
   2. Allow sufficient time for testing if required.
   3. Open and mix on the premises and in the presence of the Engineer. Any rejected material shall be at once removed from the premises. Colors shall be as selected by Engineer.

B. Storage of Materials

1. Store only acceptable materials on Project site in enclosed structures to protect them from weather and excessive heat and cold. Store in accordance with County and State Safety Codes.
2. Provide separate area and suitable containers for storage of coatings and related coating equipment.
3. Dispose of used or leftover containers, thinners, rags, brushes, and rollers in accordance with applicable regulations.

1.5 Regulatory Requirements

A. In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local and regional jurisdiction. Notify Engineer of any coating specified herein that fails to conform to the requirements for the location of the project or location of application.

B. Lead Content: Use only coatings that are totally lead free except for zinc-rich primers which shall not have a lead content over 0.06% by weight of nonvolatile content.

C. Chromate Content: Do not use coatings containing zinc- chromate or strontium chromate.

D. Asbestos Content: Materials shall not contain asbestos.

E. Mercury Content: Materials shall not contain mercury or mercury compounds.

1.6 Project Conditions

A. This Project is in a location in which drifting coatings, if spray- applied, could contaminate adjacent surfaces or vehicles nearby.
All containment precautions and application methods shall be taken into consideration and implemented to prevent the above from occurring.

1.7 Inspection Service

A. Owner will engage in the services of an independent NACE certified coating inspection service, Level III certification.

B. Inspection service will provide full-time inspection of all field surface preparation and coating applications to ensure full compliance with the requirements of this Specification. The presence of the inspection service shall not relieve Contractor for compliance with Specifications or authorized changes.

C. Inspection service will document all work, including nonconformance, using forms acceptable to Owner and Engineer. All documentation and reports will be prepared and signed by the Inspection service representative, and submitted to Engineer on a daily basis. At the completion of all coating applications, Inspection service representative will also submit a conformance report certifying that all Work relative to coatings complies with the Specifications or authorized change.

D. Inspection service will be responsible for field verification and recommendations of the following field coating operations:
   1. Surface preparation methods, equipment.
   2. Substrate conditions, moisture content of concrete, substrate profiles, and surface temperatures.
   3. Temperature, humidity, and wind conditions at times of coating applications.
   4. Specified or approved coating verification.
   5. Application equipment.
   6. Coating wet and dry film thickness.
   7. Proper coating curing.
   8. Coating system failure, causes, and remedy.

E. Inspection service representative will discuss with Engineer, Owner, and Contractor all recommended Specification deviations, changes in products, or application methods.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Acceptable manufacturers are as follows:
   1. Sauereisen
   2. Carboline
   3. Raven Lining Systems
   4. Ameron Protective Coatings Systems Group, Ameron Corp.
   5. Devoe Coating Company, Division of ICI.
   6. Futura Coatings, Inc.
   7. The Glidden Company.
   8. International Protective Coatings.
   9. Keeler & Long, Inc.
   10. Kop-Coat, Inc., Division of Carboline.
   11. Pittsburgh Paints, PPG Industries Inc.
   12. Santile, Division of Carboline Company, Inc.
   13. Tnemec Company, Inc.
   14. Polyken

2.2 General

A. Materials furnished for each coating system must be compatible to the substrate.

B. When unprimed surfaces are to be coated, entire coating system shall be by the same coating manufacturer to assure compatibility of coatings.

C. When shop-painted surfaces are to be coated, ascertain whether finish materials will be compatible with shop coating. Inform Engineer/ Architect of any unsuitable substrate or coating conditions.

D. Coating system shall be as specified below or to the manufacturer's standard, whichever is more stringent.

2.3 Areas of Application

A. Submerged Concrete Surfaces, exposed to H_2S vapor:
   1. Surface Preparation and coating system: In accordance with manufacturer's recommendations.
   2. Applied to all concrete surfaces including floors, walls, baffles and ceilings.
   3. Product and Manufacturer:
      a. Sauereisen 210
      b. Raven 405
      c. Plasite 5371
      d. Or approved equal.

B. Ferrous Metals including all Structural Steel, Miscellaneous Ferrous Metals, and all Ferrous Piping; Interior Non-submerged:
   1. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning as specified in Paragraph 3.1.
   2. Interior non-submerged applies to areas that are housed within a building and/or within a non-process, enclosed structure.
   3. Product and Manufacturer: Provide one of the following:
      a. Tnemec:
         1) Shop Primer: 66 H.B. Epoxoline – two coats, 2-3 dry mils per coat
         2) Field Primer or Filed Touchup: 66 H.B. Epoxoline – one coat, 2-3 dry mils per coat.
         3) Finish: 69 H.B. Epoxoline II – tow coats, 4-5 dry mils per coat.
      b. Or approved equal

C. Ferrous Metals, Including all Ferrous Piping; Exterior Non-submerged:
   1. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning as specified in Paragraph 3.1.
   2. Exterior non-submerged applies to areas that are not housed within a building or structure, and that are not located within process and / or water carrying structures or tanks.
   3. Product and Manufacturer: Provided one of the following:
      a. Tnemec:
         1) Primer: 66 H.B. Epoxoline – tow coats, 2-3 dry mils per coat.
         2) Intermediate: 69 H.B. Epoxoline II – one coat, 4-5 dry mils.
         3) Finish: 75 Endura-Shield – tow coats, 1.5-2 dry mils per coat
      b. Or approved equal.

D. Galvanized Metal and Non-Ferrous Metal; Interior Non-Submerged:
   1. Surface Preparation: SSPC-SP1 Solvent Cleaning, as specified in Paragraph 3.1.
   2. Interior non-submerged applies to areas that are housed within a building and/or within a non-process, enclosed structure.
   3. Product and Manufacturer: Provide one of the following:
      a. Tnemec:
         1) Primer: 66 H.B. Epoxoline – one coat, 3-4 dry mils
         2) Finish: 69 H.B. Epoxoline II – one coat, 4-5 dry mils.
      b. Or approved equal.

E. All Aluminum in Contact with Dissimilar Materials:
   1. Surface Preparation: Remove all foreign matter.
   2. Product and Manufacturer: Provide one of the following:
      a. Tnemec:
         1) 66 H.B. Epoxoline – two coats, 2.0 – 3.0 dry mils per coat
      b. Or approved equal.

F. PVC Piping, CPVC Piping, Fiberglass, Fiberglass Insulation Covering; Exterior:
   1. Surface Preparation: Sand as specified by the coating manufacturer.
   2. Exterior applies to areas that are not housed within a building and/or within an enclosed structure.
   3. Product and Manufacturer: provide one of the following
      a. Tnemec:
         1) Primer/Intermediate: 66 H.B. Epoxoline – one coat each, 2.0 – 3.0
         2) Finish: 75 Endura-Shield – one coat, 3.0 dry mils
      b. Or approved equal.

G. PVC Piping, CPVC Piping, Fiberglass, Fiberglass Insulation Covering; Interior Non-Submerged:
   1. Surface Preparation: Sand as specified by the coating manufacturer.
   2. Product and Manufacturer: Provide one of the following:
      a. Tnemec:
         1) Primer/Intermediate/Finish: 66 H.B. Epoxoline – one coat each, 2.0 – 3.0 dry mils per coat.
      b. Or approved equal.

H. Steel and Galvanized Steel Pipe; Buried Exterior:
   1. Surface Preparation: SSPC-SP10, Near-White Blast, as specified in Paragraph 3.1.
   2. Product and Manufacturer: Provide one of the following:
      a. Tnemec:
         1) Primer: 66-1211 Epoxoline – two coats, 3-4 dry mils per coat.
         2) Field Primer or Field Touchup: Surface preparation as specified.

3) Finish: 46-413 Tneme-Tar – two coats, 10.0 dry mils per coat.

b. Or approved equal.

I. Submerged or Intermittently Submerged Ferrous Metals; Interior and Exterior:

1. Definition: Submerged shall apply to all metals below the maximum water surface elevation in open top structure unless otherwise noted or otherwise shown; and to all metals within liquid or residual solids carrying structures that are covered, including all metals on the underside of the covers unless otherwise noted or otherwise shown; and to all metals within an enclosed process structure. This shall apply to all metals whether intermittently or continuously submerged.
2. Surface Preparation: SSPC-SP 10 Near-White Blast Cleaning as specified in Paragraph 3.1.
   a. Tnemec:
      1) Primer: 69-1211 Epoxoline II – tow coats, 3-4 dry milsper coat.
      2) Intermediate: 69 H.B. Epoxoline II – tow coats, 5 dry mils per coat.
      3) Finish: 69 H.B. Epoxoline II – two coats, 5 dry mils per coat.
   b. Or approved equal.

J. Special Requirements for Aluminum:

1. Aluminum surfaces bearing in or embedded in concrete and fayin surfaces of bolted aluminum joints ,except anchor bolts, shall be given two coats of 66 H.B. Epoxoline Primer, or approved equal. The primer shall be allowed to dry between coats and before concrete is poured against it.
2. Where aluminum metals are placed in contact with or fastened to ferrous or stainless steel metals, the contact surfaces of each shall receive the protective coating specified for that metal and a gasket shall be placed between the two contact surfaces. The gasket material shall be non-conductive commercial grade neoprene, 60 durometer, 0.03-inch in thickness unless otherwise specified. Bolts shall be isolated using one piece non- conductive sleeves and washers as manufactured by PSI Products, Inc., Burbank, California: Parker Seal Col, Culvert City, California, or approved equal.

K. Galvanizing: All galvanizing, where called for in the Contract Documents, shall be hot-dip process conforming to ASTM A-123:

1. Surface Preparation: All surfaces to be clean and free of contaminants prior to application of the coating system.
2. Prime Coat: Series 104 H.S. Epoxy; one coat 4-5 mils DFT.
3. Finish Coat: Series 104 H.S. Epoxy; one coat 4-54 mils DFT.

L. Concrete Semi-Gloss Latex:

1. Surface Preparation: All surfaces to be clean and free of contaminants prior to application of the coating system.
2. Prime Coat: Series 7 Tneme-Cryl; one coat 2-3 mils DFT.
3. Finish Coat: Series 7 Tneme-Cryl; one coat 2-3 mils DFT.

M. Ductile and Cast Iron (Exterior Exposure):
   1. Surface Preparation: Solvent scrub with stiff bristle brush followed by brush-off abrasive blast cleaning to a minimum surfaces profile depth of 1.5 mils.
   2. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II: one coat 3-5 mils DFT.
   3. Finish Coat: Series 73 Endura-Shield; one coat 3-4 mils DFT.

N. Ductile and Cast Iron (Interior Exposure):
   1. Surface Preparation: Clean, dry, and free of contaminants
   2. Prime Coat: Series 135 Chembuild; one coat 4-6 mils DFT.
   3. Finish Coat: Series 69 H.B. Epoxoline II; one coat 4-6 mils DFT.

O. Ductile and Cast Iron (Buried):
   1. Surface Preparation: Solvent scrub with stiff bristle brush followed by brush-off abrasive blast cleaning to a minimum surface profile depth of 1.5 mils.
   2. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat 3-5 mils DFT.
   3. Finish Coat: Series 69 H.B. Epoxoline II; one coat 4-6 mils DFT.

P. Ductile and Cast Iron (Immersions):
   1. Surface Preparation: Solvent scrub with stiff bristle brush followed by brush-off abrasive blast cleaning to a minimum surface profile depth of 1.5 mils.
   2. Prime Coat: Series 66 H.B. Epoxoline; one coat 4-6 mils DFT.
   3. Finish Coat: Series 69 H.B/ Epoxoline II; one coat 4-6 mils thick.

Q. Stainless Steel Duct (Buried):
   1. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning or manufacturer's recommendations, whichever is more stringent.
   2. Prime Coat: Polyken 1019 or 1027, or approved equal.
   3. Finish Coat: Polyken 905 tape, or approved equal.

2.4 Surfaces Not to be Coated

A. Do not field paint any of the following items unless specifically noted otherwise.
   1. Factory finished equipment, except for touch-up.
   2. Metal surfaces of aluminum, stainless steel, copper, bronze and similar finished materials.
   3. Equipment nameplates, valve stems, moving shafts and linkages.

2.5 Color Coding of Piping

A. Color Coding of Piping: Exterior and interior by color coding entire pipe.
   1. General
      a. Coat piping with solid colors as specified below for entire length of pipe in exposed finished and unfinished areas. Exclude areas in pipe chases and furred areas.
      b. Coat all other piping in colors matching adjacent surfaces. If adjacent area is unfinished, paint in color determined by Engineer/Architect.
      c. Identify piping with letters, arrows and bands as specified below. Apply after completion of finish coating.

2. Color Scheme

Description	Pipe and Band Color	Letter and Arrow Color
Potable Water (hot or cold)	Light blue	Black
Nonpotable or Raw Water	Light blue with red bands	Black
Seal Water	Dark blue with red bands	White
Low Pressure (Air) Aeration supply	Light green	Black
Sewage	Light gray	Black
Sludge	Light brown	White
Scum	Dark brown	White
Drain	Dark gray	White
Sample	Light gray with green bands	Black
Sprinkler Piping	Red	White

In addition, special painting of the following items will be required.

Item	Color
Valve hand wheels and levers	Red

Number at least 2 inches high shall be painted on or adjacent to all accessible valves, pumps, flowmeters, and other items of equipment which are identified on the drawings or in the specifications by number.

3. Location of Letters, Arrows and Bands

a. Place letters, arrows and bands on piping near connections to equipment, adjacent to valves or fittings, on both sides of walls penetrated, and at intervals not to exceed 25 feet.

b. Place arrows adjacent to or below letters depending upon visibility. Place arrows in direction of flow. For dual-flow piping, indicate both directions.

c. Locate letters to be visible from normal line of vision above floor level. Letter locations subject to approval of Engineer/Architect.

d. Band to be full circumference of pipe.

4. Letter, Arrow and Band Size

a. Block-style letters, all capitals, conforming to ANSI A13.1 and as follows:

Outside Diameter of Letters Pipe or Covering	Size of Letters and Arrows	Width of Banding
Less than 3/4"	Approved metal tag or band	6"
3/4" to 1-1/4"	1/2"	8"
1-1/2" to 2"	3/4"	8"
2-1/2" to 6"	1-1/4"	12"
8" to 10"	2-1/2"	24"
Over 10"	3-1/2"	32"

5. Vent lines, electrical conduit and related electrical accessories shall be painted to match adjacent wall surfaces as directed by ceiling space shall be painted same as surfaces adjacent to the wall surfaces.

PART 3 - EXECUTION

3.1 Surface Preparation

A. Prepare surfaces for each coating system conforming to SSPC or ASTM surface preparation specifications listed.
   1. If grease or oils are present, SSPC-SP1 must precede any other method specified.
   2. Remove surface irregularities such as weld spatter, burrs, or sharp edges prior to specified surface preparation.
   3. Undertake specified surface preparation in accordance with the coating manufacturer's recommendations.

B. Depth of profile will be as specified or as recommended by the manufacturer for each system, but in no instance shall it exceed one-third of the total dry film thickness of complete system.

C. Prepare only those areas which will receive the first coat of the system on the same day.
   1. On steel substrates, apply coating before rust bloom forms.

D. Concrete surfaces shall be adequately cured in accordance with SECTION 3300 and a minimum of 28 days old prior to coating application.

E. Abrasives for blasting shall be free of oil, washed and dry, unused silica sand, coal, copper or nickel slag that have sharp and hard cutting surfaces. Abrasives approved by Powertech Laboratories are strongly recommended.

F. Sharp projections and weld splatter shall be ground smooth. All areas ground smooth shall be reblasted prior to the coating application.

G. Sharp edges shall be ground round and smooth to radius = 1/8 prior to the coating applications for structural steel in Highly Corrosive Areas and for Immersion Services.

H. After abrasive blasting, steel surfaces must be completely dust free (cleaned by vacuum and/or blown off with oil/water-free compressed air), oil and grease free, and have a chloride concentration of less than 3 µg/cm2.

I. Unless otherwise specified, the steel profile must be 1.5 - 2.5 mils in depth and jagged as opposed to a peen pattern.

J. All welds shall be stripe coated by brush with the primer, prior to the application of the full primer coat. Note that inorganic zinc coatings shall not be applied by brush except to very small areas. Stripe coating shall be by spray.

K. Unless approved by the Paint Manufacturer to the contrary, the blast surface shall be primed prior to the development of rust bloom or other contaminants and not later than 8 hours after surface preparation.

L. Oxidation of the steel due to deleterious conditions may necessitate reblasting or sweepblasting the surface to restore the specified cleanliness standard.

3.2 Application

A. Apply coatings in accordance with coating manufacturer's recommendations.

B. All work shall be undertaken by skilled applicators who are qualified to perform the required work and have a minimum of 5 years experience in similar applications. The work shall be done in a manner comparable to the best standards of practice found in that trade. All materials shall be evenly applied so as to be free from sags, runs, crawls, wrinkles, holidays, or any other defects. All coats shall be of the minimum of brush marks. When finished and dried, brush strokes shall appear in one direction only, and there shall be no curved brush marks showing. All coats shall be thoroughly dry before the succeeding coat is applied. All coats that are intended to hide shall be given another coat if the coating does not properly hide the undercoat.

C. Use properly designed brushes, rollers, and spray equipment for all applications.

D. Spraying shall be done in the cross lap method of spraying, streaking first in one direction and shortly later spraying across this section at right angles to the first set of passes.

E. On unprimed surfaces apply first coat of the system the same day as surface preparation.

F. Dry film thickness of each system shall meet the minimum specified. Maximum dry film thickness shall not exceed the minimum more than 20% or coating manufacturer's requirements if less. Where a dry film thickness range is specified, the range shall not be less than or exceeded.

G. Shop and field painting shall remain 3 inches away from unprepared surface of any substrate such as areas to be welded or bolted.

H. Environmental Conditions:

1. Do not apply coatings when inclement weather or freezing temperature may occur within coating curing time requirements. Atmospheric temperature must be maintained between 60ºF and 85ºF for at least 48 hours prior to and during application, unless otherwise approved by coating manufacturer.
2. Wind velocities for exterior applications shall be at a minimum to prevent overspray or fallout and not greater than coating manufacturer's limits.
3. Relative humidity must be less than 85% and the temperature of the surface to be painted must be at least 5ºF above the dew point.
4. Provide adequate ventilation in all areas of application to ensure that at no time does the content of air exceed the Threshold Limit Value given on the manufacturer's Material Safety Data Sheets for the specific coatings being applied.

I. Recoat Time: In the event a coating, such as an epoxy, has exceeded its recoat time limit, prepare the applied coating in accordance with manufacturer's recommendations.

J. Protection

1. Cover or otherwise protect surfaces not to be painted. Remove protective materials when appropriate.
2. Provide signs to indicate fresh paint areas.
3. Provide daily cleanup of both storage and working areas and removal of all paint refuse, trash, rags, and thinners. Dispose of leftover containers, thinners, rags, brushes, and rollers which cannot be reused in accordance with applicable regulations.
4. Do not remove or paint over Equipment data plates or code stamps on piping.
5. Mask, remove, or otherwise protect finish hardware, machined surfaces, grilles, lighting fixtures, and prefinished units as necessary.
6. Provide cover to prevent paints from entering orifices in electrical or mechanical equipment.

3.3 Inspection

A. Contractor shall provide and use a wet film gauges to check each application approximately every 15 minutes in order to immediately correct film thickness under or over that specified.

B. Contractor shall provide and use a dry film gauge to check each coat mm (mil) thickness when dry, and the total system mm (mil) thickness when completed.

C. Use holiday or pinhole detector on systems over metal substrates to detect and correct voids when indicated on system sheet.

D. Furnish a sling psychrometer and perform periodic checks on both relative humidity and temperature limits.

E. Check temperature of the substrate at regular intervals to be certain surface is 5ºF or more above the dew point.

3.4 Cleaning and Repairs

A. Remove spilled, dripped, or splattered paint from surfaces.

B. Touch up and restore damaged finishes to original condition. This includes surface preparation and application of coatings specified.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement: No measurement will be made for this item, Protective Coatings.

4.2 Payment: Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

COATING REPORT

Contract Name: _____ Contract No.:_____
Coating Contractor: _____ Foreman: _____
Unit or Surface Identification: _____
Unit or Surface Location: Exterior: _____, Interior: _____

Surface Preparation:
Date _____; Air Temp _____ºF; Relative Humidity _____%
Method of Surface Preparation: _____
Profile achieved _____ mils (if applicable).

Touch-Up:
Date _____; Time _____; Air Temp _____ºF; Surface Temp _____ºF
Relative Humidity _____%; Dew Point _____ºF
Coating Used _____; Dry Film Obtained _____mils.

First Coat:
Date _____; Time _____; Air Temp _____ºF; Surface Temp _____ºF
Relative Humidity _____%; Dew Point _____ºF
Coating Used _____; Dry Time Before Recoat _____hrs.
Dry Film Obtained _____ mils.

Second Coat:
Date _____; Time _____; Air Temp _____ºF; Surface Temp _____ºF
Relative Humidity _____%; Dew Point _____ºF
Coating Used _____; Dry Time Before Recoat _____hrs.
Dry Film Obtained _____ mils.

Third Coat:
Date _____; Time _____; Air Temp _____ºF; Surface Temp _____ºF
Relative Humidity _____%; Dew Point _____ºF
Coating Used _____; Dry Film Obtained _____mils.

END OF SECTION 9900

DIVISION XI

EQUIPMENT

SECTION 11005

EQUIPMENT: GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes
   1. Requirement of this Section apply to all equipment provided on the Project, including that found in Divisions 11, 13, 15 and 16, even if not specifically referenced as a related section in those Specifications.
   2. Premium efficiency motors shall be supplied.

B. Related sections include, but are not necessarily limited to:
   1. Division 1 - General Requirements.
   2. Section 09800 - Special Coatings.
   3. Individual equipment specifications in Divisions 11 through 15.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society for Testing and Materials (ASTM):
      a. A307 - Standard Specification for Carbon Steel Bolts, Studs and Threaded Rods 60,000 psi Tensile Strength.
      b. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   2. Institute of Electrical and Electronics Engineers (IEEE):
      a. 112 - Standard Test Procedure for Polyphase Induction Motors and Generators.
   3. National Electrical Manufacturers Association (NEMA):
      a. 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. ICS 6 - Enclosures - Industrial Control and System.
      c. MG1 - Motors and Generators.
   4. NSF International:
      a. 61 - Drinking Water System Components

B. Unit Responsibility:
   1. Where indicated in these documents, equipment systems made up of two or more components shall be manufactured and assembled as a unit by the responsible manufacturer. The responsible manufacturer shall select all components of the system to assure compatibility, ease of construction and efficient maintenance. The responsible manufacturer shall coordinate selection and design of all system components, such that all equipment furnished under the specification for the equipment system, including equipment specified elsewhere, but referenced in the specification, is compatible and operates properly to achieve the performance requirements specified. Unless otherwise specified, the responsible manufacturer shall

be the manufacturer of the driven equipment. This requirement for unit responsibility shall in no way relieve CONTRACTOR of his responsibility to the OWNER for performance of all systems.

2. CONTRACTOR shall assure that all equipment systems provided for the Project are products for which unit responsibility has been accepted by the responsible manufacturer. Where the detailed specification requires CONTRACTOR to furnish a certificate from the Unit Responsibility Manufacturer, such certificates shall be provided prior to Shop Drawing review. No other submittal material will be processed until a Certificate of Unit Responsibility has been received and has been found to be satisfactory. Failure to provide acceptable proof that the unit responsibility requirement has been satisfied will result in withholding approval of progress payments for the subject equipment even though the equipment may have been installed in the Work.

1.03 DEFINITIONS

A. Product: Manufactured materials and equipment.

B. Equipment: One or more assemblies capable of performing a complete function. Mechanical, electrical, instrumentation or other devices requiring an electrical, pneumatic, electronic or hydraulic connection. Not limited to items listed under "Equipment" article within Specifications.

1.04 SUBMITTALS

A. Shop Drawings:

1. General for all equipment:
   a. See Section 01340 - Shop Drawing Procedures.
   b. Acknowledgement that products submitted comply with the requirements of the standards referenced.
   c. Manufacturer's delivery, storage, and handling instructions.
   d. Equipment identification utilizing tagging system and name utilized in Drawings.
   e. Equipment installation details:
      1) Location of anchorage.
      2) Type, size, and materials of construction of anchorage.
      3) Anchorage setting templates.
      4) Manufacturer's installation instructions.
   f. Equipment area classification rating.
   g. Shipping and operating weight.
   h. Equipment physical characteristics:
      1) Dimensions (both horizontal and vertical).
      2) Materials of construction and construction details.
   i. Equipment factory primer and painting and coating data.
   j. Manufacturer's recommended spare parts list.
   k. Piping and duct connection size, type and location.
2. Mechanical and Process Equipment
   a. Operating characteristics:

1) Technical information including applicable performance curves showing specified equipment capacity, rangeability, and efficiencies.
2) Brake horsepower requirements.
3) Copies of equipment data plates.

b. Piping and duct connection size, type, and location.
c. Equipment bearing life certification.
d. Field noise testing reports if such testing is specified in specific equipment sections.
e. Equipment foundation data:
1) Equipment center of gravity.
2) Criteria for designing vibration, special or unbalanced forces resulting from equipment operation.

3. Electrical and control equipment:
a. Electric motor information:
1) Nameplate data.
2) Service factor on motors ½ HP and above.
3) Motor enclosure type.
4) NEMA frame size, if applicable.
5) NEMA design code, if applicable.
6) Insulation type.
7) Efficiency and power factor at full load, 3/4 load, ½ load and 1/4 load.

b. Control panels:
1) Panel construction.
2) Point-to-point wiring diagrams.
3) Scaled panel face and subpanel layout.
4) Technical product data on panel components.
5) Panel and subpanel dimensions and weights.
6) Panel access openings.
7) Nameplate test.
8) Panel anchorage.

c. Motor tests reports.
d. Certification that equipment has been installed properly, has been initially started up and is ready for operation.
e. Certification prior to Project closeout that electrical panel drawings for manufacturer-supplied control panels truly represent panel wiring including any field-make modifications.

B. Operations and Maintenance Manuals:
1. Section 01340.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Motors:
   a. US Motors.
   b. Baldor

2.02 MANUFACTURED UNITS

A. Electric Motors:

1. Provide Totally Enclosed Fan Cooled (TEFC), squirrel cage induction type, 460 volt, 60 Hz, 3 phase electric power premium efficiency motor.
2. Motors shall be cast iron, Nema Energy Spec ISO9000 certified.
3. Provide air cooled anti-friction guides, oil lubricated thrust bearings, and reverse rotation ratchets.
4. Motor shall have a stainless steel plate indicating all essential lubricating information.
5. The motor shall not be loaded more than 90% of rated horsepower.
6. Provide premium efficiency motors designed and applied in compliance with NEMA, IEEE, and the NEC for specific duty imposed by driven equipment.
7. Where used in conjunction with adjustable speed drives, provide motors fully compatible with the variable speed controllers. These motors shall be inverter duty.
8. Where frequent starting applications are specified, design for frequent starting duty equivalent to duty service required by driven equipment.
9. Rate for continuous duty at 50 Deg C ambient. Design in accordance with NEMA standards for Class F insulation with Class B temperature rise above 50 Deg C ambient on continuous operation or intermittent duty at nameplate horsepower.
10. Design for full or reduced voltage starting, as appropriate.
11. Design bearing life based upon actual operating load conditions imposed by driven equivalent.
12. Size for altitude of Project.
13. Size so that, under maximum continuous load imposed by driven equipment, motor nameplate horsepower for continuous operation is minimum of 15 percent more than driven load.
14. Provide encapsulated windings in wet/corrosive and for outdoor applications.
    a. Provide encapsulation using a silicone or epoxy seal after the windings have been dried to less than 1 percent moisture.
15. Furnish with clamp-type grounding terminals inside motor conduit box.
16. Furnish with oversized external conduit boxes.
17. Furnish with stainless steel nameplates with information to include all data as required by paragraph 430-7 of the National Electric Code, NFPA 70.

2.03 ACCESSORIES

A. Guards:
   1. Provide each piece of equipment having exposed moving parts with full length, easily removable guards, meeting OSHA requirements.
   2. Interior Applications:
      a. Construct from expanded galvanized steel rolled to conform to shaft or coupling surface.
      b. Utilize non-flattened type 16 GA galvanized steel with nominal ½ IN spacing.
      c. Connect to equipment frame with hot-dip galvanized bolts and wing nuts.
   3. External Applications:
      a. Construct from 16 GA stainless steel or aluminum.
      b. Construct to preclude entrance of rain, snow, or moisture.
      c. Roll to conform to shaft or coupling surface.
      d. Connect to equipment frame with stainless steel bolts and wing nuts.

B. Anchorage:
   1. Cast-in-place anchorage:
      a. Provide ASTM F593, Type 316 stainless steel anchorage for exposed equipment.
      b. For continuously submerged anchorage, utilize ASTM A307 anchorage. For intermittently submerged applications, use 316 stainless steel.
      c. Configuration and number of anchor bolts shall be per manufacturer's recommendations.
      d. Provide two nuts for each bolt.
   2. Drilled anchorage:
      a. Epoxy grout per Section 03600.
      b. Threaded rods same as cast-in-place.

C. Data Plate:
   1. Attach a stainless steel data plate to each piece of rotary or reciprocating equipment. Permanently stamp information on data plate including manufacturer's name, equipment operating parameters, serial number and speed.

2.04 FABRICATION

A. Design, fabricate, and assemble equipment in accordance with best modern engineering and shop practices.

B. Manufacture individual parts to standard sizes and gages so that repair parts, furnished at any time, can be installed in field.

C. Furnish like parts of duplicate units to be interchangeable.

D. Assure that equipment has not been in service at any time prior to delivery, except as required by tests.

E. Furnish equipment which require periodic internal inspection or adjustment with access panels which will not require disassembly of guards, dismantling of piping or equipment or similar major efforts. Quick opening but sound, securable access ports or windows shall be provided for inspection of chains, belts, or similar items.

F. Provide common, lipped base plate mounting for equipment and equipment motor where said mounting is a manufacturer's standard option. Provide drain connection for tubing.
G. Machine the mounting feet of rotating equipment.
H. Shop or Factory Finishes shall be in accordance with Section 09800.

PART 3 - EXECUTION

3.01 ERECTION/INSTALLATION/APPLICATION

A. Install equipment as shown on Drawings and in accordance with manufacturer's directions.
B. Utilize templates for anchorage placement for slab mounted equipment.
C. For equipment having drainage requirements such as seal water, provide 3/4-inch PVC or clear plastic tubing from equipment base to nearest floor or equipment drain. Route clear of major traffic areas and as approved by OWNER.
D. Extend all non-accessible grease fittings using stainless steel tubing to a location which allows easy access of fittings.
E. Construct subbases, either concrete, steel or cast iron, level in both directions. Particular care shall be taken at hold-down bolt locations so these areas are flat and level.
F. Machine Base:
    1. Mount machine bases of rotating equipment on subbases in manner that they are level in both directions according to machined surfaces on base. Use machinist level for this procedure.
    2. Level machine bases on subbases and align couplings between driver and driven unit using steel blocks and shims.
        a. Size blocks and shims to provide solid support at each anchor bolt location. Area size of blocks and shims shall be approximately 1-1/2 times area support surface at each anchor bolt point.
        b. Provide blocks and shims at each anchor bolt. Blocks and shims shall be square shape with "U" cut out to allow blocks and shims to be centered on anchor bolts.
        c. After all leveling and alignment has been completed and before grouting, tighten anchor bolts to proper torque value.
        d. Do not use nuts below the machine base on anchor bolts for base leveling.

Grouting:

    3. After machine base has been shimmed, leveled, couplings aligned and anchor bolts tightened to correct torque value, a dam or formwork shall be placed around base to contain grouting. Dam or formwork shall extend at least ½ IN above the top of leveling shims and blocks.
    4. Grouting mixture shall be non-shrink grout per Division 3 requirements.

5. When the grout has sufficiently hardened, remove dam or framework and finish the exposed grout surface to fine, smooth surface. Cover exposed grout surfaces with wet burlap and keep covering sufficiently wet to prevent too rapid evaporation of water from the grout. When the grout has fully hardened (after a minimum of 7 days) tighten all anchor bolts and recheck driver-driven unit for proper alignment.

G. Identification of Equipment and Hazard Warning Signs:
   1. Identify equipment and install hazard warning signs in accordance with Section 10400.

Field coat in accordance with Section 09800.

3.02 WIRING CONNECTIONS AND TERMINATION

A. Clean wires before installing lugs and connectors.
B. Coat connection with oxidation eliminating compound for aluminum wire.
C. Terminate motor circuit conductors with copper lugs bolted to motor leads.
D. Tape uninsulated conductors and connectors with electrical tape, 150 percent of insulation value of conductor.
E. Connections to carry full ampacity of conductors without temperature rise.
F. Terminate spare conductors with electrical tape.

3.03 FIELD QUALITY CONTROL

A. Furnish equipment manufacturer services as specified in the individual equipment specifications.
B. Inspect wire and connections for physical damage and proper connection.
C. Check rotation of motor before connection to driven equipment, before couplings are bolted or belts installed. Before motor is started to check rotation, determine that motor is lubricated.

*** END OF SECTION ***

SECTION 11210

PUMPING EQUIPMENT: GENERAL STATEMENT

PART 1 - GENERAL

1.01 SUMMARY

A. General work included in this Section:
   1. All pumping equipment.

B. Related Sections include, but are not necessarily limited to:
   1. Division 1.
   2. Section 01340 - Technical Submittals.
   3. Section 01650 - Demonstration of Systems/Commissioning.
   4. Section 01715 - Equipment Operation and Maintenance Instructions.
   5. Section 09800 - Special Coatings.
   6. Section 11005 - Equipment: General Requirements.

C. Reference Standards:
   1. NSF International Standards 60- 61 - Drinking Water System Components.

1.02 QUALITY ASSURANCE

A. The pumping equipment shall include furnishing and installing the specific type of pumps as shown, together with all accessories and appurtenances necessary for a complete installation. The work includes furnishing motors, variable frequency drives if required and all electrical and other controls:
   1. The pumps including drive units, controls and other accessories and appurtenances, shall be furnished by a single pumping manufacturer for each particular process category of pump types. The pumps shall be arranged as shown and suitable for installation in the space as shown. The equipment shall be designed for the foundation arrangements shown and piping connections shall be located to preclude any appreciable change in the arrangement of the suction and discharge lines shown.
   2. Fully coordinate all mechanical seal and seal water systems specified to assure pump/seal compatibility.
   3. For variable speed pumping applications, the pump manufacturer is designated to have single source responsibility for coordination for the pump motor/VFD drive system.

1.03 DEFINITIONS

A. NPSHR - Net Positive Suction Head Required.

B. NPSHA - Net Positive Suction Head Available.

C. VFD - Variable Frequency Drive.

D. Pump Service Category - Pump or pumps having identical names (not tag numbers) used for specific pumping service.

1.04 SUBMITTALS

A. Shop Drawings:
   1. Certified pump performance curves.
   2. Pump accessories data.
   3. Pump bearing supports, brackets, shafting details and lubrication provisions.
   4. Solids passage information.
   5. Anchor bolt sizes and locations.
   6. See Section 11005.
   7. NSF 61 Certification for all parts that are contact with water.

B. Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.01 ACCESSORIES

A. See Section 11005.

2.02 SOURCE QUALITY CONTROL

A. If specifically required in the individual pump Sections, provide factory tests.
   1. Adjustable speed units:
      a. Head (FT) versus flow (gpm) pump curves:
         1) Maximum, minimum and two equally spaced intermittent speeds.
         2) Efficiencies along each curve.
         3) Brake horsepowers along each curve.
         4) NPSHR along each curve.
      b. Hydrostatic test at 150 percent of shutoff head for a minimum of 5 minutes.
   2. Constant speed units:
      a. Head (FT) versus flow (gpm) pump curves:
         1) Efficiencies along curve.
         2) Brake horsepower along each curve.
         3) NPSHR along each curve.

B. Balance:
   1. All rotating parts accurately machined and in as near perfect rotational balance as practical.
   2. Excessive vibration is sufficient cause for equipment rejection.
   3. Unit mass and distribution is such that resonance is avoided.
   4. Max. Shaft vibration displacement (peak-to-peak) at stuffing box face: 2.0 mils

5. Max. vibration displacement (peak-to-peak) at any point on the machine

Nominal Rotative Speed	Maximum Displacement
3,500 rpm	2.0 mils
1,800 rpm	2.0 mils
1,200 rpm	3.0 mils
900 rpm	3.5 mils
720 rpm	4.0 mils
600 rpm & below	5.0 mils

6. Ratio of rotative speed to critical speed of a unit or components thereof less than 0.8 or more than 1.3.
7. Each pump motor will have an electrical disconnect that is not integral to the motor, but located adjacent to the motor, for quick disconnection of electrical power supply. The local disconnect shall be NEC code approved.

PART 3 - EXECUTION

3.01 ERECTION/INSTALLATION/APPLICATION

A. See Section 11005.

Floor/pad mounted units (Non-Submersible):

1. Vertically and horizontally align, level, wedge and plumb units to match piping interface.
2. Assure no unnecessary stresses are transmitted to equipment flanges.
3. Tighten flange bolts at uniform rate and manufacturer's recommenced torque for uniform gasket compression.
4. Support and match flange faces to uniform contact over entire face area prior to bolting pipe flange and equipment.
5. Permit piping connecting to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
6. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.
7. Assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment.
8. Coat units as defined in Section 09800.
9. Provide pressure gauge on discharge of all pumps and on suction of all non-submersible units.

3.02 FIELD QUALITY CONTROL

A. Employ and pay for services of equipment manufacturer's field service representative(s) to:
   1. Conduct initial startup of equipment and perform operational checks.
   2. Provide a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by OWNER's personnel.

3. Instruct OWNER's personnel for start-up testing for specified minimum number of hours at jobsite on operation and maintenance of the pumping equipment.

END OF SECTION

SECTION 11219

VERTICAL MULTI-STAGE CENTRIFUGAL PUMPS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope: CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install one (1) vertical multi-stage centrifugal pump (Tag I.D.: BPS-4-05) complete and operational with motors, Soft start motor controls, control equipment, and appurtenances. Anchor bolts are included in this Section.

B. Related Sections: CONTRACTOR shall coordinate the requirements of the Work in this Section along with the requirements of the Sections listed below which includes, but is not necessarily limited to, Work that is directly related to this Section.
   1. Section 01600 - Product Delivery, Storage, and Handling.
   2. Section 01340 - Technical Submittal.
   3. Section 05052 - Anchor Bolts, Toggle Bolts, and Concrete Inserts.
   4. Section 09900 - Special Coatings.
   5. Division 15, as applicable.
   6. Division 16, as applicable.

C. See Drawings

D. In order to centralize responsibility, it is required that all equipment and services provided under this Section be furnished by a single supplier or manufacturer who shall assume full responsibility for the completeness of the system. CONTRACTOR shall guarantee and be the source of information on all equipment furnished regardless of the manufacturing source of that equipment.

1.02 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years' experience of producing substantially similar equipment, and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:
   1. Obtain all equipment included in this section regardless of the component manufacturer from a single pump manufacturer or supplier. The pump shall arrive complete to the jobsite, including OEM discharge lead, column pipe and bowl assembly.

2. The pump manufacturer or supplier shall review and approve or shall prepare all Shop Drawings and other submittals for all components furnished under this Section.
3. All components shall be specifically designed for pumping service and shall be integrated into the overall equipment design by the pump manufacturer or supplier.

C. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
1. National Electrical Code.
2. Standards of National Electrical Manufacturers Association.
3. Institute of Electrical and Electronic Engineers.
4. American Gear Manufacturers Association.
5. American National Standards Institute.
6. Anti-Friction Bearing Manufacturer's Association.
7. Standards of the Hydraulic Institute.
8. Standards of the American Water Works Association.
9. National Sanitation Foundation.
10. ASTM A 48, Specification for Gray Iron Castings.
11. ASTM A 53, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
12. ASTM A 276, Specification for Stainless Steel Bars and Shapes.
13. ASTM B 584, Specification for Copper Alloy Sand Castings for General Applications.

D. Shop Tests:
1. All pumps shall be shop performance tested.
2. Hydrostatic Test: All pump discharge heads, columns, and bowl assemblies shall be hydrostatically tested to twice the total head or one and half times the shutoff head, whichever is greater.
3. Performance Test Requirements:
   a. Pump bowl assembly shall be operated from zero to maximum capacity as shown on the approved curve. Results of the test shall be shown in a plot of test curves showing head, flow, horsepower, efficiency and current drawn. Readings shall be taken at a minimum of seven evenly spaced capacity points including shutoff, design point and 125 percent of flow at best efficiency point. Tests shall be conducted in conformance with applicable methods and standards of Section A6 of AWWA E101 or ISO 9906: 2012 Grade 3B.
   b. Curves shall be corrected for column and discharge head losses, shaft friction loss, and operating speed to show the anticipated field performance of the complete pump assembly.
   c. Performance of the pumping units shall be within the tolerances specified in the Hydraulics Institute Standard, latest revision, when operated at design speed and capacity.

d. Should the test results indicate that the pumping unit does not meet the above requirements, it shall be modified at no additional cost to the OWNER and retested until full compliance with specified performance can be demonstrated.

4. If manufacturer cannot run tests at full speed because of limitations in manufacturer's testing facilities, reduced speed tests, acceptable to ENGINEER, may be utilized and the results corrected to design conditions by means of accepted hydraulic computations.
5. The complete pumping unit shall conform to the vibration requirements set forth in Section 9.6.4 of the 2018 edition of the Hydraulic Institute Standards.
6. All test measurements shall be taken with properly calibrated instruments and all procedures shall conform to the test code of the Hydraulics Institute, unless modified herein. Acceptance criteria shall be Grade 1U as defined by table 14.6.3.4 in Hydraulic Institute Standards 14.6 - 2011.
7. Pumps shall not be shipped until the ENGINEER has approved the test reports and test curves.

1.03 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
1. Manufacturer's literature, illustrations, paint certification, specifications and engineering data including: dimensions, materials, size, and weight.
2. Performance data and curves showing overall pump efficiencies, required net positive suction head, allowable suction lift, flow rate, head, brake horsepower, motor horsepower, speed, and shut off head. Supply data on pump head losses to include entrance, column, pump, discharge head and valve losses.
3. Shop Drawings showing fabrication methods, assembly, accessories, and installation details and wiring diagrams.
4. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
5. Three copies of certified pump performance test results and hydrostatic test.
6. Three copies of motor test results and data.
7. List of all deviations from the Contract Documents.

B. Operation and Maintenance Manuals:
1. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation and spare parts information.
2. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01340 - Technical Submittals.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the site to ensure uninterrupted progress of the Work. Deliver

anchor bolts and anchorage devices, which are to be embedded in cast in place concrete in ample time not to delay that Work.

B. All boxes, crates, and packages shall be inspected by CONTRACTOR upon delivery to the site. CONTRACTOR shall notify ENGINEER of any loss or damage to equipment or components. Replace losses and repair damage to new condition, in accordance with manufacturer's instructions.

C. Store materials to permit easy access for inspection and identification. Keep steel members off the ground, using pallets, platforms, and other supports. Protect steel members and packaged materials from corrosion and deterioration.

D. Store all mechanical equipment in covered storage off the ground and prevent condensation.

PART 2 - PRODUCTS

2.01 PRODUCT MANUFACTURER

A. Pumps shall be:
   1. Grundfos Domestic Pump: Grundfos CR 45-5-22, 238 gpm @200psi

B. Provide motors as manufactured by one of the following:
   1. U.S. Motors
   2. Baldor

2.02 SERVICE CONDITIONS

A. Pumps shall be vertical multi-stage centrifugal type pumps to meet various flow and pressure conditions.

B. The characteristic curve of the pump shall rise from minimum head condition to shut off without dips. The complete pumping unit consisting of the pump and respective motor shall be suitable in all respects for continuous and stable performance without cavitation and in accordance with the vibration criteria specified in Hydraulic Institute Standards.

C. Each complete pumping unit, including the motor, shall be capable of safely operating at up to 125% of full load speed in reverse rotation without sustaining damage.

D. Materials in Contact with Potable Water:
   1. All surfaces, including coatings which will be in contact with water that will become potable following additional treatment, shall under both pump operating and non-operating (stagnant) conditions:

a. Not impart taste or odor to water nor produce an organic or inorganic content in the water in excess of the maximum level established by applicable laws or regulations.
b. Be listed by the National Sanitation Foundation as being suitable for contact with potable water, as applicable.

E. Pumps shall be specially designed, constructed, and installed for the service intended and shall comply with the following minimum conditions. The requirements in this section shall govern for pump performance compliance. (Hydraulic Institute's tolerance for testing and hydraulic efficiency are not applicable):

Domestic Flow Pump Parameters	**Value**
Number of Pumps Required	1
Number of Soft starters	4
Number of Stages on Each Pump (Minimum)	5
Flow Rate (for Each Pump), gpm	238
Head (for Each Pump), psi	200 psi
Minimum Efficiency, %	91.7
Min. Shutoff Head, psi	240 psi
Design Point 2 for Each Pump, gpm	570
Design Point 2 for Each Pump, psi (min)	130
Maximum Operating Speed, rpm	3525
Impeller Diameter, inches	5.34 in
Liquid type	Water
Drive Type	Constant Speed
Max Water Temperature, Deg F	68
Motor HP, Each (Maximum)	40

1. Based on the given flow and pressure conditions, either one or two pumps shall be running at a time. ~~One of the three pumps shall be a standby pump (unless demand is high).~~ Pumps shall be run alternately each time Booster Pump Station (BPS) comes online, this will allow rotation among the two pumps.

2.03 DETAILS OF CONSTRUCTION

A. Pump Materials and Construction:
1. Pump Body and Inlet Bell: The castings shall be of close-grained cast iron, ASTM A 48, Class 30 or ductile iron, having a minimum tensile strength of 30,000 pounds per square inch, free from blow holes, and sand holes. The inlet bell shall provide conservative entrance velocities and direct the flow to the impeller. The inner surfaces of the bell shall be smooth and free of

sharp projections or cavities which might cause turbulence or cavitation. A streamlined housing, centered and held in the bell by means of rigid vanes, shall be provided to properly direct the flow to the impeller. The bowl shall be designed for a flanged, indexed fit to the inlet bell and discharge column to provide proper bearing alignment. The interior surfaces shall be smooth and free of sharp projections, transitions, and cavities which might incite turbulence and undesirable vibration. The contours of the bowl shall be designed to closely match the shape of the impeller's vanes and to provide a smooth conversion of kinetic to potential energy. A bearing housing, centered in the bowl by rigid vanes shall be positioned immediately above the impeller to ensure minimum shaft deflection at all conditions of service. Bowls shall be fitted with a replaceable bronze bowl wearing rings. Bowl fasteners shall be Type 316 stainless steel. Bowl suction case shall have four webs to support lower bowl bearing. Bowl inlet shall have a stainless steel strainer with anti-vortex blades

2. Impellers: Provide enclosed impellers of one piece, constructed of NSF 61 approved Type 316 Stainless Steel or nickel aluminum bronze. Provide impellers with vanes of uniform spacing, rounded inlet edges, and smooth water passages. Provide removable bronze wear rings at the inlet end of the impeller and at the casing, secured by a positive mechanical method to prevent loosening in any operating mode. Secure impeller to the shaft by a stainless steel key and locknut or locking collar so that it cannot unscrew or become loose due to torque or rotation in either direction.
3. Bowl shaft: The bowl shaft shall be ASTM A 276, Type 316 stainless steel, turned, ground, and polished. Shafts shall be sized as recommended by the manufacturer.
4. Discharge Head Assembly (see item 1 above):-
5. Mechanical Seal: The mechanical seal must be removable without removing or raising motor silicon carbide face material rated at 450 psi. Provide one spare seal for each pump.
6. Provide removable, adjustable water slinger fitted to pump shaft to prevent pressurized leakage from the stuffing box from entering the motor enclosure. The stuffing box shall be bronze, ASTM B 584 or cast iron, ASTM A 48.
7. Type 316 stainless steel anchor bolts and inserts shall be furnished under this Section and shall be sized and installed in accordance with the manufacturer's recommendations
8. All bolts, nuts and cap screws shall have hexagon heads, and be Type 316 stainless steel.
9. Stainless steel nameplates giving the manufacturer's model and serial number, rated capacity, head, speed and all other pertinent data shall be attached to the pump.
10. A suitable gasket shall be provided to prevent leakage at the mounting flange.
11. As the motor shall be vertical solid shaft.

12. Pump base: Each pump motor, discharge assembly, shall be mounted on the concrete base as shown on the Drawings. The pump manufacturer shall provide anchor bolts, vibration isolation soleplate and installation instructions.

B. Motors:

1. Motors shall operate on 460 volts, 60 Hz, 3 phase electric power
2. Motors shall be in accordance with all current applicable standards of NEMA, IEEE, AFBMA, NEC, HI, ASTM, ANSI, and AWWA.
3. Service Conditions:
   a. Suitable for serving indoor in a clean environment.
   b. Voltage variation of ± 10%.
   c. Frequency variation of ± 5%.
4. Enclosure shall be NEMA TEFC.
5. Motors shall be Totally Enclosed Fan Cooled (TEFC), squirrel cage induction type, 460 volt, 60 Hz, 3 phase electric power. Motors shall be cast iron, Nema Energy Spec ISO9000 certified. Provide air cooled anti-friction guides,~~.~~ Motor shall have a stainless steel plate indicating all essential lubricating information. The motor shall not be loaded more than 90% of rated horsepower.
6. Motors shall be of the full voltage starting, squirrel cage induction type, of sufficient size so that there will be no overload on the motor above rated nameplate horsepower under any condition of operation from shut off to zero head, unless otherwise specifically permitted in this Section.
7. Insulation system shall be rated minimum Class F (155oC). Magnet wire shall be copper and rate Class H (180oC) or better. Magnet wire shall be classified Pulse Endurance, suitable for variable frequency applications. Varnish shall be 100% polyester. Water borne varnish is not acceptable.
8. Provide T-stat for motor over temperature protection built into windings. It shall protect against overload, high ambient temperature, too frequent starting, abnormal voltage, ventilation failure, and single phase condition.
9. Motors shall be capable of carrying full load current continuously without injurious temperature rise in an ambient temperature of 54°C.
10. Motors shall be provided with a service factor of 1.15.
11. Motors shall be premium efficiency in accordance with "NEMA PREMIUM" value for horsepower, speed, and enclosure.
12. Motors applied to variable frequency drives shall adhere to NEMA MG-1 Part 31 and shall be nameplated accordingly.
13. Provide each motor with air-cooled anti-friction guide and thrust bearings. Thrust bearings shall be oil lubricated; guide bearings shall be oil or grease lubricated. All bearings shall have a minimum L-10 or B-10 life of 100,000 hours as defined by the Anti-Friction Bearing Manufacturer's Association. Thrust bearings shall be angular contact ball or roller type rated for continuous operation and a total load consisting of the weight of the motor rotor, pump impellers and lineshafting plus the hydraulic thrust imposed by the pump at rated operating conditions. Thrust bearings shall have adequate

capacity to carry the upthrust at starting and the combined downthrust at shutoff. The use of tandem or series bearings will not be acceptable. Thrust bearings for each motor shall be provided with a visual indicator for lubricant level and readily accessible connections for adding and draining lubricant. The lubricating system shall be designed to provide the correct amount of oil to the bearing with a minimum of foaming or aeration. Each motor shall be supplied with a stainless steel information plate indicating all essential information such as, type of lubricant, viscosity, and other pertinent data.

14. Lubrication of motor bearings shall be as recommended by the manufacturer.
15. Each motor shall have a stainless steel nameplate which shall provide the following: Type, frame, insulation, class, HP, full load current, RPM, centigrade degrees rise, manufacturers name and serial no., model, voltage, locked rotor KVA code, bearing numbers and a connection diagram. The motor terminal box shall be oversized to provide adequate space for connections. The motor terminal box shall be of cast iron or fabricated steel, neoprene gasketed and bolted, and oversized to provide adequate space for connections. The motor leads shall be permanently marked in agreement with the connection diagram.
16. Motors shall be high efficiency design type. Efficiencies shall be determined in accordance with NEMA Standard MGI-12.53a and IEEE Standard 112, Test Method B. Nominal and guaranteed efficiencies shall be included on motor nameplates in compliance with NEMA Standard MGI-12 53b.
17. Vibrations shall not exceed 0.08 inches per second, peak to peak.
18. Noise level shall not exceed 85 dbA at 1 meter.
19. Motors shall have permanent lifting lugs capable of a safety factor of 10.

C. Variable Frequency Drives: Use soft starters.

D. Provide control panel and accessories as per Division 16.

2.04 CONTROLS

A. All Controls and Instrumentation per Drawings and Specifications.

B. Pressure Gauge:

1. Provide indicating gauge on the discharge piping as shown on Drawings. Gauges shall be furnished with diaphragm seals (with flush connection) and gauge cocks. Range of the pressure gauge shall be 0 to 250 psi.

2.05 ANCHOR BOLTS

A. Furnish anchor bolts and nuts of ample size and strength for the purpose intended, sized by the equipment manufacturer. Anchor bolt materials shall be Type 316 stainless steel and shall conform to the requirements of Section 05052, Anchor

Bolts, Toggle Bolts and Concrete Inserts.

2.06 TOOLS, SPARE PARTS AND MAINTENANCE MATERIALS

A. Each pump shall be furnished with a manufacturers repair kit which shall include as a minimum the following:
   1. Two sets of special tools required for maintenance and operation.
   2. One set of sleeve bearings for shafting.
   3. Wear rings, one for each impeller.
   4. A complete set of all fasteners, bolts, nuts, pins, keys, washers and the like which are not of standard manufacture.
   5. All bearing grease, and any other lubricants required for initial operation, properly labeled and boxed.
   6. One complete mechanical seal kit.
   7. Complete set of gaskets.

B. Spare parts shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the OWNER at the conclusion of the Project.

2.07 SURFACE PREPARATION AND SHOP PAINTING

A. Pumps, motors, and appurtenances shall receive shop primer and shop finish coating conforming to requirements of Section 09800 - Special Coatings. If any damage to the paint system occurs, the equipment shall be repainted as directed by the ENGINEER. The interior surfaces of the pump, suction bell and discharge column pipes, and the interior surfaces of the pump head and suction barrel shall be cleaned with a Near White Metal Sandblast (SSP-SP10), and coated with an NSF approved paint. Approved coating manufacturer: TNEMEC

B. All gears, bearing surfaces, machined surfaces, and other surfaces which are to remain unpainted shall receive a heavy application of grease or other rust-resistant coating. This coating shall be maintained during storage and until the equipment is placed into operation.

PART 3 - EXECUTION

3.01 INSPECTION

A. Inspection:
   1. Inspect and verify that structures or surfaces on which the equipment will be installed have no defects which will adversely affect installation.
   2. Inspect all equipment prior to installation.
   3. Promptly report defects which may affect the Work to the ENGINEER.

3.02 INSTALLATION

A. Install the pump equipment in a manner and to the tolerances recommended by the equipment manufacturer. CONTRACTOR shall arrange for a qualified service representative from each manufacturer of equipment to assist in the installation of the equipment, to check the equipment before it is placed into operation, and to provide start-up service.

B. Lubricants: Install products recommended by equipment manufacturer for initial operation.

C. Install pumping units on concrete bases and secure with anchor bolts in accordance with the manufacturer's recommendations and as shown on the Drawings. The concrete bases shall be poured as per the Drawings. Concrete work and grout are specified in Division 3, Concrete. The base with the equipment mounted thereon, or the soleplate, shall then be accurately shimmed to grade and the spaces between filled with an approved non-shrink grout. After the grout has reached its initial set, exposed edges shall be cut back 1/2-inch and the edges neatly finished with one to two cement mortar.

D. Support piping independent of the pump.

E. Check and align all pump, motor, and flexible shafting.

3.03 START-UP AND FIELD TEST

A. CONTRACTOR shall verify that structures, pipes, and equipment are compatible.

B. Make adjustments required to place system in proper operating condition.

C. Field Vibration Tests (perform only if excessive vibration is noticed):
   1. These tests shall be performed after the pump has been installed on its foundation, and under both operating and non-operating conditions. Suitable tests may be conducted subject to ENGINEER'S approval of CONTRACTOR'S written request and description of the tests proposed.
   2. Vibration measurements shall be made at the upper motor bearing of pump while operating over its speed range. Measurements shall be made in each of two orthogonal horizontal directions one of which shall be in the plane of the greatest vibration and in the vertical (pump axial) direction. Measured levels in the horizontal direction of the operating pump shall not exceed those in the Hydraulic Institute Standards latest edition.
   3. CONTRACTOR shall provide the services of an Engineer to conduct the vibration tests.

D. Testing, checkout, start-up and commissioning of the equipment shall be performed under the technical direction of the manufacturer's factory-trained representative. The pump system shall not be energized without authorization from the manufacturer's representative.

3.04 MANUFACTURER'S SERVICES

A. A factory-trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of two visits (8 hours, each) to the site. The first visit shall be for assistance in the installation of equipment. The second visit shall be for checking the completed installation and start-up of the system. Manufacturer's representative shall test the system in the presence of the ENGINEER and verify that the pumps conform to requirements. Representative shall revisit the job site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

B. All costs, including travel, lodging, meals and incidentals, shall be considered as included in CONTRACTOR'S bid price.

*** END OF SECTION **

SECTION 11339
PRESSURE RELIEF VALVES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes: Pressure Relief Valves:
   1. Provide one 4" pressure relief valve and one 2" pressure relief valve as shown on Drawings.
   2. CONTRACTOR to provide all labor, materials, tools, equipment, and services for all valve equipment as specified herein or as required for a complete functioning system.
   3. All valve equipment shall be furnished by a single manufacturer who shall be responsible for proper operation and interfacing of the equipment, testing and startup.
   4. Although such work may not be specifically indicated, the manufacturer of the valve equipment shall furnish all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
   5. See Drawings for valve schedule.

B. Related Sections include but are not necessarily limited to:
   1. Section 01340 - Technical Submittals.
   2. Section 15110 - Valves.

1.02 QUALITY ASSURANCE

A. Source Quality Control:
   1. The manufacturer shall use only equipment which is compatible in function, arrangement, reliability, and accuracy and will perform in the modes of operation outlined herein.

B. Reference Standards:
   1. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
      a. Occupational Safety and Health Act.
      b. Joint Industrial Council (JIC).
      c. Instrumentation, Systems, and Automation Society.
      d. National Sanitation Foundation (NSF) 61 - Drinking Water System Components - Health Effects.
      e. American Society of Mechanical Engineers (ASME).
      f. American Society of Testing Materials (ASTM).
      g. American National Standards Institute, Inc. (ANSI)

1.03 SYSTEM DESCRIPTION

A. The Pressure Relief Valves shall maintain a specified pressure with the use of a pressure relief control. The pressure control used with the valve will relieve a pressure above the design pressure of the booster pumps (between 100 - 150 psi).

B. A ductile iron pressure relief valve shall be provided on the pump station discharge header that allows water to recirculate to the suction header in a high pressure situations such as a pump stuck in the on position. The pressure relief valve shall be installed upstream of the station's flow meter to avoid recording flows that are recirculated to the pump header. Surge anticipation valves are not allowed. The pressure relief valve shall be a hydraulic diaphragm type valve with V-port plug, position indicator, limit switch, and stainless steel control lines and accessories. The pressure relief valve shall have a pressure rating greater than or equal to the pipeline it is connected to.

1.04 SUBMITTALS

A. The equipment manufacturer shall:

1. Submit shop drawings showing the layout of all equipment furnished, dimensional data, fabrication assembly, and the piping configuration.
2. Submit operation and maintenance manuals incorporating all major equipment furnished under these Specifications. Also, submit copies of all approved shop drawings.
3. Provide data on range, accuracy and repeatability as applicable for all major equipment furnished under these Specifications.
4. Submit data on capacity, weight, and material of each item of equipment.

1.05 WARRANTY

A. Provide a written warranty that the equipment furnished and installed under these Specifications will be free of defects in material and workmanship and operate without problems for a period of at least 3 years from date of shipment, provided the valve is installed and used in accordance with all applicable instructions.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Cla-Val:

1. Pressure relief valve shall be a Cla-Val Co. Model # 50-01 (Globe Style). The valve shall have CRL-60 pressure relief control.

B. Bermad

C. Or approved equal

2.02 MAIN VALVE

A. General:

1. The valve shall be hydraulically operated, pilot controlled, diaphragm, globe pattern.
2. The valve shall consist of three major components: the body with seat installed, the cover with bearing installed, and the diaphragm assembly.
   The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure.

B. Features:

1. Valve body and cover shall be of ductile iron.
2. The valve shall contain a resilient, synthetic rubber disc forming a tight seal against a single removable seat insert. The disc guide shall permit smooth transition of flow and shall hold the disc firmly in place. The disc retainer shall be of a sturdy one-piece design capable of withstanding opening and closing shocks. It must have straight edge sides and a radius at the top edge to prevent excessive diaphragm wear as the diaphragm flexes across this surface.
3. The diaphragm assembly containing a non-magnetic 303 stainless steel stem of sufficient diameter to withstand high hydraulic pressures shall be fully guided at both ends. The seat shall be a solid, one-piece design for a positive, drip-tight shut off.
4. The stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure.
5. The main valve seat and the stem bearing in the valve cover shall be removable for ease of maintenance. To insure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. Cover bearing, disc retainer, and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline.

C. Materials:

1. Valve Size: See Drawings.
2. Main Valve Body and Cover: Ductile Iron.
3. Main Valve Trim: Bronze.
4. Pressure Rating: 250 psi.
5. Rubber Material: Buna-N.
6. Exterior Coating: According to Section 09800 – Special Coatings.
7. Interior Lining: According to Section 15110 - Valves.

2.03 MANUAL PILOT SYSTEM

A. General:

1. Pressure adjustments and set points: Provide an adjusting screw on the pilot control for adjustment.
2. A pressure gauge shall be located upstream of the valve, and the pilot will be adjusted to design pressure.

2.04 CONTROLS

A. Provide a close limit switch on the valve.

PART 3 - EXECUTION

3.01 START-UP AND TEST

A. All equipment shall be operationally-tested by the CONTRACTOR at the job site following installation of the equipment, controls, valves and piping. Should the tests indicate any malfunction, the CONTRACTOR shall make all necessary repairs and/or adjustments. Tests and adjustments shall be repeated until, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent continuous operation.

3.02 MANUFACTURER'S SERVICES

A. The CONTRACTOR shall provide the services of a qualified, factory trained representative of the manufacturer to check and approve the installation before it is placed in service, supervise initial operation, and testing in the presence of the ENGINEER. The Supplier's representative shall revisit the job site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

B. The CONTRACTOR shall provide the services of a qualified, factory trained representative of the manufacturer to instruct the OWNER'S personnel in operation and maintenance of the equipment. Four (4) hours of training will be provided. The 4 hours may not be consecutive if more than one training session is necessary.

*** END OF SECTION ***

SECTION 11405
SURGE/HYDROPNEUMATIC TANK

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: One pressure vessel for use with the surge control system and included in the mechanical package. Vessel manufacturer shall provide piping connections and appurtenances as shown on the Construction Drawings and specified herein.

B. Supplier Qualifications: the vessel supplier shall have 3-years' experience with the manufacturing of steel surge and hydropneumatic tanks for water applications.

C. Related Sections: Include but are not necessarily limited to:

1. Section 01340 - Technical Submittals.
2. Section 09800 - Special Coatings.
3. Section 11005 - Equipment: General Requirements.
4. Section 15495 – Disinfection of Potable Water Piping.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. A 36 - Specification for Structural Steel.

B. American National Standards Institute/National Sanitation Foundation (ANSI/NSF):

1. Standard 61.

American Society of Mechanical Engineers (ASME):

2. ASME Code - Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels, Division 1.

C. Steel Structures Painting Council (SSPC):

1. Steel Structures Painting Manual, Volumes 1 and 2.
2. Pictorial Standards for Surface Preparation - SSPC - VIS 1.
3. Measurement of Dry Paint Thickness with Magnetic Gages - SSPC SP A2.

1.03 OPERATING CONDITIONS

A. Pressure: The vessel and all appurtenances shall have the following rated pressure, which includes 25 psi factor of safety per ASME Code: 350 psi.

B. Seismic: Design for seismic loading.

C. Ambient Air Temperature: Design for 0° F to 115° F.

1.04 SUBMITTALS

A. Product Data: List of materials and coatings used.

B. Form U-1, Manufacturer's Data Report for Unfired Pressure Vessels.

C. Shop Drawings and Calculations:

1. Provide calculations and detail drawings to indicate compliance with the specified requirements. Calculations shall be sealed by a Professional ENGINEER registered in Arizona.

2. Provide dimensional drawings verifying vessel dimensions, wall thickness, internals and vessel anchorage requirements.
3. Provide vessel installation procedures.
4. Provide certification and ASME Code data reports in accordance with the ASME Code as applicable 49 CFR 178.337 or other similar codes. The certification shall include certification of hydrostatic testing.
5. Provide fabrication drawing.
6. Provide the pressure testing specifications and test results.
7. Provide calculations for anchor bolts.
8. Provide calculations for head and side shell thickness.

1.05 QUALITY ASSURANCE

A. Equipment provided under this Section shall be fabricated, assembled, and transported in full conformity with Drawings, Specifications, and engineering data.

B. Components of the pressure vessel shall be the latest standard products of manufacturers regularly engaged in the production of equipment of this type.

C. Provide 7 days' notice to the ENGINEER prior to final assembly and surface preparation of each vessel to allow the ENGINEER to thoroughly inspect the interior and exterior at the fabrication shop.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Pressure Vessels:

1. Supplied by approved ASME Code vessel manufacturer:
   a. AMTROL ST-457C Series (ASME) – 300 PSIG

2.02 MATERIALS

A. Vessel: Construct the vessels using SA 516-70 Carbon Steel (ASME steel plate).

2.03 SYSTEM DESCRIPTION

A. Vessel Design and Performance Requirements:

1. Tank Size: Tank size shall be as indicated on the Drawings.
2. Vessels Heads: The vessels shall have ASME Code heads. The heads shall meet the design requirements for formed heads subject to internal pressure as described in the ASME Code, and have the following specifications:
   a. SA 516-70 Carbon Steel (ASME steel plate)
3. Provide calculations for head and side shell thickness.

B. Protective Coating: Prepare the surface to be lined in accordance with the ANSI Surface Preparation Specifications. Interior coating systems shall be in accordance with Section 09800, System 2, and shall be applied at the vessel manufacturing location after all required attachments to the vessel interior have been made. For exterior coating, only primer is required at the factory. Coat exterior surfaces with a UV resistant, epoxy coating system (System 1). Approved coating manufacture:

TNEMEC or approved.

C. Base Plate: Each leg shall come equipped with a base plate for mounting purposes. CONTRACTOR shall provide anchor bolts per Drawings.

2.04 COMPONENTS

A. Lifting Lugs: Provide exterior lifting lugs to facilitate vessel installation.

B. Nameplates and Code Stamps: Design, fabricate, and test vessels in accordance with the ASME Code. Each tank shall bear a stainless steel ASME nameplate. Each nameplate shall bear the applicable code symbol. The manufacturer shall be authorized by ASME to apply the applicable code symbols. A permanent name plate shall be provided that includes manufacturer name, working pressure at rated temperature, maximum allowable pressure, serial number, date of fabrication, thickness and tensile strength of shell and head steel.

C. Fittings shall be as indicated on the Drawings. All fittings shall be flanged. Reinforce openings in accordance with the ASME Code.

D. Attachments: Weld shell attachments for tank gages, instruments, and other items as indicated on the Drawings before application of the tank coating.

2.05 APPURTENANCES

A. Appurtenances shall include mounting flanges, inspection hatch, lifting lugs, and other items, as indicated on the Drawings.

2.06 FABRICATION

A. Welded: Weld reinforcement shall be in accordance with ASME Code. Excessive reinforcement shall be ground down to within the ASME Code requirements, and as required to install the lining systems. Fill penetration welds shall be used for heads and side shells when adjoining multiple steel plates. All internal corners and edges shall be ground to 1/8-inch radius, or a greater radius if required by the lining system.

B. Coating: Refer to Paragraph 2.03.B.

2.07 SOURCE QUALITY CONTROL

A. Hydrostatic test the vessel in accordance with the ASME Code for Unfired Pressure Vessels. The vessel shall be airtight and watertight.

B. The vessel manufacturer shall prepare a Form U-1 “Manufacturer’s Data Report for Unfired Pressure Vessels” to certify that the vessel was built in accordance with ASME Code Rules for the Construction of Unfired Pressure Vessels and inspected by a certified inspector. Submit copies of this report to the National Board of Boiler and Pressure Vessel Inspectors; and to the CONTRACTOR with copies for submittal.

PART 3 - EXECUTION

3.01 WARRANTY

A. Vessels shall be warranted by the manufacturer for a period of one year from the date of delivery to the job site. This shall cover all labor and materials required to correct deficiencies in workmanship at the location of the installation.

*** END OF SECTION ***

DIVISION 15

MECHANICAL

SECTION 15050

BASIC PROCESS PIPING MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Basic piping materials and methods.

1.02 REFERENCES

A. American Society of Testing and Materials (ASTM):
   1. A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
   2. D2240-15e1 - Standard Test Method for Rubber Property - Durometer Hardness.
   3. A536-84(2019)e1 - Standard Specification for Ductile Iron Castings.
B. National Sanitation Foundation (NSF) 61 - Drinking Water System Components - Health Effects.
C. AWWA C111 - Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
D. Refer to Section 09800 for coating requirements for exterior of exterior piping.

1.03 DEFINITIONS

A. Exposed Piping: Piping within buildings, vaults, tunnels, or other structures without regard to elevation of piping, or exposed piping outside buildings and structures.
B. Buried Piping: Piping actually buried in soil or cast in concrete.
C. Wet Wall: Wall with water on at least one side.

1.04 INTENT OF DRAWINGS AND SPECIFICATIONS

A. Except in details, piping is indicated diagrammatically. Sizes and locations are indicated on the Drawings. Not every offset and fitting, or structural difficulty that may be encountered has been indicated on the Drawings.
B. Perform minor modifications to piping alignment where necessary to avoid structural, mechanical, or other type of obstructions that cannot be removed or changed:
   1. Modifications are intended to be of minor scope, not involving a change to the design concept or a change to the Contract Price or Contract Time.

1.05 SYSTEM DESCRIPTION

A. Performance Requirements:
   1. Restraining Piping:
      a. Restrain piping as follows:
         1) When piping is underground, use mechanical restraints throughout. All buried piping shall be restrained.
         2) When piping is aboveground or under water, use mechanical or structural restraints.
      b. Provide restraints with ample size to withstand thrust forces resulting from test pressures.
   2. Connections to Existing Piping:
      a. Expose existing piping to which connections are to be made with sufficient time to permit, where necessary, field adjustments in line, grade, or fittings:
         1) Protect domestic water supplies from contamination:
            a) Make connections between domestic water supply and other water systems in accordance with requirements of public health authorities.
            b) Provide devices approved by owner of domestic water supply system to prevent flow from other sources into the domestic supply system.
      b. Make connections to existing piping and valves after sections of new piping to be connected have been tested and found satisfactory.
      c. Provide sleeves, flanges, nipples, couplings, adapters, and other fittings needed to install or attach new fittings to existing piping and to make connections to existing piping.
   3. Connections to In-Service Piping:
      a. Shutdown in-service piping in accordance with Section 01040:
         1) Establish procedures and timing in a conference attended by CONTRACTOR, ENGINEER, and OWNER of the in-service piping.
   4. Connections of Dissimilar Metals:
      a. Connect ferrous and nonferrous metal piping, tubing, and fittings with dielectric couplings especially designed for the prevention of chemical reactions between dissimilar metals.
      b. Nonferrous metals include aluminum, copper, and copper alloys.
      c. For flanged piping with dissimilar metals, use an insulated coupling or insulating gasket.
   5. All pipe tapping saddles are to be of bronze construction, unless noted otherwise on the Drawings.

PART 2 - PRODUCTS

2.01 ESCUTCHEONS (AS NEEDED)

A. Manufacturers: One of the following or pre-approved equal:
   1. Dearborn Brass Company, Model Number 5358.
   2. Keeney Manufacturing Company, Model Number 102 or Number 105.
   3. Beaton and Corbin, Model Number 1 or Number 13.
B. Material: Chrome plated steel plate.

2.02 MODULAR SEAL

A. Manufacturers: One of the following or pre-approved equal:
   1. Linx by Calpico, Inc.
   2. Link-seal by Thunderline Corporation.

B. Characteristics:
   1. Modular mechanical type, consisting of interlocking neoprene or synthetic rubber links shapes to continuously fill the annular space between the pipe and wall opening.
   2. Assemble links solely with stainless steel bolts and nuts to form a continuous rubber belt around the pipe.
   3. Provide a stainless steel pressure plate under each bolt head and nut. Isolate pressure plate from contact with wall sleeve.

2.03 COUPLINGS

A. Ductile Iron Couplings:
   1. Provide ductile iron couplings for use in connection of smooth end joints of ductile iron, steel or other types of pipe.
   2. General Requirements.
      a. Sleeve or center rings shall be of nominal O.D. size, range and length specified. Sleeve shall be of Ductile Iron ASTM A 536. Ends shall have a smooth inside taper to provide uniform gasket seal. Sleeve shall be given a shop coat of oil-modified urethane, corrosion-resistant paint.
      b. Follower flanges or end rings shall be of the thickness determined by the coupling size, and shall be of ductile iron, ASTM A 536. Flanges shall be identified by a color coded shop coat finish as described in Item 2a.
      c. Gaskets shall be compression-type, formed with Virgin Styrene Butadiene Rubber (SBR), compounded with ingredients to produce permanence and resistance to set after installation. O.D. range shall be imprinted on the gasket in permanent ink (minimum).
      d. Bolts and nuts shall be of high-strength, low-alloy steel, with nominal coarse thread, and hex nuts with black finish. Dimensions and minimum stress values shall be in accordance with AWWA/ANSIC111/A21.11.
      e. Where specification states a cast transition or reducing coupling in place of a straight coupling, the sleeve and follower flange shall be of the same manufacturer and compatible for the specific use intended.
      f. Quality control procedures shall be employed to ensure that the sleeve, follower flanges, and gaskets are properly fabricated and free of any visible defects. Coupling shall have pressure rating of 150 psi.
   3. Manufacturer: EBAA Iron Inc., Romac Industries Inc., or Pre-approved equal.
      Expansion Joint (Flexible Bellows Coupling):
   4. Manufacturer: General Rubber or approved equal.
   5. Performance and Design:
      a. Provide single and double arch expansion joints, as shown on the Drawings, complete with restraining rods to prevent over-expansion. Provide flanged spool with single or multiple arches, designed to provide motion capability as specified. Rubber expansion joints shall be rated for 250°F and 150 psi.

6. Materials:
    a. Tube - Provide single, seamless, leakproof tube made of Buna-N that extends through the bore to the outside edges of both flanges.
    b. Body - Fabric reinforcement shall be used as the flexible and supporting member between the tube and the cover. Fabrics of high strength synthetic fibers shall be used. All Fabrics plies shall be impregnated with rubber or synthetic compounds to permit flexibility between the fabric plies to reduce service strain.
    c. Cover - The exterior surface of the joint shall be formed from synthetic rubber to protect the body from outside damage. Utilize special polymers to resist sunlight.
    d. Integral Flanges - Constructed of resilient rubber, and smooth finish, the full-faced flanges form a tight seal against the pipe flange without the need of gaskets. Provide standard AWWA flanges as specified in Section 15062.
    e. Provide restraining rods attached to flanges for thrust protection.
7. Execution:
    a. Install expansion joint as shown on the Drawings and in accordance with the manufacturer's recommendations.

B. Flanged Coupling Adapter:
1. Description: One end of adapter shall be flanged and the other end shall have a sleeve type flexible coupling.
2. Pressure and Service: Same as connected piping.
3. Material: Cast iron or steel.
4. Bolts and Nuts: Type 316 stainless steel.
5. Harnessing:
    a. Harness adapters to restrain pressure piping. Test pressures for pressure pipelines shall conform to the requirements of Section 15050, Piping Systems.
    b. For adapters 12-inch diameter and less, provide 1/2-inch minimum stainless steel anchor studs installed in a pressure tight anchor boss. Provide number of studs required to restrain test pressure and service conditions. Harness shall be as designed and recommended by manufacturer; however, the following minimum anchor studs shall be provided, unless otherwise approved by ENGINEER:
        1) 6-inch diameter and less: Two.
        2) 8-inch diameter and less: Four.
        3) 10-inch diameterr and less: Six.
        4) 12-inch diameter and less: Eight.
    c. For adapters larger than 12-inch diameter, provide split-ring harness clamps with a minimum of four Type 316 stainless steel bolts. Harness assembly shall be as designed and recommended by manufacturer. Dimensions, sizes spacings and materials shall be suitable for service and conditions encountered and shall be approved by ENGINEER.
6. Product and Manufacturer: Provide one of the following:
    a. Smith-Blair, Model 912.
    b. Romac Industries Inc., FC400/FCA501/RFCA.
    c. Ford FFCA.

C. Dismantling Joint:
   1. Description: Adjustable telescoping restraint with tie-rods that can be adjusted to length to allow access for installation or removal of valves and other equipment.
   2. Pressure and Service: Same as connected piping.
   3. Material: Ductile iron or steel.
   4. Bolts and Nuts: Type 316 stainless steel or ASTM A588 HSLA bolt material.
   5. Product and Manufacturer: Provide one of the following:
      a. Romac Industries Inc., DJ400
      b. Or Approved Equal

2.04 CONTROLLED LOW STRENGTH MATERIAL

A. Controlled low strength material shall consist of Portland cement coarse and fine aggregate, and water.
B. Cement content shall be 0.5 sack of cement per yard.
C. The material shall have slump of 7 inches ± dye inch.
D. Compressive strength at 28 days shall be 70 psi ± 30 psi.

2.05 BURIED PIPING

A. All buried plastic piping shall have tracer wire placed 1 foot above the crown of the pipe. The magnetic tracer wire shall be 12 gauge insulated solid copper wire.
B. All buried piping shall also be provided with an identification tape (non detectible) placed 3 feet above the crown of the pipe. The tape shall be an inert polyethylene-plastic impervious to alkalis, acids, chemical reagents, and solvents likely to be encountered in the soil. The tape shall be a minimum of 4.0 mils thick and not less than 3" wide. The color of the tape and the text will be selected by OWNER. Lettering shall be minimum 1 ½" high. OWNER will select text for each pipe run using manufacturer's normally available stock.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verification of Existing Conditions:
   1. Locate and expose existing structures, piping, conduits, and other facilities and obstructions which may affect construction of underground piping before starting excavation for new underground piping and appurtenances.
   2. Verify sizes, elevations, locations, and other relevant features of existing facilities and obstructions. Determine conflicts for the construction of the new underground piping and appurtenances.
   3. Make piping location and grade adjustments to resolve conflicts between new piping and existing facilities and obstructions.

3.02 WALL AND SLAB PENETRATIONS

A. Provide sleeves for piping penetrations through masonry and concrete walls, floors, ceilings, roofs, pilasters, columns, piers, and beams unless specified or otherwise indicated on the Drawings.

B. For piping 1 inch in nominal diameter and larger, provide sleeves with minimum inside diameters of 1 inch plus outside diameter of piping. For piping smaller than 1 inch in nominal diameter, provide sleeve of minimum twice the outside diameter of piping:
   1. Arrange sleeves and adjacent joints so piping can be pulled out of sleeves and replaced without disturbing the structure.
   2. Cut ends of sleeves flush with surfaces of concrete, masonry, or plaster.
   3. Conceal ends of sleeves with escutcheons where piping runs through floors, walls, or ceilings of finished spaces within buildings.
   4. Seal spaces between pipes and sleeves.

C. Cast couplings or wall pieces in walls for penetrations of buried rigid piping including cast iron, ductile iron, reinforced concrete, and vitrified clay through structures:
   1. Provide couplings or wall pieces with mechanical push-ons, or similar flexible joints at outside of walls.
   2. Provide additional similar joints in piping at transition points between trenches and structure excavations.
   3. For steel piping, single joints may be used in lieu of two joints. Locate single joints outside within 2 feet from outside faces of walls.

D. Modular Seal for Pipe Penetration: Provide Link-Seal or approved equal. Provide two modular seals to seal at wet wall sleeves or penetrations. Mount one seal on the inside face of the wall and the other on the outside face of the wall. Coordinate the inside diameter of the wall sleeve with the size of the seal to provide watertight sealing. For dry wall penetrations, provide 1 modular seal.

3.03 EXPOSED PIPING

A. Install exposed piping in straight runs parallel to the axes of structures, unless indicated otherwise:
   1. Install piping runs plumb and level, unless otherwise indicated on the Drawings.

B. Install exposed piping after installing equipment and after piping and fitting locations have been determined.

C. Support piping in accordance with Section 15141 and as shown on Drawings:
   1. Do not transfer pipe loads and strain to equipment.

D. In addition to the joints indicated on the Drawings, provide unions, flexible couplings, flanged joints, and other types of joints or means which are compatible with and suitable for the piping system, and necessary to allow ready assembly and disassembly of the piping.

E. Assemble piping without distortion or stresses caused by misalignment:
   1. Match and properly orient flanges, unions, flexible couplings, and other connections.
   2. Do not subject piping to bending or other undue stresses when fitting piping. Do not correct defective orientation or alignment by distorting flanged joints or subjecting flange bolts to bending or other undue stresses.
   3. Flange bolts, union halves, flexible connectors, and other connection elements shall slip freely into place.
   4. After piping assembly to fit when proper fit is not obtained.
   5. Install eccentric reducers or increasers with the top horizontal for pump suction piping.

3.04 BURIED PIPING

A. Bury piping with minimum 4 foot cover without air traps, unless otherwise indicated on the Drawings.

B. Where 2 similar services run parallel to each other, piping for such services may be laid in the same trench. Lay piping with sufficient room for assembly and disassembly of joints, for thrust blocks, for other structures, and to meet separation requirements of public health authorities having jurisdiction.

C. Laying Piping:

1. Lay piping in finished trenches free from water or debris. Begin at the lowest point with bell ends up slope.
2. Place piping with top or bottom markings with markings in proper position.
3. Lay piping on an unyielding foundation with uniform bearing under the full length of barrels.
4. Where joints require external grouting, banding, or pointing, provide space under and immediately in front of the bell end of each section under and immediately in front of the bell end of each section laid with sufficient shape and size for grouting, banding, or pointing of joints.
5. At the end of each day's construction, plug open ends of piping temporarily to prevent entrance of debris or animals.

3.05 CLEANING

A. Piping Cleaning:

1. Upon completion of installation, clean piping interior of foreign matter and debris. Perform special cleaning when required by the Contract Documents.
2. Maintain pipe in clean condition during installation.
3. Before jointing piping, thoroughly clean and wipe joint contact surfaces and then properly dress and make joint.
4. Immediately prior to pressure testing, clean and remove grease, metal cuttings, dirt, or other foreign materials which may have entered the system.
5. At completion of work and prior to final acceptance, thoroughly clean work installed under these Specifications. Clean equipment, fixtures, pipe, valves, and fittings of grease, metal cuttings, and sludge which may have accumulated by operation of system, from testing, or from other causes. Repair any stoppage or discoloration or other damage to parts of building, its finish, or furnishings, due to failure to properly clean piping system, without cost to Owner.
6. Clean chlorine piping by pulling a cloth saturated with trichloroethylene or other suitable chlorinated solvent through each length of pipe. Disassemble valves and clean with suitable solvent. All surfaces which may come in contact with chlorine shall be thoroughly dry, and free of oil or grease before placing in service.

B. Cleaning Potable Water Piping:

1. Flush and disinfect potable water piping in accordance with Section 15495.

3.06 FIELD QUALITY AND CONTROL

A. General:
   1. Upon completion of piping, but prior to application of insulation on exposed piping or covering concealed/buried piping, test all piping systems.
   2. Test all piping systems at 200 psi for 2 hours, unless otherwise indicated. Pressure shall stabilize within 2% of 200 psi.
   3. Isolate equipment which may be damaged by the specified pressure test conditions.
   4. Perform pressure test using calibrated pressure gauges and calibrated volumetric measuring equipment to determine leakage rates. Select each gauge so that the specified test pressure falls within the upper half of the gauge's range. Notify the OWNER 24 hrs prior to each test.
   5. Unless otherwise specified, completely assemble and test new piping systems prior to connection to existing pipe systems.
   6. Acknowledge satisfactory performance of tests and inspections in writing to OWNER prior to final acceptance.
   7. Provide all necessary equipment and perform all work required in connection with the tests and inspections.
   8. Bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination.
   9. CONTRACTOR to dispose of testing water.

B. Pressure Testing Methods and Criteria:
   1. Types of pressure testing and inspection to be employed include hydrostatic pressure testing, and hydrostatic infiltration/exfiltration testing.
   2. Liquid systems:
      a. The following liquid piping systems shall have zero leakages at the specified test pressure throughout the specified duration:
         1) Exposed piping.
         2) Buried insulated piping and buried or exposed pressure piping.
   3. Hydrostatic pressure testing:
      a. All joints, including welds, are to be left exposed for examination during the test.
      b. Provide temporary restraints for expansion joints for additional pressure load under test. Equipment in piping system with rated pressure lower than pipe test pressure shall be isolated by valves or blind flanges.
      c. Do not paint or insulate exposed piping until successful performance of pressure test.
      d. Test soil, waste and drain piping at completion of installation of each stack or section of piping by filling system with water to highest point and checking joints and fittings for leaks. Leaks must be eliminated before proceeding with work or concealing piping. Minimum test heights shall be 10 ft.

3.07 PIPING SCHEDULE

A. See Drawings.

END OF SECTION

SECTION 15062

DUCTILE IRON PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Ductile iron piping, joints, fitting, and pipe lining and coating.

1.02 REFERENCES

A. American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME):
   1. B 16.1 - Grey Iron Pipe Flanges and Flanged Fittings - Classes 25, 125, and 250.
B. American Society for Testing and Materials (ASTM):
   1. A 47 - Standard Specification for Ferritic Malleable Iron Castings.
   2. A 183 - Standard Specification for Carbon Steel Track Bolts and Nuts.
   3. A 536 - Standard Specification for Ductile Iron Castings.
   4. A 674 - Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids.
   5. D 792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
   6. D 4976 - Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
C. American Water Works Association (AWWA):
   1. C 104 - Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
   2. C 105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
   3. C 110 - Ductile-Iron and Gray-Iron Fittings.
   4. C 111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   5. C 115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
   6. C 150 - Thickness Design of Ductile-Iron Pipe.
   7. C 151 - Ductile-Iron Pipe, Centrifugally Cast.
   8. C 600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
   9. C 900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. Through 60 in.
D. National Sanitation Foundation (NSF) 61 - Drinking Water Components - Health Effects.

1.03 SUBMITTALS

A. Layout Drawing: Detailed layout drawings showing alignment of pipes, location of valves, fittings, and appurtenances, types of joints, and connections to structures.
B. Product Data: Photographs, drawings, and descriptions of fittings, gaskets, couplings, grooving of pipe and fittings, and pipe lining.

C. Test Reports: Manufacturer's test reports for polyethylene lining certifying successful performance of the wet sponge spark tests.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Block piping material for shipment, prevent damage to castings and linings.
B. Carefully handle piping material during loading, unloading, and installation. Do not drop piping material from trucks. Lower piping material by mechanical means. Do not drop or pound pipe to fit grade.
C. Repair damaged pipe lining to match quality, thickness, and bonding or original lining. When lining cannot be repaired or repairs are defective, replace defective piping with undamaged piping.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Ductile Iron Piping:
   1. Yard piping shall be ductile iron in conformance with AWWA M41, C110, C115, C150, C151, C153 and MAG 750."
B. Joints:
   1. Flanged Joints:
      a. Flanges: One of the following with diameter, thickness, drilling, and other characteristics in accordance with ANSI B 16.1:
         1) Cast integrally with the pipe.
         2) Screw-on: Comply with the following:
            a) Ductile iron.
            b) Long hub, threaded, and specially designed for ductile iron pipe.
            c) After attaching to pipe, machine flange face to make pipe end and flange even and perpendicular to the axis of the pipe.
      b. Bolt Holes: Two-holed and aligned at both ends of pipe.
      c. Cap Screw or Stud Bolt Holes: Tapped.
      d. Bolt and Nuts: ANSI/ASME B 16.1 or when connecting flanges underground, in concrete pipe valve boxes, or underwater, Type 316 stainless steel; cut and finished to project a maximum of 1/4 inch beyond nut when joints are assembled.
      e. Class 150 flange (suitable for 250 psi).
   2. Mechanical Joints: AWWA C 111/ANSI A 21.11.
   3. Restrained Mechanical Joints:
      a. Mega-lug restrained joints.
      b. Or Pre-approved equal.
   4. Gaskets for Flanged Ductile Iron:
      a. Suitable for pressures equal to and less than 150 psi, temperatures equal to and less than 100 degrees Fahrenheit.
      b. Neoprene with minimum durometer hardness value of 70 when tested in accordance with ASTM D 2240, Type A; minimum 3/32 inch thick for less than 10 inch pipe; minimum 1/8 inch thick for 10 inch and larger pipe. Provide gaskets with inserted 13 ounce nylon fabric cloth for pipes 20 inch or larger.
      c. Manufacturers: One of the following or equal:

1) Griffin Pipe Products
2) US Pipe
3) American Cast Iron Pipe Co.

2.02 ACCESSORIES

A. Fittings: AWWA C 110/ANSI A 21.10 or AWWA C 153/ANSI A 21.53 with the same pressure rating and joint configuration as that of the associated piping.

2.03 PIPE LININGS

A. Cement-Mortar Lining and Coating: AWWA C 104/ANSI A 21.4, applied on clean bare metal surfaces; extended to faces of flanges, ends of spigots, and shoulders of hubs; painted with bituminous material.
   1. Coating: The exterior of the ductile iron yard piping shall be coated with a bituminous coating and wrapped in polyethylene encasement per MAG 610 and COS MAG Supplement and AWWA C105.
   2. Lining: The interior of the ductile iron yard piping shall be shop applied cement mortar lined per AWWA C104.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:
   1. Install ductile iron piping in accordance with AWWA C 600, modified as specified in Section 15050.
   2. Lay mechanical joint or bell and spigot pipe with 1/8 inch space between the spigot and shoulder of the pockets.
   3. All buried piping shall be restrained.

B. Special Techniques:
   1. Polyethylene Encasement: Wrap ductile iron pipe to be buried with polyethylene encasement in accordance with ASTM A 674. Repair tears and make joints with double plastic tape wrap.
      a. Polyethylene: AWWA C 105.
      b. Plastic Tape Wrap: Manufacturers shall be one of the followings or Pre-approved equal:
         1) Polyken Pipeline Coatings, Polyken Number 910.
         2) The Tapecoat Company, Tapecoat CT.

3.02 JOINTS

A. Install type of Joints as specified in Piping Schedule on Drawings.

3.03 FIELD QUALITY CONTROL

A. Clean and test ductile iron piping as specified in Section 15050.

END OF SECTION

SECTION 15063
COPPER PIPING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies copper piping, tubing, couplings and fittings.

1.02 REFERENCES

A. This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
   1. ASME/ANSI B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
   2. ASME/ANSI B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes
   3. ASTM B32 - Standard Specification Solder Metal
   4. ASTM B88 - Standard Specification for Seamless Copper Water Tube

PART 2 - PRODUCTS

2.01 COPPER TUBING

A. Copper tubing shall be seamless copper, conforming to ASTM B88. Unless otherwise specified, copper tubing shall be Type L, drawn.
B. Provide Type K - Soft for buried piping and Type K - Hard for exposed piping.

2.02 COUPLINGS AND FITTINGS FOR COPPER TUBING

A. Unless otherwise specified, couplings and fittings for copper tubing 1/2-inch and smaller nominal diameter shall be compression type, brass or bronze, capable of holding the full bursting strength of the tubing; shall meet the requirements of ANSI B16.26; and shall be Swagelok, Gyrolok, or pre-approved equal.
B. Couplings and fittings for copper tubing larger than 1/2-inch nominal diameter shall be wrought copper or bronze, solder joint pressure fittings and shall conform to ANSI B16.22.

2.03 SOLDER

A. Solder to be used in copper piping shall be ASTM B32, Alloy Grade 50B.

PART 3 - EXECUTION

3.01 FABRICATION

A. SOLDER JOINTS: All pipe and fittings to be jointed with solder shall be free from all burrs and wire brushed or steel wool cleaned. After cleaning, a paste flux shall be evenly and sparingly applied to the surfaces to be joined. Solder shall then be applied and flame passed toward the center of the fitting until the solder disappears. All excess solder shall be removed while it is still plastic. Absolutely no acid flux or acid wipe shall be used in making solder joints.

B. TAKEDOWN COUPLINGS: Takedown couplings shall be screw union type.

C. DIELECTRIC PROTECTION: Copper tubing or fittings shall not be permitted to come in contact with steel piping, reinforcing steel, or other steel at any location. Electrical checks shall be made to assure no contact is made between copper tubing and steel elements. Wherever electrical contact is demonstrated by such tests, the CONTRACTOR shall provide dielectric protection.

3.02 INSTALLATION, CLEANING, DISINFECTION, AND TESTING

A. The installation, cleaning, disinfection, and testing of copper piping shall be in accordance with governing codes and authorities.

END OF SECTION

SECTION 15075

PLASTIC PIPING AND TUBING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Plastic pipe, tubing, and fittings.

1.02 REFERENCES

A. American National Standards Institute (ANSI):
   1. B 16.12 - Cast Iron Threaded Drainage Fittings.
B. American Society for Testing and Materials (ASTM):
   1. D 648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
   2. D 1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
   3. D 1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated by Poly (Vinyl Chloride) (CPVC) Compounds.
   4. D 1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
   5. D 1869 - Standard Specification for Rubber Rings for Fiber-Reinforced Cement Pipe.
   6. D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity-Flow Applications.
   7. D 2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
   8. D 2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
   9. D 2467 - Standard Specification for Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
   10. D 2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings.
   11. D 2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
   12. D 2661 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings.
   13. D 2665 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic, Waste and Vent Pipe and Fittings.
   14. D 2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Pipe.
   15. D 2751 – Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.

16. D 3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
17. D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
18. D 3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
19. D 3350 - Standard Specification for Polyethylene Plastic Pipe and Fittings Material.
20. D 4101 - Standard Specification for Propylene Plastic Injection and Extrusion Materials.
21. F 439 – Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
22. F 441 – Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
23. F 477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
24. F 483 – Standard Method for Total Immersion Corrosion Test for Aircraft Maintenance Chemicals.
25. F 493 – Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
26. F 645 – Standard Guide for Selection, Design and Installation of Thermoplastic Water-Pressure Piping Systems.
27. F 679 – Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
28. F 714 – Standard Specification for Polyethlene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter.

C. American Water Works Association (AWWA):
   1. C 900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In.
   2. C-115 – Flanged Ductile Iron Pipe with Ductile-Iron or Grey-Iron Threaded Flanges.

D. Code of Federal Regulations:
   1. Title 49.

E. Plastic Pipe Institute (PPI):
   1. PE 3408.

F. United States Department of Transportation:
   1. Materials Transportation Bureau.

G. National Sanitation Foundation (NSF) 61 - Drinking Water Components - Health Effects.

1.03 ABBREVIATIONS

A. ABS: Acrylonitrile-Butadiene-Styrene.
B. CPVC: Chlorinated Polyvinyl Chloride.
C. DWV: Drain, waste, and vent.
D. ID: Inside diameter of piping or tubing.

NPS: Nominal pipe size followed by the size designation.

E. NS: Nominal size of piping or tubing.
F. PE: Polyethylene.
G. PP: Polypropylene.
H. PVC: Polyvinyl Chloride.
I. SDR: Standard dimension ratio.

1.04 SUBMITTALS

A. Product Data: Describe materials and installation equipment including fusion machine.
B. Manufacturer's Published Installation Instructions.
C. Certificates:
   1. Submit manufacturer's certificate attesting that plastic pipe, tubing, and fitting meet specified requirements.
   2. Copies of solvent cement manufacturer's report and certification in accordance with ASTM D 2564 for PVC piping, and ASTM F 493 for CPVC piping.
D. Qualifications of installation crew for PE piping, including qualifications of the fusion machine technician.

1.05 QUALITY ASSURANCE

A. Fusion Machine Technician Qualifications: 1 year experience in the installation of similar PE piping systems from the same manufacturer.
B. Provide pipe and tubing bearing NSF seal, except for drainage piping.
C. Mark plastic pipe with nominal size, type, class, schedule or pressure rating, and manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect piping materials from sunlight, scoring, and distortion.
B. Do not allow surface temperatures on pipe and fittings to exceed 120 degrees Fahrenheit.
C. Store and handle pipe and fittings as recommended by manufacturer in published instructions.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Extruding and Molding Material: Virgin material containing no scrap, regrind, or rework material except where permitted in the referenced standards.
B. Fittings: Same material as the pipe and of equal or greater pressure rating, except the DWV fittings need not be pressure rated.
C. Unions 2-1/2 inches and smaller: Socket end screwed unions. Make unions 3 inches and larger with flange ends with 1/8 inch full face soft rubber gasket.

2.02 PVC PIPING, SCHEDULE TYPE

A. Materials:
   1. PVC schedule type piping: Designation PVC 1120 conforming to ASTM D 1785 and appendices thereto.
      a. Pipe and fittings: Extruded from Type I, Grade 1, Class 12454-B material in accordance with ASTM D 1784.
      b. PVC Schedule Type Piping: Schedule 80 unless otherwise indicated on the Drawings.
   2. Fitting:
      a. Supplied by pipe manufacturer.
      b. Pressure Fittings: In accordance with ASTM D 2466 or ASTM D 2467.
      c. DWV Fittings: In accordance with ASTM D 2665.
   3. Solvent Cement: In accordance with ASTM D 2564.

2.03 PVC PIPING, CLASS TYPE

A. Materials:
   1. PVC pipe, Class type: Pipe shall have outside diameters of ductile iron pipe sizes:
      a. ASTM D2241 PVC Pipe, Pressure rating 250 psi: SDR 17 and Uni-Bell Standard UNI-B-2-72.
      b. PVC Pipe, Class Type: AWWA C 900, Pressure Class 150 and SDR 18.
      c. Bell Section: At least as strong as the pipe barrel.
   2. Fittings: Cast or ductile iron fittings as specified under Section 15062, sized for the dimensions of the pipe being used.
      a. Fittings for joining pipe 4 inches in diameter and larger: Flanged fitting to meet AWWA C115, and nitrite gaskets.
   3. Gaskets: Meeting the requirements of ASTM D 1869 or ASTM F 477.

2.04 PVC EXPANSION JOINTS

A. Materials:
   1. PVC schedule type expansion joints: Designation PVC 1120 conforming to ASTM D 1785 and appendices thereto.
   2. Seals: EPDM or Viton.
B. Manufacturers:
   1. Spears.
   2. Or Pre-approved equal.
C. PVC expansion joints shall be provided every 50 ft for pipe run.

2.05 PE AND HDPE PIPING FOR DRAIN, WATER, AND VENT

A. General:
   1. Pipe and fittings: High density polyethylene.
   2. Dimensions of pipe and fittings: Based on controlled outside diameter in accordance with ASTM F 714.
      a. SDR: Equal to or less than 11.

B. Materials:
1. Manufacturers: One of the following or equal:
a. DuPont, Sclairpipe.
b. Polaris, Duratuff; or Pre-approved equal:
1) Pipe, fittings, and adapters: Furnished by the same manufacturer, and compatible with components in the same system and with components of other systems to which connected.
2. Polyethylene: In accordance with ASTM D 1248, Type III, Class C, Category 5, Grade P34; listed by the Plastic Pipe Institute under the designation PE 3408; and have a minimum cell classification, in accordance with ASTM D 3350, of 345434C.
a. Pipe and fittings: Manufactured from material with the same cell classification.

2.06 SOURCE QUALITY CONTROL

A. PVC Piping, Schedule Type:
1. Mark pipe and fittings in accordance with ASTM D 1785.

B. PVC Piping, Class Type:
1. Test pipe to withstand, without failure, 150 psi, hydrostatic pressure .
2. Test integral bell with the pipe.

C. CPVC Piping:
1. Mark pipe and fittings in accordance with ASTM F 441.

2.07 DETECTABLE TAPE

A. Materials:
1. 3.5 mil thick solid foil core encased in a protective plastic jacket.
2. Resistant to alkalies, acids and other destructive elements commonly found in soil.
3. Lamination shall have sufficient strength that the layers cannot be separated by hand.
4. Total composite thickness shall be 4.3 mils minimum.
5. Foil core to be visible to ensure continuity.
6. Minimum tensile strength of 63 lbs in the machine direction and 68 lbs in the transverse direction per three (3) inch strip.
7. Continuous warning message repeated every 16 to 36 inches shall be imprinted on the tape surface. Tape shall be colored.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:
1. Where not otherwise specified, install piping in accordance with ASTM F 645, or manufacturer's published instructions for installation of piping, as applicable to the particular type of piping.
2. Provide molded transition fittings for transitions from plastic to metal or IPS pipe. Do not thread plastic pipe.

3. Locate unions where indicated on the Drawings, and elsewhere where required for adequate access and assembly of the piping system.
4. Provide serrated nipples for transition from plastic pipe to rubber hose.
5. All buried plastic pipe shall have detectable tape applied along the entire length of pipe.
6. PVC expansion joints installed on PVC pipelines as conditions require.

B. Installation of PVC Piping, Schedule Type:
1. Exposed 4-inch and larger connections will be van stone style flanged as shown on the drawings. Spigot van stone style will be used to flange fittings. Socket van stone style will be used for piping flanges exposed less than 4" and smaller connections will be solvent welded.
2. Neoprene gaskets will be used for all water piping.
3. Solvent weld joints in accordance with ASTM D 2855.
4. Install piping in accordance with manufacturer's published instructions.

C. Installation of PVC Piping, Class Type:
1. Install piping in accordance with the Appendix of AWWA C900 complemented with manufacturer's published instructions.
2. For contraction and expansion at each joint, provide rubber ring and integral thickened bell as part of each joint.
3. Direct burial installation tie-ins will be done at the proper buried temperatures.

D. Installation of Polyethylene (PE) Tubing and Fittings:
1. Install small bore PE tubing in accordance with manufacturer's printed instructions, in neat straight lines, supported at close enough intervals to avoid sagging, and in continuous runs wherever possible.
2. Bundle tubing in groups of parallel tubes within protective sheath.
3. Tubes within protective sheath may be color coded, but protect tubing other than black outside the sheath by wrapping with black plastic electrician's tape.
4. Grade tubing connected to meters in one direction.

E. Installation of PE Piping for Drain, Waste, and Vent:
1. Install piping as recommended in manufacturer's published instructions.

3.02 FIELD QUALITY CONTROL

A. Clean and test piping as specified in Section 15050.

END OF SECTION

SECTION 15110

VALVES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Basic requirement for valves:
   1. Requirements indicated on the Drawings and specified elsewhere in these Specifications take precedence over the requirements specified under this Section.
   2. Furnish and install valves required for proper piping and equipment operation and maintenance, in addition to the valves indicated on the Drawings, and specified.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. A126 - Standard Specification for Gray Icon Casting for Valves, Flanges, and Pipe Fittings.
   2. A48 - Standard Specification for Gray Iron Castings.
   3. A536 - Standard Specification for Ductile Iron Castings.

B. American Water Works Association (AWWA):
   1. C111 - Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
   2. C504 - Rubber Seated Butterfly Valves, 3 In. Through 72 In.
   3. C508 - Swing Check Valves for Waterworks Service, 2-In. through 24-In. NPS.
   4. C110 - Ductile-Iron and Grey-Iron Fittings.
   5. C207 - Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In.

C. Steel Structures Painting Council (SSPC):
   1. SP-2 - Hand Tool Cleaning.
   2. SP-10 - Near-White Blast Cleaning.

D. American National Standards Institute (ANSI):
   1. B1.20.1 - Pipe Threads, General Purpose.

E. NSF 61 - Drinking Water System Components - Health Effects.

1.03 DESIGN REQUIREMENTS

A. Pressure Rating: 250 psi.

B. Valve To Piping Connections:
   1. Valves 3 inch nominal size and larger: Flanged ends unless otherwise specified on the Drawings.
   2. Valves less than 3 inch nominal size: Screwed ends.

1.04 SUBMITTALS

A. Product Data: Submit detailed technical information relating to the valve including description of component parts, materials of construction, performance, dimensions, and weights.

B. Manufacturer's Published Instructions:
   1. Submit instructions for installation, operation, and maintenance of valves.
   2. Furnish bound sets of installation, operation, and maintenance instructions for each type of valve 3 inch nominal size and larger.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Valves: Manufactured by manufacturers whose valves have had successful operational experience in comparable service.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Underground Bolts: Low-alloy steel in accordance with AWWA C111.
B. Bronze And Brass Alloys: Use bronze and brass alloys with not more than 6 percent zinc and not more than 2 percent aluminum in the manufacturing of valve parts.
C. Interior Protective Coating:
   1. Epoxy coat interior non-working surfaces, except stainless steel surfaces.
   2. Coating Types:
      a. Powder Epoxies:
         1) Manufacturers: One of the following or equal:
            a) 3-M Company, ScotchKote 134; certified to NSF 61 for drinking water use.
            b) Michigan Chrome and Chemical Company, Micron 650 or 651.
            c) Or Pre-approved equal.
      b. High Solids Polyamine Cured Epoxy:
         1) Manufacturers: One of the following or equal:
            a) Tnemec: Series 140N Pota Pox
            b) Or Pre-approved equal
   3. Clean surfaces to meet SSPC-SP-10, near-white metal blast cleaning, with grit of size recommended by epoxy manufacturer.
   4. Apply in accordance with manufacturer's published instructions:
      a. High Solids Polyamine Cured Epoxy:
         1) Not less than 2 coats to the specified thickness.
   5. Coating Thickness: 12 mils except that:
      a. Coating thickness in grooves for gaskets: 5 mils.
      b. Do not coat seat grooves in valves with bonded seat.
   6. Quality Control:
      a. Coating Thickness: Measured with a nondestructive magnetic type thickness gauge.
      b. Verify coating integrity with a holiday detector set at 1,800 volts.
      c. Consider tests successful when coating thickness meets specified requirements and when no pin holes are found:
         1) Correct defective coating disclosed by unsuccessful tests, and repeat test.

2) Repair pinholes in accordance with manufacturer's published recommendations.

D. Underground Valves:
   1. Provide underground valves with flanged, mechanical, or other type of joint required for the type of pipe to which the valve is to be connected.
   2. Coating and Wrapping:
      a. Paint buried valves with 3 coats of asphalt varnish in accordance with AWWA C 504:
         1) Protect coating from damage during handling and installation; repair coating where damaged.
      b. After installation, wrap valves in polyethylene as specified for ductile iron piping in Section 15062:
         1) Ascertain that polyethylene wrapping does not affect operation of valve.
   3. All interior epoxy coatings shall be NSF 61 certified.

E. Valve Boxes:
   1. Furnish and install access to operators of buried valves through cast-iron valve boxes, as shown on Drawings:
      a. Do not support boxes on valve, valve operator, or pipe.
      b. Boxes: Fabricated of cast-iron; provided with cover, asphalt varnished or enameled. Adjust to grade, install centered around the upper portions of the valve and valve operator.
      c. Use seamless pipe inside valve box. If seam is required, use a sealed bell joint.
      d. Minimum clear inside diameter of 6 inches.
      e. Install per MAG Detail 391-1 Type A.

F. Valve Operators:
   1. Open counterclockwise.
   2. Provide valves located below operating level or deck with extensions for key operation or floor stands and handwheels.
   3. Provide manually operated valves and gates located not more than 6 feet above the operating level with levers, tee handles, wrenches, or handwheels, as shown on Drawings.
      a. Make the valve operator more conveniently accessible by rolling valves, located more than 5 feet but less than 6 feet above the operating level, toward the operating side.
      b. Secure tee handles and wrenches to the valve head or stem, except where a handle or wrench so secured constitutes a hazard to personnel; in which case, stow handle or wrench immediately adjacent to the valve on or in a suitable hanger, bracket, or receptacle.
   4. Fit valves located more than 6 feet above operating level with chain operated handles or valve wheels:
      a. Chains: Sufficient length to reach approximately 4 feet above the operating level.
      b. Where chains constitute a nuisance or hazard to operating personnel, provide hold-backs or other means for keeping the chains out of the way.

G. Combined Air/Vacuum Release Valve:
   1. Manufacturer: ARI, Val-Matic, Apco or Pre-approved equal.
   2. Orifice: 5/16".
   3. Size: See Drawings.
   4. Body: stainless steel.
   5. Float: HDPE.
   6. Seat: Buna-N (soft seat).
   7. Float Guide: stainless steel.
   8. O Ring Seat: EPDM rubber.
   9. Other internal parts: stainless steel.
   10. Pressure rating: 250 psi.
   11. Provide isolation valve upstream of air release valve.

H. Air Release Valve (ARV): Air release valves shall be provided in accordance with Chapter 6-1.410 of the City DSPM. The ARV shall have a pressure rating greater than or greater than the pipeline it is connected to. Approved manufacturers: ARI, Val-Matic, Apco or approved equal.

I. Valves equal to and larger than 6-inches and/or throttling service valves shall include handcrank and wormgear actuators. Valves located 60-inches or higher above finished floor level shall include chainwheel actuators. Chains shall hang down within 36-inches of the finished floor level.

2.02 FABRICATION

A. Valves:
   1. End connections:
      a. Provide end connections for valves as required in Piping Schedule.
      b. Assure end connections meet the following standards:
         1) Threaded: ANSI B1.20.1
         2) Flanged: AWWA C207.
         3) Bell and spigot or mechanical (gland) type: AWWA C111.

PART 3 - EXECUTION

3.01 PREPARATION

A. Once flanged valves and flanged check valves are selected, determine face-to-face dimensions of valves.

B. Fabricate piping to lengths taking into account the dimensions of flanged valves and flanged check valves.

3.02 INSTALLATION

A. Prior to installation, valves that will be electrically actuated shall have actuators mounted and tested by the valve manufacturer. Actuators will be shipped by the actuator manufacturer to the valve manufacturer for mounting and testing.

B. Provide incidental work and materials necessary for installation of valves including flange gaskets, flange bolts and nuts, valve boxes and covers, concrete bases, blocking, and protective coating.

C. Where needed, furnish and install additional valves for proper operation and maintenance of equipment and plant facilities under the following circumstances:
   1. Where such additional valves are required for operation and maintenance of the particular equipment furnished by CONTRACTOR.
   2. Where such additional valves are required as a result of a substitution or change initiated by CONTRACTOR.
   3. Install valves with their stems in vertical position above the pipe, except as follows:
      a. Butterfly valves, gate valves aboveground, globe valves, and angle valves may be installed with their stems in the horizontal position.

D. Install valves so that handles clear obstructions when the valves are operated from full open to fully close.

E. Place top of valve boxes flush with finish grade or as otherwise indicated on the Drawings.

3.03 ADJUSTING

A. Make sure all adjustments to valves, operators and appurtenant equipment prior to Project Acceptance. Operate valve, open/close, at system pressures.

END OF SECTION

SECTION 15111

BALL VALVES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: DIP ball valves, plastic body ball valves and instrument isolation ball valves.

1.02 REFERENCES

A. American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME):
   1. B16.5 – Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch.
B. American Petroleum Institute (API).
C. American Society for Testing and Materials (ASTM):
   1. A 351 – Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
D. American Water Works Association (AWWA):
   1. C 507 – Ball Valves, 6 In. Through 60 In.
E. National Sanitation Foundation (NSF) 61 - Drinking Water Components - Health Effects.

1.03 SYSTEM DESCRIPTION

A. General: Unless otherwise indicated on the Drawings use:
   1. Plastic body ball valves on plastic pipelines.
   2. Where valves are connected to electric actuators, the valve and actuator assembly shall be supplied by the same Supplier/Manufacturer.

PART 2 - PRODUCTS

2.01 BALL VALVE TYPES

A. Full Port Ductile Iron (DI) Ball Valves:
   1. Manufacturers: One of the following or equal.
      a. Conbraco.
      b. Dezurik.
      c. Or pre-approved equal.
B. SS Ball Valves:
   1. Manufacturers: One of the following or equal.
      a. Apollo.
      b. Or pre-approved equal.

C. General:
   1. Type: Non-lubricated and capable of sealing in either flow direction.
   2. End Connections: flanged or threaded end connections.
   3. Operator Handle: Lever.
   4. Valves bodies requiring actuators shall have integrally mounted molded stem support and platform to assure proper alignment of the actuator to the valve.
   5. 250 psi pressure rated.

D. Materials:
   1. Body: Ductile iron body for DI valves; 316 SS body for SS valves.
   2. Ball: 316 SS.
   3. Seats: FKM (Viton) or EPDM or PTEF.
   4. O-rings: FKM (Viton) or EPDM.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install each type of valve in accordance with manufacturers' printed instructions.
B. Schedule: All valves 3-inches and smaller are not shown on the Valve Schedule in the Drawings.

END OF SECTION

SECTION 15112

BUTTERFLY VALVES, OPERATORS,
AND APPURTENANCES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Metal body lugged butterfly valve, operators, and appurtenances.
B. Related Sections:
   1. Section 09900 - Special Coatings.
   2. Section 15110 - Valves.
C. Where valves are connected to electric actuators, the entire valve and actuator assembly shall be supplied by same Manufacturer/Supplier.

1.02 REFERENCES

A. American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME):
   1. ANSI/ASME B16.1 – Gray Iron Pipe Flanges and Flanged Fittings, Classes 25, 125 and 250.
   2. ANSI/ASME B16.5 – Pipe Flanges and Flanged Fittings, NPS ½ Through NPS 24 Metric/Inch Standard.
B. American Society for Testing and Materials (ASTM):
   1. A 126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   2. D 429 - Standard Test Methods for Rubber Property - Adhesion to Rigid Substrates.
C. American Water Works Association (AWWA):
   1. C 110 – Ductile-Iron and Gray-Iron Fittings.
   2. C 504 – Rubber-Seated Butterfly Valves.
D. National Sanitation Foundation (NSF) 61 - Drinking Water Components - Health Effects.

1.03 SYSTEM DESCRIPTION

A. Design Requirements:
   1. General Purpose Butterfly Valves:
      a. Design Standard: In accordance with AWWA C 504 as modified and complemented herein.
      b. Class: AWWA Class 150B, when not otherwise specified or indicated on the Drawings.
   2. Design Requirements for General Purpose Butterfly Valves:
      a. Design valves and actuators for maximum operating torque, in accordance with and using safety factors required in AWWA C504 and using the following values:
         1) Maximum Water Velocity: 16 feet per second with valve fully open.

2) Maximum pressure differential across the closed valve in accordance with AWWA Class designation, or as indicated on the Valve Schedule.

b. System head loss characteristic, exclusive of valve, and proportional to the velocity head.

c. Coefficient for seating and unseating torque, dynamic torque, and bearing friction in accordance with valve manufacturer's published recommendations.

3. Valve Disc: Seat in at angular position of 90 degrees to the pipe axis and rotate at angle of 90 degrees between fully open and closed positions.

a. Do not supply valves with stops or lugs cast with or mechanically secured to the body of the valve for limiting the disc travel.

b. Unacceptable Thrust Bearings: Do not provide valves with thrust bearings exposed to the fluid in the line and consisting of a metal bearing surface in rubbing contact with an opposing metal bearing surface.

B. Performance Requirements:

1. General Purpose butterfly valves:

a. Tight shutoff at the AWWA rated class with flow in either direction.

2. Suitable for the following service conditions:

a. Throttling.

b. Frequent operation.

c. Operation after long periods of inactivity.

d. Installation in any position and flow in either direction.

1.04 SUBMITTALS

A. Shop Drawings: Include certified drawings and material specifications in accordance with AWWA C504, Sections 1.4 and 1.5.

1. Include description of the method of attachment of the edge to the valve disc.

2. Provide size and dimensions of operator/actuators.

B. Product Data: Include manufacturer's published recommendations for seating and unseating torque coefficient, dynamic torque, and bearing friction for calculation of maximum operating torque.

C. Provide valve tags for the butterfly valves included in the shop drawing.

D. Test Reports: Records of tests performed in accordance with AWWA C504.

E. Certificates: Affidavit of compliance specified in AWWA C504, Section 1.7.

PART 2 - PRODUCTS

2.01 GENERAL PURPOSE BUTTERFLY VALVES

A. Manufacturers: One of the following:

1. Mueller

B. Valve Body:
   1. Material: Cast-iron ASTM A 126, Class B or ASTM A536 Grade 65-45-12 ductile iron.
      a. Flanges: 150 pound ANSI/ASME B16.1.
      b. Mechanical Joint Ends: In accordance with AWWA C 110.
   2. Body Design:
      a. Provide short body or long body valves at CONTRACTOR's option, subject to:
         1) Location in the piping system so that when the valve is operated, its operation will not interfere with, nor be impaired by, adjacent fittings, valves, equipment or other installations.
   3. Valve body including all internals shall be rated as shown on the Valve Schedule.

C. Disc Materials:
   1. For Liquid Service: Stainless steel or nickel-chrome mating edge on a cast-iron or ductile iron disc. For high pressure applications (see Drawings), only ductile iron is allowed.
   2. For Low Pressure Air Service: Stainless steel.

D. Shaft and Bearings:
   1. Shaft: Type 304 or 316 stainless steel.
   2. Thrust Bearings: Self-lubricating, sleeve type; Teflon lined with fiberglass backing, or polytetrafluoroethylene (PTFE) with phenolic or stainless steel backing.
   3. Valves in Low Pressure Air Systems and Systems with Operating Temperatures of 250 Degrees Fahrenheit or Higher: Provide valves with Teflon lined bearings with fiberglass backing.
   4. Valves in Other Service Applications: Provide valves with polytetrafluoroethylene with phenolic or stainless steel backing.

E. Disc Pins: Secure valve disc to shaft by means of solid, smooth sided, Type 316 stainless steel or monel, taper or dowel pin.
   1. Extend pins through shaft and mechanically secure in place.

F. Seats:
   1. For valves less than 24 inches Nominal size, bond or vulcanize seats into the valve body.
   2. For valves 24 inches Nominal size and larger, mechanically retain seats in the valve body:
      a. Achieve retaining effect by an epoxy injection method that expands the seat into the body, or by segmented clamping tee lock ring with adjusting screws.
      b. Provide means to prevent nuts and screws used to retain rubber seats from loosening due to vibration or cavitation.
      c. Seat Retainers: Type 316 stainless steel.
   3. Do not provide valve with seats retained by a snap ring.
   4. Seat Materials:
      a. Liquid Service: Buna N, Acrylonitrile Butadiene, natural rubber.
      b. Low Pressure Air Service: Synthetic rubber suitable for continuous operation at 250 degrees Fahrenheit.

G. Valve Packing:
   1. Valves 4 inches to 48 inches in Nominal Size: Self-adjusting V-type packing or chevron type packing.

2. Valves 54 inches in Nominal Size and Larger: Adjustable V-type packing with bronze packing gland or self-adjusting V-type packing.

2.02 BUTTERFLY VALVE OPERATORS

A. Type of Actuator is shown in the Valve Schedule.
B. Manual Operators for Valves less than 8 Inch Diameter: Hand lever type with a locking device so that the valve can be locked in any position with a wing nut.
C. Provide underground valves 6 inches in nominal size and larger with a totally enclosed worm gear operator mounted on the valve:
   1. Valve Shaft: Extend from the valve to the operator and be as specified for valve shafts.
   2. Operator: Gasketed for watertightness.
D. Manual Operators on Aboveground Butterfly Valves Larger than 8 Inches in Nominal Size: Worm geared; valves 10 inches in nominal size and smaller on low pressure air service may be lever operated.
E. Fit exposed butterfly valves not specified to have geared operators with ell or tee wrenches, or speed handles for operation.
F. Where handwheels are specified in Valve Schedule, provide speed crank.

2.03 FABRICATION

A. Shop coat interior and exterior ferrous metal surfaces of valves and accessories, except as follows:
   1. Finished surfaces.
   2. Bearing surfaces.
   3. Stainless steel components.
B. Surface Coatings:
   1. Unfinished Surfaces:
      a. Interior Surfaces:
         1) High solids polyamine cured epoxy.
      b. Exterior Surfaces:
         1) Submerged Valves: High solids polyamine epoxy.
         2) Buried Valves, Valves in Manholes and Vaults: Coal tar.
         3) Other Valves: Rust-inhibitive primer.
   2. Polished and Machined Surfaces: Rust-preventive compound.
   3. Actuators and Accessories: Rust-inhibitive primer.

C. Coating Materials:
   1. High Solids Polyamine Cured Epoxy:
      a. Application: Shop apply to iron and steel surfaces, except stainless steel.
      b. Product: As specified in Section 09800.
      c. Quality Control: After coating is cured, check coated surface for porosity with a holiday detector set at 1,800 volts.
      d. Repair holidays and other irregularities and retest coating.
         1) Repeat procedure until holidays and other irregularities are corrected.

e. Additional field coating, other than touchup coating of damaged surfaces, will not be required.
    1) Perform touchup coating within the recoat time recommended by the paint manufacturer.
    2) When touchup coating is required after expiration of the recoat time, precede coating by blast cleaning or other surface preparation recommended by manufacturer of the coating material for satisfactory adhesion between coats.

2. Rust-Inhibitive Primer:
    a. Rust-inhibitive Primers: Compatible with the piping systems coating specified in Section 09800.
    b. Surface Preparation: As specified in Section 09800.
    c. Rust-Preventive Compound: One of the following or pre-approved equal:
    d. Houghton, Rust Veto 344.
    e. Rust-Oleum, R-9.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install valves with valve shafts horizontal, unless a vertical shaft is required to suit a particular installation, and unless a vertical shaft is indicated on the Drawings.

B. Install pipe spools or valve spacers in locations where butterfly valve disc travel may be impaired by adjacent pipe lining, pipe fittings, valves, or other equipment.

3.02 SCHEDULE

A. See Drawings.

END OF SECTION

SECTION 15114

CHECK VALVES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Globe Silent check valves.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. A 48 – Standard Specification for Gray Iron Castings.
   2. A 126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   3. A 276 – Standard Specification for Stainless Steel Bars and Shapes.
   4. B 582 – Standard Specification for Nickel-Chromium-Iron-Molybdenum-Copper Alloy Plate, Sheet and Strip.
   5. B 584 – Standard for Copper Alloy Sand Castings for General Applications.
B. American Water Works Association (AWWA):
   1. C 508 – Swing-Check Valves for Waterworks Service, 2 - 48 Inch NPS.
C. American Petroleum Institute (API).
D. National Sanitation Foundation (NSF) 61 - Drinking Water Components - Health Effects.

1.03 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Check Valves: When not otherwise specified as indicated on the Drawings, provide check valves suitable for service as follows:
      a. In either horizontal or vertical position.
      b. Under pressures equal and less than 150 psig.
      c. Plastic body ball check valves on plastic pipelines.

PART 2 - PRODUCTS

2.01 SILENT CHECK VALVES (METAL BODY)

A. Globe Style Silent Check Valves 3 Inches through 24 Inches:
   1. Manufacturers: One of the following or equal:
      a. Mueller
      b. Or pre-approved equal.
   2. Valve Design:

a. Globe
b. Valve plug will be spring loaded, normally closed, by means of one or more stainless steel springs.
c. Check valve must be capable of silent operation when installed in the vertical or horizontal position - flow up or down.
d. Spring must be helical or conical. Seat and plug shall be hand replaceable in the field for ease of maintenance.
e. The flow area through the body shall be equal to or greater than the cross sectional area of the equivalent pipe size.
f. Valves shall be of the type that begins to close as the forward flow diminishes and is fully closed at zero velocity.
g. Valve shall permit flow in one direction only and close tightly, without slamming, when its discharge pressure exceeds its inlet pressure

3. Materials:
   a. Body: Ductile-iron, ASME B16 with 125/150 or 250/300 flange bolt circles
   b. Doors: Stainless steel, Type 316
   c. Hinge Pins: Stainless steel, Type 316
   d. Sealing element: Stainless steel, Type 316
   e. End Connections: Flanged.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install with proper orientation of flow direction arrow on valve body.

3.02 ADJUSTING

A. Adjust cushioned check valves in the field by means of external adjustment devices to minimize pressure surges.
B. Adjust weight on check valves to affect proper closing action on equipment shutdown.

END OF SECTION

SECTION 15141

MECHANICAL - PROCESS PIPE SUPPORTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Supports for pipe, fittings, valves, and appurtenances.

1.02 REFERENCES

A. American National Standard Institute or Manufacturer's Standardization Society (ANSI/MSS):
   1. SP 58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation.
   2. SP 69 - Pipe Hangers and Supports - Selection and Applications.

1.03 SUBMITTALS

A. Shop Drawings: Include schedule, indicating where supports will be installed, and drawings of pipe support system components.

PART 2 - PRODUCTS

2.01 PIPE SUPPORTS

A. Pipe Supports:
   1. 3-inch and larger: As indicated on the Drawings.
   2. 2-inch and smaller: Supplied by CONTRACTOR under constraints of these specifications. Locations for these supports are not specifically shown in drawings but are the responsibility of the CONTRACTOR.

2.02 MATERIALS

A. Materials: As indicated on the Drawings.
B. Materials Not Specifically Indicated on the drawings: Hot-dip galvanized steel with stainless fasteners.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Properly support, suspend or anchor exposed pipe, fittings, valves, and appurtenances to prevent sagging, over-stressing, or movement of piping and to prevent thrusts or loads on or against connected pumps, valves, meters and other equipment.
B. Carefully determine locations of inserts. Anchor to form work prior to placing concrete.
C. Do not use stud type powder actuated fasteners for securing metallic conduit or steel pipe larger than 1 inch to concrete, masonry, or wood.
D. Suspend pipe hangers from hanger rods. Secured with double nuts.
E. Install continuously threaded hanger rods only where indicated on the Drawings.
F. Use adjustable ring hangers; or adjustable clevis hangers, for 6-inch and smaller diameter pipe.
G. Use adjustable clevis hangers for pipe larger than 6 inches in diameter.
H. Secure pipes with galvanized double nutted U-bolts or suspend pipes from hanger rods and hangers.
I. Support Spacing (unless otherwise specified on drawings):
    1. Support 2-inch and smaller piping on horizontal and vertical runs at maximum 5 feet on center, unless otherwise specified.
    2. Support larger than 2-inch piping on horizontal and vertical runs at maximum 8 feet on center, unless otherwise specified.
    3. Support exposed polyvinyl chloride and other plastic pipes at maximum 5 feet on center, regardless of size.
    4. Support tubing, copper pipe and tubing, fiber-reinforced plastic pipe or duct, and rubber hose and tubing at intervals close enough to prevent sagging greater than 1/4 inch between supports.
J. Install Supports at the following Locations (unless otherwise shown on Drawings):
    1. Horizontal bends.
    2. Both sides of flexible pipe connections.
    3. Base of risers.
    4. Floor penetrations.
    5. Connections to pumps, blowers and other equipment.
    6. Valves and appurtenances.
K. Securely anchor plastic pipe, valves, and headers to prevent movement during operation of valves.
L. Anchor plastic pipe between expansion loops and direction changes to prevent axial movement through anchors.
M. Size hanger rods, supports, clamps, anchors, brackets, and guides in accordance with ANSI/MSS SP 58 and SP 69.
N. Do not use chains, plumbers' straps, wire, or similar devices for permanently suspending, supporting, or restraining pipes.
O. Support plumbing drainage and vents in accordance with Uniform Plumbing Code.
P. Supports, clamps, brackets, and portions of support system bearing against copper pipe: Copper plates, copper throughout, or isolated with neoprene or PVC tape.

Q. Where pipe is insulated, install over-sized supports and hangers.
R. Install insulation shield in accordance with ANSI/MSS SP 69, Type 40. Shield shall be galvanized steel unless specified elsewhere.
S. Install riser clamps at floor penetrations and where indicated on the Drawings.
T. Paint or Coat support system components as specified in Section 09800.

END OF SECTION

SECTION 15495

DISINFECTION OF POTABLE WATER PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Disinfection of water lines and piping, bacteriological testing, and flushing at lines at completion of construction. This includes piping at water treatment facility site.

1.02 REFERENCES

A. American Water Works Association (AWWA):
   1. AWWA C 651 - Disinfecting Water Mains.

B. Standard Methods for Examination of Water and Wastewater.

1.03 SUBMITTALS

A. Submit disinfection test plan which details procedure to be utilized to disinfect water lines including:
   1. Method and locations of disinfectant application.
   2. Locations of sampling points.
   3. Method of flushing and location of flushing ports.
   4. Method of dechlorination.
   5. Disposal location for dechlorinated water.

B. Submit disinfection reports and include the following:
   1. Date issued.
   2. Project name and location.
   3. Treatment subcontractor’s name, address, and phone number.
   4. Type and form of disinfectant used.
   5. Time and date of disinfectant injection start.
   6. Time and date of disinfectant injection completion.
   7. Test locations.
   8. Initial and 24-hour disinfectant residuals in part per million for each outlet tested.
   9. Time and date of flushing start.
   10. Time and date of flushing completion.
   11. Disinfectant residual after flushing in parts per million for each outlet tested.

C. OWNER will perform sampling and laboratory analyses for microbiological testing.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protect against damage and contamination.
B. Maintain caution labels on hazardous materials.
C. Maintain storage room dry with temperatures as uniform as possible between 60 and 80 degrees Fahrenheit.

1.05 PROTECTION

A. Provide necessary signs, barricades, and notices to prevent persons from accidentally delivering water for potable use.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Disinfectant: Free chlorine in liquid form.

PART 3 - EXECUTION

3.01 CLEANING WATER LINES

A. Prior to chlorination, remove by flushing or other means, soil, and debris from water lines.

3.02 INSPECTION

A. Verify that water line system is completed and cleaned.
B. Start disinfection of water lines when conditions are satisfactory.

3.03 SYSTEM TREATMENT

A. Perform disinfection of water lines in accordance with AWWA C 651 and as specified in this Section.
B. Starting at outlet closest to water source, bleed water from each outlet until water produces odor of disinfectant. Repeat process at each outlet throughout system.
C. Test for disinfectant residual at each of following locations and other locations in accordance with submitted disinfection test plan:
    1. Ends of piping runs.
    2. Remote outlets.
D. Maintain disinfectant in system for 24 hours.
E. When disinfectant residual is less than 25 parts per million after 24 hours, repeat system treatment.

3.04 FLUSHING

A. Remove disinfectant from water lines.
B. Flush water lines with potable water containing no more disinfectant residual than the active distribution system or 1.0 parts per million, whichever is greater.
C. Continue flushing until water at designated flushing ports contains disinfectant residual equal to concentrate specified above.

3.05 DISPOSAL OF CHLORINATED WATER

A. For on-site piping, dechlorinate and dispose water into backwash holding tank (if available on site or into RID canal with appropriate NPDES permit and approvals).

3.06 MICROBIOLOGICAL TEST

A. Advice OWNER to take water samples no sooner than 24 hours after flushing system.
B. At the end of 24 hours and before the water main is placed in service, collect microbiological samples in accordance with the submitted disinfection test plan at each piping run.
C. When microbiological test proves water quality to be unacceptable, repeat disinfection treatment.

END OF SECTION

DIVISION 16

GENERAL ELECTRICAL REQUIREMENTS

SECTION 16000

GENERAL ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. Furnish and install all electrical Work as shown on the Drawings and specified. Work includes electrical connections to equipment, wiring devices, disconnects, panelboards for electrical distribution, service entrance, conduit, conductors, and control panels.

1.2 RELATED WORK

A. Refer to all drawing sheets for the scope of the electrical work.

1.3 QUALITY ASSURANCE

A. All work to be completed to latest edition of National Electrical Code.

B. All material to be U.L. listed.

C. All equipment to conform to ANSI and NEMA standards.

1.4 SHOP DRAWINGS

A. Submit complete Shop Drawings for:

1. Wiring Devices
2. PLC/RTU panel
3. Booster pump and air compressor control panels

1.5 CERTIFICATES AND FEES

A. The Electrical Contractor will pay for all fees, connection charges, permits and inspections.

1.6 GROUNDING

A. All grounding, as a minimum, will be according to the latest edition of the National Electrical Code, Article 250. Provide a full-size grounding conductor in all conduits.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials and equipment direct to the job site utilizing Contractor's personnel and not to the Owner's receiving area.

B. Store all materials and equipment in a dry area, protected from the weather. Verify location of storage areas with the Owner.

1.8 EXISTING CONDITIONS

A. Visit the site and become familiar with existing conditions and limitations.

B. Perform all cutting necessary to install the electrical work indicated and all patching, painting, etc. to return the finished surfaces to the original condition. All wiring devices to be installed flush unless noted otherwise.

PART 2 PRODUCTS

2.1 CONDUIT
- A. PVC below grade. Rigid steel conduit (RSC) for exterior above grade.

2.2 CONDUCTORS
- A. Copper, THHN-2. Minimum size is #12 with other sizes as shown on Drawings.

2.3 WIRING DEVICES
- A. Equal to Hubbell, specification grade, ivory in color.

2.4 DEVICE PLATES
- A. Plastic, ivory, equal to Sierra "P" series.

2.5 MANUAL MOTOR STARTERS
- A. Equal to Square D, size as required for motor, fractional horsepower controller.

PART 3 EXECUTION

3.1 GENERAL
- A. Install all electrical Work as shown on the Drawings.
- B. Utilize conduits for all feeders, branch circuiting, and control wiring.
- C. Coordinate service requirements with Unisource Energy Services. Contact Ron Holmgreen 928-505-7031

** END OF SECTION 16000 **

SECTION 16010

GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 Description

A. This Division includes the complete installation of power, control, instrumentation, wiring, lighting, and other electrical systems as specified in the Sections of Division 16. In general, work includes, but is not limited to, the following:

1. Electrical work associated with this Project. This includes the provision and installation of grounding, power distribution, lighting, instrumentation, process equipment, and data gathering systems (SCADA System).
2. Provision and installation of wiring connections to equipment specified in this and all other divisions, unless indicated otherwise.
3. Provision and installation of wiring connections to Equipment furnished by Owner.
4. Assist electrical utility with installation of utility equipment dedicated to this project.
5. SCADA System equipment installation (PLC, Radio, Termination Cabinet, etc.)
6. All necessary SCADA System programming modifications required to make system operational.

B. Related Work Specified Elsewhere

1. All sections this Division.

1.2 References

A. As specified in each applicable section, this Division.
B. National Fire Protection Association
National Electrical Code, NFPA 70
Standard for Electrical Safety in the Workplace, NFPA 70E
C. National Electrical Safety Code, IEEE C2.
D. Occupational Safety and Health Administration, OSHA.

1.3 Submittals

A. As specified in each applicable Section, this Division.

PART 2 - MATERIALS

2.1 General

A. All equipment and materials shall be in accordance with the latest edition of the National Electrical Code (NEC) as adopted by Lake Havasu City.

B. All equipment conductor termination provisions shall be UL listed for the conductor temperatures specified.

C. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

2.2 Systems to be Installed

A. Power - 480-VAC, 3-phase, 60-Hertz, 4-wire power system.

B. Power – 208/120-VAC, 3- phase, 60-Hertz, 4-wire power system.

C. Grounding systems.

D. Control systems.

Underground conduit system.

Instrumentation systems.

Electrical utility transformer secondary conduits and wiring and metering equipment, CT cabinet, and assistance to local utility.

SCADA System equipment (radio, PLC, antenna mast antenna, wiring) and programming.

Temporary lighting and power facilities during construction.

2.3 Warranty

A. All electrical equipment and workmanship shall be warranted for a minimum period of one (1) year or as designated in Section 700 of this document by the contractor. Where manufacturers' warranty exceeds the one (1) year general warranty period of the contractor, the manufacturers' extended warranty period shall be the governing factor.

PART 3 - EXECUTION

3.1 Installation

A. As specified in each applicable section, this Division.

B. All work shall be in accordance with the National Electrical Code (NEC) and all other applicable standards, refer to clause 1.2 above.

C. Equipment power ratings, horsepower and kilowatt indicated are approximate. If equipment of a different size is furnished, the Contractor shall furnish and install the proper motor starter, fuses, circuit breaker, disconnect switch, wire, and conduit required for the equipment furnished, at no additional cost to the Owner.

D. Provide temporary power to all on site construction trailers.

E. Provide temporary power as required to support construction trades.

Note: all work, including temporary construction related activities shall be in accordance with the NEC, and all other requirements of the standards and safety codes.

3.2 Work on Existing Equipment

A. Do not remove any Equipment from service without obtaining permission from Owner and Engineer. A minimum of 48 hours notice to be given to the Owner and Engineer by contractor before work is begun.

B. Perform work that requires taking Equipment out of service at times designated by Owner so as to cause minimum interruption in plant operation.

C. Continue work with as many workmen as can be efficiently used from the time any Equipment is removed from service until Equipment is tested and back in service.

D. Connect electrical equipment to provide same phasing as existing equipment, unless otherwise specified or indicated.

E. Any work on energized (live) equipment shall meet the requirements of NEC 2005 110.16.

3.3 Testing

A. Test all electrical equipment upon completion of installation to ensure that the equipment operates satisfactorily and to conform to Contract Documents.

B. Furnish temporary power source of proper type for testing purposes when normal supply is not available at the time of testing.

C. Upon successful completion of testing and acceptance by owner provide physical protection of equipment to prevent damage.

3.4 Coordination and Scheduling

A. Coordinate Electrical Installation with other trades to avoid interference of exposed conduit, lighting fixtures, or other equipment until all piping, pipe hangers, ducts, and equipment which are above or behind have been installed, unless release is given in specific cases by Engineer.

B. Coordinate installation of equipment and wiring with the established construction schedule.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

*** END OF SECTION 16010 **

SECTION 16111
CONDUIT, FITTINGS AND ACCESSORIES

PART 1 - GENERAL

1.1 Description: This Section includes all conduit, fittings and accessories.

1.2 References

1. American National Standards Institute (ANSI)
   ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated.
2. American Society For Testing and Materials (ASTM)
   ASTM A123 - Zinc (Hot Galvanized) Coating on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strips.
   ASTM A153 - Zinc Coating (Hot Dip) on Iron and Steel Hardware.
3. National Electrical Code (NEC)
4. National Electrical Manufacturers Association (NEMA)
   FB1 - Fittings and Supports for Conduit and Cable Assemblies.
   RN1 - Polyvinyl-Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing.
5. Underwriters' Laboratories, Inc. (UL)
   1 - Flexible Metal Electric Conduit.
   6 - Rigid Metal Electrical Conduit.
   263 - Fire Tests of Building Construction and Materials.
   360 – Liquid tight Flexible Steel Conduit
   514A - Metallic Outlet Boxes, Electrical.
   514B - Fittings for conduit and Outlet Boxes.
   514C - Nonmetallic Outlet Boxes, Flush Device Boxes and Covers.
6. Steel Structures Painting Council (SSPC)
   SP3 - Power Tool Cleaning.
   SP11 - Power Tool Cleaning to Bare Metal.
7. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor’s responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Submittals

. Submit as specified in SECTION 1330.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Rigid Steel Conduit
   1. Allied Tube and Conduit Corporation.
   2. LTV Steel.
B. Rigid Steel Conduit with Bonded Polyvinyl Chloride (PVC) Jacket

1. OCAL Inc.
2. Robroy Industries.
3. Perma-Cote Industries.

C. Liquid-tight: Flexible Metal Conduit:
1. Anamet, Inc.
2. Electri-Flex Company.

D. Rigid Polyvinyl Chloride (PVC) Conduit
1. Cantex
2. Allied Tube & Conduit
3. Carlon or equal

E. Rigid Steel Conduit Fittings
1. Heavy-duty Cast Malleable Iron Fittings
   a. Appleton Electric Company.
   b. Crouse Hinds Company.
2. Conduit Expansion and Deflection Fittings
   a. O-Z /Gedney Company.

F. Rigid Steel Conduit Boxes

1. Indoor and Outdoor Boxes
   a. Hoffman Engineering Company of Anoka, Minnesota.
2. Conduit Hubs
   a. Appleton Electric Company.
   b. Myers Industries, Inc. (ITT).
   c. Crouse-Hinds Company.
   d. O-Z /Gedney Company.

G. Supports
1. B-Line Company.
2. Midland-Ross Corporation.
3. Unistrut Products Corporation.
4. U.S. Gypsum Company.
5. Van-Huffel Tube Corporation.

H. Wall Entrance Seals
1. O-Z/Gedney Company.

I. Explosion-proof Fittings
1. Crouse-Hinds Company
2. Appleton Electric Company

J. Fire-stopping Materials
1. 3M, (Minnesota Mining and Manufacturing Company)
2. Thomas and Betts
3. Hilti
4. Dow Corning

K. Duct Seal
1. Ideal Industries
2. 3M, (Minnesota Mining and Manufacturing Company)

2.2 Design Requirements

A. Each length of threaded conduit furnished with coupling on one end and metal or plastic thread protector on other end.
B. UL listed and labeled conduit, on each length, fittings and accessories.
C. Sizes of conduit, fittings and accessories as indicated, specified or as required by Electrical Codes and Standards.
D. Provide and meet the requirements of the following sections for the conduit, fittings and accessories indicated.

2.3 Rigid Steel Conduit

A. Conform to ANSI C80.1 and UL-6.
B. Mild ductile steel, circular in cross section with uniform wall thickness sufficiently accurate to cut clean threads.
C. Each length threaded on both ends with threads protected.
D. All scale, grease, dirt, burrs and other foreign matter removed from inside and outside prior to application of coating materials.
E. Galvanized by the hot-dip process as follows:
    1. Interior and exterior surfaces coated with a solid, unbroken layer of 99% virgin zinc by dipping.
    2. Coating not to show fixed deposits of copper after four 1-minute immersions in a standard copper sulfate solution.
    3. One coat of zinc chromate finish on inside and outside surfaces to prevent oxidation and white rust.
F. Couplings and elbows fabricated, coated and finished by the same process as conduit.

2.4 Rigid Steel Conduit and Fittings with Bonded Polyvinyl Chloride (PVC) Jacket

A. Conform to hot-dipped galvanized rigid steel conduit as specified in NEMA-RN1, RIGID STEEL CONDUIT, this Section, and as follows.
B. Prior to application of PVC coating, clean interior and exterior surfaces to remove contaminates to provide a suitable surface for bonding.
C. Bond the PVC coating to the conduit. Extruded PVC jackets are unacceptable.
D. Coated externally with PVC to a nominal 40 mils, 0.035-inch to 0.045-inch.
E. Uniformly coat around outside diameter and full length of the conduit.
F. Coat the prethreaded ends with a urethane coating having a nominal thickness of 2 mils (0.002-inch).
G. Coat the interior surfaces of all conduits and feed-through fittings (except where prohibited by design) with a two-part, chemically cured, urethane coating having a nominal thickness of 2 mils (0.002-inch).
H. Exceed the tensile strength of coating with bond between metal and jacket.
I. Couplings, elbows, and other conduit fittings, boxes, cover-plates, supports, hardware and related items shall be treated and coated with the same process as conduit.
J. Each coupling and fitting shall include a PVC sleeve that overlaps the conduit.

K. Length of the overlapping sleeve equals diameter of the conduit or 2 inches, whichever is least.
L. Final cured PVC coating capable of withstanding a minimum electrical potential of 2000V.
M. All conduit accessories, clamps, and hardware that are uncoated shall be stainless steel.

2.5 Liquid-Tight Flexible Metal Conduit
A. Conform to UL-360.
B. Liquid-tight conduit with flexible galvanized-steel core and a synthetic rubber, polyvinyl chloride, or thermoplastic covering.
C. Spiral encased copper bonding conductors for conduit in sizes 1-1/4 inches and smaller.
D. External grounding jumper as required.
E. Polyvinyl chloride (PVC) jacket, Type HA or Type O.R. "Seal-Tite" for oil-resistant applications.

2.6 Rigid Polyvinyl Chloride (PVC) Conduit
A. Fabricated from self-extinguishing high-impact polyvinyl chloride designed for aboveground and underground installations.
B. Type EPC Schedule 80 heavy-wall rigid conduit.
C. Fittings and accessories fabricated from same materials as conduit.
D. Solvent-cement-type joints as recommended by manufacturer.

2.7 Rigid Steel Fittings
A. Heavy-Duty Cast Malleable Iron Fittings
1. Mogul type for conduit sizes 1-1/2 inches and larger.
2. LBD or roller action type LB for right angle fittings for conduit sizes 2 inches and larger.
3. Full-threaded hubs and rubber-gasketed covers.
4. Zinc, cadmium-plated or bronze hardware bolts and screws for assembly.
5. Finish with cadmium-plated or galvanizing.
6. Standard and junction fittings.
B. Conduit Expansion Fittings
1. Line of Conduit Type
a. Galvanized expansion fittings for rigid conduit movement up to 4 inches.
b. Insulated metal bushing on ends of the conduit, bonding jumper, and with expansion head sealed with a high-grade graphite packing.
c. O-Z/Gedney Company, Type AX with Type AJ bonding jumper or Thomas and Betts Corporation, Type XJG.
2. End Type
a. For conduit terminating in a junction box.
b. O-Z/Gedney Company, Type EXE with Type BJ-E bonding jumper.

C. Conduit Expansion and Deflection Fittings
   1. Provide for movement of 3/4-inch from normal in all directions between two rigid conduits.
   2. Integral bonding jumper.
   3. O-Z/Gedney Company, Type DX.

D. Conduit Wall Entrance Seals
   1. Provide where required or indicated.
   2. O-Z/Gedney Company Type FSK.

E. Conform to NEMA Type 3R enclosure in all nonhazardous areas except as specified or indicated otherwise.

2.8 Fittings, Couplings and Boxes for Rigid Steel Conduit

A. Fittings
   1. Explosion-proof or weather-proof as specified.
   2. Cast malleable iron.
   3. Threaded cover to conform to NEC.
   4. Full thread hubs.
   5. Seal compound well for seal.
   6. Drain seals as indicated or required to provide a continuous automatic drain of water.
   7. Chico compound for all sealing fittings.
   8. PVC jacketed in corrosive areas and where indicated.

B. Couplings
   1. Explosion-proof or weather-proof as specified.
   2. Flexible.
   3. Conform to NEC.
   4. Threaded, steel or bronze end fittings securely fastened to the core and braided to ensure electrical continuity.
   5. Vinyl plastic coating in severely corrosive locations as indicated.

2.9 Rigid Steel Conduit Boxes

A. Indoor Boxes
   1. Hot-dipped galvanized steel.
   2. Galvanized steel covers.
   2. For special boxes where it is not possible to provide hot-dip galvanizing, apply organic zinc-rich primer at 3 mils dry film thickness after SSPC-SP3 Power Tool Cleaning.
   3. Minimum gage requirements:

No surface area exceeds	No single dimension exceeds	Steel Gage
1000 sq in.	40 in.	14
1500 sq in.	60 in.	12
over 1500 sq in.	over 60 in.	10

4. Explosion-proof or weather-proof as specified.
5. Threaded conduit entrances or rigid conduit hubs on all boxes.
6. Include piano-hinged, gasketed cover, and interior mounting panel when used for enclosing terminal blocks and control relays.
7. Oiltight JIC boxes modified for NEMA Type 3R or Type 4 enclosure for non-explosion-proof areas. Stainless steel as required on engineering drawings.

B. Outdoor Boxes
1. 11-gauge minimum galvanized steel with drip lip and galvanized-steel covers fastened with bronze or cadmium-plated screws or bolts, or cast iron with galvanized finish and flanged bolted covers.
2. For special boxes where it is not possible to provide hot-dip galvanizing, apply organic zinc-rich primer at 3 mils dry film thickness after SSPC-SP3 Power Tool Cleaning.
3. Threaded conduit entrances or rigid conduit hubs on all boxes.
4. Rubber or neoprene gasket for cover.
5. Explosion-proof or weather-proof as specified. Conform to NEMA Type 3R enclosure for non-explosion-proof applications in all outdoor installations unless indicated otherwise.
6. Include piano-hinged, gasketed cover, and interior mounting panel when used for enclosing terminal blocks and control relays.
7. Oiltight JIC boxes modified for NEMA Type 3R or Type 4 enclosure in non-explosion-proof applications.

C. Metallic Barriers
1. Designed not to separate phases of a power circuit.
2. Provide as indicated for the isolation of power circuits from other type circuits.

D. Box size as required, or as indicated, for each particular installation.

D. Include provisions for mounting cable supports where indicated, specified or as required by NEC.

E. Provide as required for cable pulling, junctions, terminals, and for mounting of switches, outlets and control devices.

2.10 Support System

A. Fabricated from structural steel or manufactured framing members equal to "Unistrut" P-3000 series as manufactured by Unistrut Corporation.

B. Minimum 12 gage.

C. Construct as required to rigidly support all conduit runs and boxes.

D. Hot-dip galvanized steel conduit clamps or stainless steel, sized for the specific conduit size, to support all exposed metallic conduit.

E. Nonmagnetic clamps to support nonmetallic conduits.

F. Provide stainless steel rods, anchors, inserts, bolts, washer, and nuts.

G. Materials shall be compatible with the equipment supported

H. Manufactured Framing Members
1. Wet Locations
a. Channel hot-dipped galvanized after all manufacturing operations are completed.
b. Galvanizing zinc weight of 2 ounces per square foot on surface to conform to ASTM A123 and ASTM A153.

2.11 Fire-stopping and Duct Seal
A. Fire-stopping
1. Weather-resistant silicone sealant.
2. Provide 4-hour fire rating.
3. UL tested system.
B. Duct Seal
1. Non-corrosive, permanently soft compound.
2. Nontoxic.
3. Provide flexible re-enterable and repairable seal around cables in conduit.
4. Prevent air movement and drafts through conduits.

PART 3 - EXECUTION

3.1 Preparation
A. Provide suitable protection for conduit risers against damage during construction.
B. Cap ends of all conduits before concrete is poured.
C. Cap all conduits and provide pullstring after cleaning where conduits are to be left empty by this contract.
D. Carefully ream ends of all conduit lengths after cutting to eliminate sharp burrs.
E. Clean out all conduit before pulling wire.
F. Clean out all conduits immediately after concrete work is finished.

3.2 Installation
A. General Requirements
1. Location
a. Install conduit as near as possible to the routing indicated.
b. Shift locations as required to avoid interference with other equipment and piping being installed.
c. Where routing of conduit is not indicated, such as for lighting home run circuits and other systems requiring small conduit runs, route conduit as specified subject to approval by Engineer.
2. Do not use conduit in sizes smaller than 3/4-inch, except 1/2-inch may be used for connections to control devices and thermocouples where necessary.

3. Holes and Sleeves
    a. Provide through floors, walls and roofs as necessary for conduit runs, including approved flashing and weather proofing at outside walls and on roofs.
    b. Install sleeves or forms for all openings in new work.
    c. Provide the required inserts and holes, completely sleeved, bonded, curbed, flashed and finished off in an approved manner, whether in concrete, steel grating, metal panels or roofs.
    d. Core-drill all holes required in existing building work using a dustless method.
    e. Place nonshrinking grout or Dow Corning 3-6548 Silicone RTV (or equivalent General Electric RTF 762) foam as specified, in the following locations:
        (1) All holes in concrete, walls, floor and roof slabs after installation of conduit.
        (2) All unused holes and sleeves as approved by Engineer.
    f. Install wall entrance seals where conduit enters the building or vaults from exterior underground.
    g. Install fire-stopping at all conduit penetration of fire rated walls, ceilings and floors. Fire-stopping shall equal or exceed the fire rating of the wall, ceiling or floor in which it is installed.
4. Make connections to boxes, panels, and other equipment as follows:
    a. For Indoor Dry Locations: Double locknuts, one inside and one outside.
    b. For Outdoor and Damp Locations: Rigid weather-proof conduit hubs.
    c. For Explosion-proof Locations: Use conduit connector seals approved for the hazardous location specified.
    d. Bushings
        (1) Threaded malleable iron or steel.
        (2) Insulated with Bakelite, molded and bonded into the bushing.
        (3) Placed on end of conduit in addition to locknuts.
        (4) Install with integral grounding connector and conductor where all conduits pass through multiple concentric panel knockouts and where the conduit must be bonded to equipment it is not attached to.
    e. Install duct seal in conduits around cables in non-hazardous locations at all conduit terminations at control panels and boxes containing terminations and splices.
5. Running threads will not be permitted.
6. Coat all field cut threads in galvanized conduit with aluminum paint.

7. Comply with applicable requirements of NEC pertaining to installation of conduit systems.
8. Place drainage fittings or weep holes at unavoidable low points where moisture can collect.
9. Install an entire conduit system that is electrically continuous with bonding jumpers provided as necessary to conform to NEC.
10. Install expansion fittings at all building expansion joints and every 100 feet of continuous conduit.
11. Provide all spare or empty conduits with pullstrings for future use.

B. Rigid Steel Conduit
   1. Exposed
      a. Install where specified or indicated on drawings.
      b. Install above grade outdoors.
      c. Install horizontal runs as high above floor as possible and in no case lower than 7 feet above floor, walkway or platforms in passage areas.
      d. Run conduit parallel or perpendicular to walls, ceiling, beams, and columns unless indicated otherwise.
      e. Route to clear all doors, windows, access wells, and openings.
      f. Group parallel runs in neatly aligned banks where possible with minimum of 1-inch clearance between conduits.
      g. Maintain 6-inch clearance between conduit and coverings on all hot lines; steam, hot water, etc.
      h. Do not exceed a distance of 8 feet between supports on horizontal or vertical runs.
      i. When terminating at cable tray, attach conduit to tray and electrically bond conduit with ground wire to the cable tray. Install duct seal in conduits around cables to prevent ingress of water.
   2. Concealed
      a. Conceal conduit for lighting, convenience outlets, and other circuits in walls, ceiling and floors where possible.
      b. Do not install conduit in concrete where conduit outside diameter exceeds one-third of concrete thickness.
      c. Install parallel runs with a minimum spacing of three conduit diameters between conduits.
      d. Use expansion and deflection fitting with bonding jumpers at all concrete expansion joints.
      e. Tie securely in place to prevent movement when concrete is poured.
      f. Install in floor slabs in as straight a run as possible. Conduit crossovers are not permitted unless conduit total outside diameter is one-third of the concrete thickness or less.

g. Use long radius elbows except on risers where curved portion of elbow would extend above the finished floor or foundation.

h. Make all joints watertight after installation by coating all finished joints with coal tar solution applied at 15 mils minimum dry film.
   (1) Kop-Coat - No. 50.
   (2) Tnemec - 46-449.

3. Buried
   a. Place where indicated.
   b. Use PVC jacketed conduit or rigid PVC Schedule 80 as indicated.
   c. Make all joints watertight by field-applied coat of vinyl plastic compound or PVC welding solution furnished by the conduit manufacturer.
   d. Use bender one size larger for conduit sized 1 inch or less and conventional bender for conduit sized above 1 inch.
   e. Use strap wrench to tighten conduit. Repair damaged coating with liquid patching compound recommended by conduit manufacturer.
   f. Install in as straight a run as possible between termination points of exact routing to be determined in the field and subject to approval by Engineer.
   g. Bury conduits a minimum of 24 inches (to top of conduit) below finish grade unless indicated otherwise or required by code.
   h. Slope conduit away from conduit risers where possible.
   i. Maintain 6-inch separation from underground piping.
   j. Use long radius bends at all risers unless indicated otherwise.
   k. After trench bottom has been finished to grade, lay conduit. Backfilling shall be as specified in DIVISION 2.
   l. Cap ends of all conduit risers before backfilling.
   m. Provide watertight seal around wires where conduit terminates in pull box.
   n. Use PVC coated rigid galvanized steel conduit when making transitions from buried to above ground conduit runs.

C. Liquid-Tight Flexible Metal Conduit
   1. Use between rigid conduit and motor terminal boxes except where conduit runs down from above and cannot be conveniently supported by a floor flange.
   2. Place between rigid conduit or conduit box and control device cases where direct connection is not desirable for reasons of equipment movement, vibration, or for ease of maintenance.

3. Install at all points of connection to equipment mounted on supports to allow for expansion and contraction.
4. Conform to NEC with installation of conductors.
5. Install at locations where rigid conduit connections are impractical.
6. Use minimum length consistent with manufacturer's standard lengths, the acceptable bending radius, and with required movement of equipment.
7. Maximum length of 3 feet unless otherwise approved by Engineer.
8. Install an external bonding jumper to conform to NEC on conduit sized 1-1/2 inches and larger.

D. Flexible Metal Conduit
1. Use between rigid conduit and devices, except in hazardous areas and areas subject to dampness, water, and corrosive fumes. Do not use with vapor-tight fixtures. Use in accordance with the National Electrical Code Article 350.
2. Use in lieu of direct connection of rigid conduit where it is not desirable for reasons of equipment movement, vibration, or for ease of maintenance.
3. Install as required for expansion and contraction.
4. Use minimum length consistent with manufacturers' standard lengths, the acceptable bending radius, and with required movement of equipment.
5. Maximum length of 3 feet unless otherwise approved by Engineer.
6. Install in sizes smaller than 3 inches.
7. Install an external bonding jumper to conform to the National Electrical Code on conduit sized 1-1/2 inches and larger.

E. Conduit Fittings
1. Installations of special fittings as required.
2. All materials shall be compatible.
3. Install as required.

F. Boxes
1. Install special boxes as indicated of size required for conduits and cables entering and leaving box.
2. Install where required for pull or junction boxes and for mounting or connecting to switches, outlets, intermediate terminal blocks or control devices.
3. Provide 1/4-inch weep holes in interior boxes where conduits enter from exterior or buried installation.

G. Supports
1. Construct with sufficient rigidity to hold all mounted equipment and material in permanent and neat alignment.
2. Design to provide 1/4-inch space between equipment housings and walls or columns upon which they are mounted.
3. Do not exceed load requirements in NEC and NEMA standards.

4. After Power Tool Cleaning SSPC-SP11, paint all welds, field cuts and damaged areas with organic zinc-rich primer at 3 mils dry film thickness.
    a. Ameron - 68HS.
    b. Carboline - Carbozinc 858.
    c. Porter - Zinc-Lock 308.
    d. Tnemec-Tneme Zinc 90-93.
5. Use electrogalvanized steel conduit clamps and nonmagnetic conduit clamps to support electrogalvanized steel conduit and nonmagnetic conduit, respectively.
6. Provide stainless steel rods, anchors, inserts, bolts, washers and nuts.

I. Explosion-proof Fittings
1. Install explosion-proof fittings in the rigid steel conduit system as required by the NEC.
2. Install necessary fittings where not indicated, but required by code.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

*** END OF SECTION 16111 **

SECTION 16120
WIRE, CABLE, AND ACCESSORIES

PART 1 - GENERAL

1.1 Description

A. This Section includes furnishing and installing (including terminations) of all electrical wire, cable, and accessories.

B. Related Work Specified Elsewhere

Lighting	Section 16500
Grounding	Section 16450
Field Testing	Section 16950
Instruments and Controls	Sections 16900-16950

1.2 References

1. American Society for Testing and Materials (ASTM)

ASTM B3 - Soft or Annealed Copper Wire.
ASTM B8 - Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

ASTM B33 - Tinned Soft or Annealed Copper Wire for Electrical Purposes.

ASTM B172 - Rope-Lay-Stranded Copper Conductors, Having Bunch Stranded Members, for Electrical Conductors.

ASTM B189 - Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes.

2. Insulated Cable Engineers Association (ICEA)

S-19-81 - Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

S-61-402 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

S-66-524 - Cross-Linked Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

S-68-516 - Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

S-81-570 – 600-Volt Rated Cables of Ruggedized Design for Direct Burial.
S-105-692 – 600Volt Single Layer Thermoset Insulated Utility Underground Distribution Cables.

T-29-520 – Vertical Cable Tray Flame Tests at 210,000 Btu.

3. National Electric Manufacturers Association (NEMA) and Insulated Cable Engineers Association (ICEA)

   WC55/S-82-552 – Instrumentation Cables and T.C. Wire.
   WC57/S-73-532 – Standard for Control Cables.
   WC70/95-658 - Non-Shielded Power Cables Rated 2000V or Less.

4. Institute of Electrical and Electronic Engineers (IEEE)

   48 - Test Procedures and Requirements for High Voltage Alternating-Current Cable Terminations.

5. National Fire Protection Association

   National Electrical Code (NEC) NFPA-70.
   Standard for Electrical Safety in the Workplace, NFPA 70E

6. Underwriters Laboratories, Inc. (UL)

   44 - Rubber-Insulated Wires and Cables.
   83 - Thermoplastic-Insulated Wires and Cables.
   263 - Fire Tests of Building Construction and Materials.
   854 - Service Entrance Cables.
   1277 - Electrical Power and Control Tray Cables with Optional Optical Fiber Members.

7. National Electrical Safety Code, IEEE C2.

8. Occupational Safety and Health Administration, OSHA.

9. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Submittals

A. Submit as specified in Section 1330.
B. Includes, but not limited to, the following:
   1. Data sheets for each wire and cable type specified.
   2. Data sheets for wire and cable accessories.
   3. Cable manufacturer's approval of splicing and terminating materials.
   4. Cable manufacturer's approval of pulling compounds.
   5. Cable manufacturer's installation requirements such as maximum pulling tensions, sidewall pressures, minimum bending radii, etc.
   6. Other equipment and materials to be used.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Wire and Cable

Acceptable manufacturers for each wire and cable type will be manufacturers that have been manufacturing the specified cable for a minimum of five years and meet all the requirements listed on the Wire and Cable Specification Sheets.

B. Wire and Cable Accessories

1. Cable Connectors for Control and Instrument Cable
   a. AMP Special Industries.
   b. Hollingsworth Solderless Terminal Company.
   c. Panduit Corporation.
   d. Minnesota Mining and Manufacturing (3M).
   e. Thomas and Betts Company, Inc.
2. Cable Connectors for Power Cable
   a. AMP Special Industries.
   b. Thomas and Betts Company, Inc.
   c. Minnesota Mining and Manufacturing (3M).
   d. Panduit Corporation.
3. Termination and Splice Kits
   a. Minnesota Mining and Manufacturing (3M).
   b. Raychem.
4. Tape and Insulation Putty: Minnesota Mining and Manufacturing (3M).
5. Cable Ties
   a. AMP Special Industries.
   b. Dennison Manufacturing Company.
   c. Panduit Corporation.
   d. Minnesota Mining and Manufacturing (3M).
   e. Thomas and Betts Company, Inc.
6. Cable Supports
   a. O-Z/Gedney Company.
   b. Hubbell, Kellems Grips.
7. Terminal Blocks
   a. Allen-Bradley.
   b. Buchanan.
   c. Phoenix Contact.
   d. Weidmuller.
8. Cable Identification Tags
   a. Allen Marking Products, Kansas City, MO.
   b. Floy Tag and Manufacturing Co., Seattle, WA.
   c. Panduit Corporation (Panduit).
   d. Specialty Products Company, Rock Hill, SC.
   e. Thomas and Betts Company, Inc. (Thomas and Betts).

9. Cable Fire and Smoke Stop Fittings
   a. Crouse Hinds.
   b. Nelson Electric.
   c. O-Z/Gedney Company.

2.2 Wire and Cable

A. Building Wires
   1. Conductors: stranded for 12 AWG and larger. Minimum size: 12 AWG.
   2. Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90 or as indicated on drawings.

B. MC, Metal Clad Cables
   1. Conductors:
      .1 Grounding conductor: copper.
      .2 Circuit conductors: copper, size as indicated.
   2. Insulation: Chemically cross-linked thermosetting polyethylene rated type RW90, 600 V or as indicated on drawings.
   3. Inner jacket.
   4. Armour: continuous aluminum.
   5. Overall covering: flame retardant polyvinyl chloride material meeting requirements of Vertical Tray Fire Test.

C. Instrument Cable – Shielded Twisted Pairs/Triads
   1. Conductors: stranded for 16 AWG and larger. Minimum size: 16 AWG.
   2. Copper conductors: size as indicated, with 600 V insulation of PVC material rated RW90. Color code shall use pigmented compounds, white and black for pairs, white, black and red for triads. Each conductor shall include sequential numbers printed on surface of conductors.
   3. Conductor jacket: nylon.
   4. Shields: aluminized mylar or polyester tape with tinned copper drain wire. Jacket: Polyvinyl chloride (PVC).

D. Control Cables
   1. Class B or C soft annealed stranded copper conductors, sized as indicated, with cross-linked thermosetting polyethylene, outer PVC jacket rated for outdoor use.
   2. 600 V type: with cross-linked polyethylene type, RW90 (x-link) and overall jacket.

E. Temperature Rating
   Cables shall be suitable for operation with a maximum conductor temperature of 90ºC, continuous, wet or dry locations.

F. Insulation and Jacket Thickness
   See references, Section 1.2.

G. Factory Tests
   See references, Section 1.2, including the flame test requirement, ICEA T-29-520 and UL 1277.

H. Certification

Cables shall be certified to be in conformance with all applicable codes and standards as referenced.

All cables shall include surface identification showing manufacturer's name, insulation type, conductor size, conductor type, voltage rating and UL label.

2.3 Connectors

A. General Requirements

1. Designed and sized for specific cable being connected.
2. Solderless, pressure-type connectors constructed of non-corrodible tin-plated copper.
3. Rated current-carrying capacity equal to or greater than the cable being connected.
4. Application tooling for connectors shall contain die or piston stops to prevent over-crimping and cycling or pressure relief to prevent under-crimping. Dies of all application tooling shall provide dot or wire size coding for quality control verification. All tooling shall be manufactured by the connector manufacturer.
5. All terminations shall be installed with protective heat shrink.

B. Power Connectors (10 AWG and Smaller) 600V and Below

1. "Scotchlok" preinsulated spring wire connectors.
2. Buchanan open-end copper splicing caps, applied with "Lok-Seal" tool, with nylon snap-on insulators.

C. Power Connectors (sizes 8-4 AWG) 600V and Below

1. Noninsulated ring-tongue type.
2. Ring tongue sized to match terminal stud size.
3. Brazed barrel seam.
4. Application tooling designed to crimp the wire barrel (conductor grip) with a one-step crimp.

D. Power Connectors (sizes 2 AWG - 750 kcmil) 600V and Below

1. Non-insulated one-hole rectangular tongue for sizes 2 AWG through 3/0 AWG and two-hole rectangular tongue for 4/0 AWG through 750 kcmil.
2. Application tooling shall be hydraulically operated.

E. Control, Instrument, and Specialty Cable Connectors

1. Tin-plated copper.
2. Vinyl preinsulated spring-type spade terminals. (Hollingsworth "Mini Spring Spades"; Thomas and Betts "Locking-Fork"; Panduit "Locking Fork.")
3. Sized to match terminal stud size.
4. Have insulation grip sleeve to firmly hold to cable insulation.
5. Insulation grip sleeve shall be funneled to facilitate wire insertion and prevent turned-back strands.
6. Application tooling designed to crimp the wire barrel (conductor grip) and the insulation grip sleeve with a one-step crimp.

2.4 Motor Lead Termination/Splice (Low-Voltage, 600v and Below, Power Cable)

A. Splices shall be made using compression-type connectors bolted together. The compression-type connectors shall be properly sized for the cables.

B. Splice to be covered with heat-shrinkable tubing connector insulators or slip-on rubber boot or sleeve.

C. Splicing shall be done in accordance with the instructions provided with the Raychem brand MCK Motor Connector Kit or 3M Company 5300 Series Motor Lead Splice Kit.

2.5 Cable Supports

A. Cable supports for cables in vertical conduit risers shall be O-Z/Gedney Type "R" wedging plug type or approved equal.

B. Kellems basket type wire mesh grip for cables in vertical installations.

2.6 Cable Ties

A. Nylon self-locking type.

B. Have a normal service temperature range of -40ºC to 85ºC.

C. Be weather-resistant and sun-light resistant type for outdoor use.

D. Meet requirements of Military Specifications MIL-S-23190D.

E. AMP Special Industries "AMP-TY," Dennison Manufacturing Company "BAR-LOK," Panduit Corporation "PAN-TY," Thomas & Betts "TY-RAP," or Minnesota Mining and Manufacturing 3M Brand cable ties.

2.7 Terminal Blocks

A. For mounting in terminal boxes (TBs)

1. Designed and sized for the cables being terminated.
2. Block rated 600V.
3. Binding screw-type terminals for power cables and strap screw or tubular clamp terminals for control and instrument cables.
4. Rated current carrying capacity equal to or greater than the cable being terminated.
5. Marking strip.

B. For Mounting in Cabinets, Panels, Control Boards, Etc.

1. Designed and sized for the cables being terminated.
2. Block rated 600V.
3. Binding screw type terminals for power cables and current transformer circuits and strap screw or tubular clamp terminals for control and instrument cables.
4. Rated current carrying capacity equal to or greater than the cable being terminated.
5. Marking strip on blocks for power cables and control and instrument cables.
6. Short-circuit strips with one shorting screw for each terminal for current transformer circuits.

2.8 Cable Identification Tags

A. Designed to provide a permanent wire and cable identification system.

B. Show complete cable number. Cable numbers are defined in the Cable Schedule and/or Contract Drawings.

C. Cable numbers may be stamped or typed in a legible and permanent manner. Hand-lettering is not acceptable.

D. Character size for cable numbers shall be a minimum of 1/8-inch.

E. Material shall be nonmetallic and impervious to moisture and resistant to fading in sun-light.

F. Be securely attached to cables and accessible for inspection.

G. Cable identification tags, marking and attachment methods shall be subject to approval of the Engineer.

2.9 Fastenings

1. One hole malleable iron straps to secure surface cables 2 inch diameter and smaller. Two hole steel straps for cables larger than 2 inches.

2. Channel type supports for two or more cables.

3. Threaded rods: 3/8 inch dia. stainless steel to support suspended channels.

PART 3 – EXECUTION

3.1 Installation

A. Wire and Cable

1. General Requirements

a. Install in conduit, duct system or tray as indicated.

b. Do not subject cable to pulling tensions or sidewall pressures in excess of manufacturer's recommendations.

c. Attach pulling grips over the cable sheath to prevent slipping of the insulation.

d. Do not subject cable to bending radius less than those recommended by the cable manufacturer or as noted below (whichever is greater) during or after installation:

(1) Eight times the cable outside diameter for 600V or lower rated cables.

e. Install intermediate splices only as indicated or as required to avoid subjecting cable to excessive pulling tension or sidewall pressures. Cable splicing locations shall be approved by Engineer prior to cable installation.

f. Support cables at connections or termination points such that any strain on cable will not be transmitted to the connection or termination.

g. Install cable supports in vertical runs of conduit, at boxes and at terminations in equipment, and as required to meet intermediate support requirements of National Electrical Code (NEC).

h. All pulling compounds shall be approved by wire and cable manufacturer as being compatible with cable materials.

i. Attach a cable identification tag to each cable at all termination or end points.

j. Install fire and smoke stop fittings at all cable penetration of fire rated walls, floors and ceilings.

2. Power (600V and Below), Control, Instrument, and Specialty Cable

a. Install metallic barrier in all tray and boxes to separate power, control and instrumentation from low-level signal (50V or less) instrumentation circuits where run in the same box.

b. Cables in vertical trays shall be secured every 3 feet or less.

c. Tie together with cable ties all single conductor cable on each individual circuit in each junction box, and equipment at intervals not to exceed 6 feet.

d. Attach a cable identification tag to each cable.

(1) At each terminal to identify the circuit and cable.

(2) Use nylon ties and identification tabs color coded as follows:

(a) 480V circuits - Red.

(b) 277, 240, or 208Vac circuits - Orange.

(c) 120V circuits - White.

(d) Control cables - Natural Nylon.

e. Insulation Color Coding

(1) Conductors shall be coded or numbered over the entire length.

(2) Colors shall not be changed between source and device. No white wire shall be used in lighting and convenience outlets except as a grounded neutral conductor.

f. Tag each individual conductor or wire with wire markers as follows:

(1) With terminal designation indicated on schematic diagrams or given on manufacturer's equipment drawings.

(2) At each terminal.

(3) In addition to specified circuit tags.

g. Terminate and ground, control, instrument, and specialty cable shields as indicated and recommended by the manufacturer of the equipment being connected. In general, ground the shields at the control boards for control cables and at the receiving end equipment for instrumentation and specialty cables.

h. Control and instrument cable splices shall be as follows:

(1) Made only in junction or terminal boxes.

(2) Made on terminal blocks with marking strips.

(3) Conductor color coding shall be maintained.

(4) For shielded cables, shield continuity and isolation shall be maintained.

i. Power cable (600V or below) splices and motor terminations shall be as follows:
   (1) Made only in junction or terminal boxes.
   (2) Splices shall be made using compression type connectors bolted together.
   (3) Splice to be covered with a heat-shrinkable connector insulator.

j. Lighting Cable: Install as specified in this Division.

k. Ground Cable: Install as specified in this Division.

l. Install fire and smoke stop fittings at all cable penetrations of fire-rated walls, floors, and ceilings.

3. Cable Connections and Terminations
   a. Make up clean and tight to assure a low-resistance joint.
   b. Make only in terminal boxes, equipment or other accepted enclosures and not in conduit.
   c. Install all connectors with tooling manufactured by the connector manufacturer and as specified.

3.2 Field Quality Control

A. Manufacturer's Field Services: Provide as specified in DIVISION 1.

B. Field Testing: Specified in Section 16950.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

** END OF SECTION 16120 **

SECTION 16180
STARTERS, RELAYS, SWITCHES, CIRCUIT BREAKERS AND
TRANSIENT VOLTAGE SURGE SUPPRESSORS

PART 1 - GENERAL

1.1 Description: This Section includes relays, switches, circuit breakers, and surge suppressors for equipment.

1.2 References

1. National Fire Protection Association (NFPA)
2. National Electrical Code (NEC)
3. National Electrical Manufacturers Association (NEMA)
   250 - Enclosures for Electrical Equipment (1,000V maximum).
   KS1 - Enclosed Switches.
   AB1 - Molded-Case Circuit Breakers.
   ICS - Industrial Controls and Systems.
4. Underwriters Laboratories (UL)
   50 - Electrical Cabinets and Boxes.
   98 - Enclosed and Dead-Front Switches.
   489 - Molded-Case Circuit Breakers and Circuit Breaker Enclosures.
   508 - Electrical Industrial Control Equipment.
   869 - Electrical Service Equipment.
   977 - Fused Power Circuit Devices.
   1449 - Transient Voltage Surge Suppressors.
5. National Electrical Safety Code
6. Standard for Electrical Safety in the Workplace – NFPA 70E
7. Occupational Safety and Health Administration, OSHA.
8. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Submittals

Submit as specified in Section 1330.

A. Includes, but not limited to, the following:
   1. Enclosure details.
   2. Schematic diagrams.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Allen-Bradley Company.
B. Cutler-Hammer/Westinghouse Incorporated.
C. General Electric Company.
D. Benshaw Inc.
E. Siemens Energy & Automation.
F. National Lightning Protection Corp.
G. Current Technology

2.2 Design Requirements

A. Provide equipment with the rated enclosures as indicated in the Contract Drawings.
B. Phenolic nameplate on cover of each unit with wording as approved by Engineer.
C. All enclosures housing variable speed controller to be equipped with A/C unit to keep operating equipment within design parameters with an exterior ambient temperature of 120ºF (50ºC).

2.3 Magnetic Starters

A. Full-voltage, nonreversing, reversing or two speed with disconnect switch, thermal-magnetic circuit breaker or motor circuit protector circuit breaker as specified or indicated.
B. Three overload heaters in 3-phase units to match motor nameplate data.
C. Built-in 120V control transformer of adequate capacity for all control devices as indicated on wiring diagrams.
D. Necessary auxiliary contacts as required by means of starter or relay.
E. Low-voltage protection.
F. Starter shall be provided with 2 auxiliary contacts.

2.4 Disconnect Switches

A. Provide as required by NEC, specified or indicated.
B. Positive quick-make, quick-break mechanism, visible blades, and line terminal shield.
C. Fused type where indicated with time delay fuses.
D. Coordinate fuses with the ratings of the switch.
E. Furnish heavy-duty type.

2.5 Circuit Breakers

A. Rated 480 VAC, 3-phase, (240VAC, 1-phase for individual loads) 60-hertz, with interrupting rating as indicated on drawings.

B. External handle which clearly indicates when breaker is "ON," "OFF," or "TRIPPED" and is lockable in the "OFF" position.

C. Molded-case, manually-operated, 3-pole.

D. Trip-free from handle.

E. Inverse time thermal element overload protection.

F. Instantaneous magnetic short-circuit protection on all poles.

G. Coordinate trip ratings with magnetic starter ratings and overload relays.

H. Circuit breakers used as service equipment to be labeled and rated “suitable for use as service entrance equipment”.

26 Push Buttons and Selector Switches

A. Heavy-duty oil-tight type.

2.7 Auxiliary Relays

A. Coils rated 120-VAC.

B. Contacts rated 6 A up to 300V.

C. Contacts as required for control of associated equipment.

D. General Electric CR120A 300V industrial or CR2810 600V machine-tool type relays.

2.8 Time Delay Relays

A. Solid state type.

B. Adjustable timing range.

C. On delay, off delay, or on-and-off delay as indicated.

D. Contact arrangement as indicated.

E. Contacts rated 5 amperes continuous at 75% power factor at 120Vac, and 5 amperes make or break at 24Vdc, except as indicated otherwise.

F. Operating voltage as indicated.

G. Repeat accuracy "1% for constant voltage and temperature.

H. Operating temperature range: -10ºC to +55ºC.

I. Transient protection: 2,000V for 100 microseconds.

J. Enclosure for bolted mounting or plug-in type as indicated.

K. Timing indication provided by LED which flashes during timing, glows steadily after timing, and is off when timer is deenergized.

L. Furnish relays as manufactured by Eagle Signal Co., Agastat, Allen Bradley, General Electric Co., or Potter & Brumfield.

2.9 Transient Voltage Surge Suppressors

A. Main Service Protector

1. UL 1449 listed.
2. Provide NEMA 4 enclosure capable of being rack mounted .
3. Surge capacity minimum: 160 KA independent of load current.
4. 25% threshold above nominal line voltage.
5. Replaceable fuse for each phase.
6. Failure mode indicator for each protected phase.
7. Terminal strip connectors.
8. Relative humidity, 0 to 95% noncondensing.
9. Temperature: -40 to 85ºC.
10. For operation on 480VAC, 3 phase, 3 wire system.
11. Integral deadfront disconnect.
12. Furnish Model, as manufactured by Current Technology, or approved equal.
13. Install and connect as indicated to equipment to be protected.

PART 3 - EXECUTION

3.1 Installation

A. Install relays, switches, and circuit breakers at locations indicated or as follows:

1. Mount on equipment rack not to exceed 6 feet in height above the ground when possible.

2. Arrange with proper clearances from other equipment and material to obtain accessibility for operation and maintenance.
3. Provide engraved phenolic nameplates on cover of each device identifying the loads connected.
4. Ground all neutral buses to the ground system.

3.2 Field Testing: Specified in Section 16950.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

*** END OF SECTION 16180 ***

SECTION 16420
SERVICE ENTRANCE SECTION

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section covers the service entrance section and related service equipment.

1.02 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, and elsewhere in the Contract Documents, prior to installation.

B. The contractor shall submit shop drawings, catalog cuts, single line diagrams, component layout drawings and equipment elevation. Shop drawings must indicate all ratings, bus bracing, phasing, and utility requirements.

C. Catalog cuts must be submitted for the service entrance section and components within. Each catalog cut must be properly identified with catalog number and indexed for easy reference.

D. Single line diagrams must be complete with circuit numbers to match the Drawings. Components must be sized and shown in a bill of materials.

E. A wiring diagram must be submitted to show connection and control of devices such as ground fault protection, phase protection relays, and other components. Wiring diagram must include component numbers, matching the bill of materials.

F. Service entrance section must be approved for connection by the serving utility company. Manufacturer shall submit their drawings to utility company for approval prior to Engineer's review.

G. The SES must be UL listed as a complete assembly suitable for Service Entrance Duty.

PART 2 - PRODUCTS

2.01 SERVICE ENTRANCE SECTION (SES)

A. The SES shall be a single panel, frame or assembly of panels on which shall be mounted on a deadfront mounting plate, circuit breakers or fused switches, metering equipment and any monitoring or protection devices as indicated on the drawings.

B. The SES shall be a one-piece enclosure with front accessibility unless otherwise required. The SES shall have a metered distribution section complete with meter socket and factory installed test blocks, customer metering, and a pull section, overhead or underground, as indicated on the drawings; all of which shall comply with the requirements of the serving utility.

C. The enclosure shall be zinc coated steel, minimum 12 gauge thickness. Cabinet shall be protected against corrosion in accordance with U.L. 50, Cabinets and Boxes, Section 13. Exterior covers to be minimum 14 gauge steel, and shall have padlocking provisions. Deadfront shall be a hinged type, 16 gauge minimum, and shall not require the use of a tool to expose interior components for installation or servicing. Factory installed components shall be U.L. listed. Factory installed conductors shall be copper, size and type to conform to NEC and U.L. requirements

(minimum size #14 AWG). Construction shall be such to prevent the entry of rodents into the interior. Ventilation openings shall be provided.

D. Unless otherwise indicated on the Drawings, the enclosure shall be rated NEMA 3R for outdoor use, or NEMA 1A for indoor use.

E. Bus bars (including neutral and ground) shall be silver- or tin-plated solid copper and braced to withstand short circuit amps as indicated on the Drawings.

F. The SES shall have a steel nameplate stamped indicating the equipment switchboard designation, voltage, amperage, and short circuit withstand rating, manufacturer's name, general order number, and item number mounted on the outside of the enclosure. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, black characters on white background. Characters shall be 3/16-inch high, minimum. Nameplates shall give item designation and circuit number as well as frame ampere size and appropriate trip rating.

G. Padlocking provisions shall be provided to lock the device in the "OFF" position.

H. The overcurrent protection shall be rated as indicated, and as specified elsewhere herein.

I. Metering and instrumentation shall be as indicated, and as specified elsewhere herein.

J. On circuit breakers 800 amps and larger, a trip button shall be provided.

K. The Service Entrance Section shall be as manufactured by Eaton, Square D, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The Service Entrance Section shall be installed per manufacturer's instructions, as indicated on the drawings, per all applicable NEC and local codes and regulations, and shall comply with serving utility's requirements.

B. Grounding shall be provided as required by the NEC, and as indicated on the Drawings.

*** END OF SECTION ***

SECTION 16450
GROUNDING

PART 1 - GENERAL

1.1 Description
A. This Section includes the following:
1. Facility ground grid and ground rod system.
2. Ground riser extensions to structural steel, electrical equipment, and mechanical equipment.
B. Related Work Specified Elsewhere
Field Testing .....Section 16950

1.2 References
1. American Society for Testing and Materials (ASTM)
ASTM B8 - Concentric-Lay Stranded-Copper Conductors, Hard, Medium-Hard, or Soft.
2. National Electrical Safety Code (NESC)
3. National Fire Protection Association (NFPA)
70 - National Electrical Code.
70E – Standard for Electrical Safety in the Workplace
4. Underwriters' Laboratories (UL)
467 - Electrical Grounding and Bonding Equipment.
5. Occupational Safety and Health Administration, OSHA.
6. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Submittals
A. Submit as specified in Section 1330.
B. Includes, but not limited to, catalog cuts for the following:
1. Ground Rods.
2. Cable.
3. Grounding Lugs.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers
A. Ground Rods
1. ERICO
2. A.B. Chance Company
3. Harger
Or Equal.

B. Cable-to-Equipment Ground Lugs
1. Burndy Corporation (Burndy).
2. Knight-Metalcraft, Division of Whitaker Cable.
3. Harger

2.2 Wire and Cable
A. Type BC2 as specified in this Division (Section 16120).
B. Conductor Sizes
1. As indicated for specific connections.
2. For required connections not indicated, use conductor size not less than No. 2/0 AWG if buried in earth or cast in concrete, or No.2 AWG at other locations, unless otherwise noted.

2.3 Ground Rods
A. Copper-clad steel or copper-alloy sectional-type rods.
B. One end pointed to facilitate driving.
C. 3/4-inch diameter x 10 feet long with diameter and length stamped near top of rod.

2.4 Connection Materials
A. Cable-to-cable and cable-to-rod cable-to-connector connections of exothermic-welding-type process.
B. Cable-To-Equipment Ground Lugs
1. Compression type.
2. Bolted to equipment housing with silicon bronze bolts and lock washers.

2.5 Coatings
A. Coal Tar
1. Kop Coat - No. 50.
2. Tnemec - 46-449.

PART 3 - EXECUTION

3.1 Inspection: Do not cover up connections before they are inspected by Engineer.
3.2 Installation
A. Wire and Cable
1. Install using as few joints as possible.
2. Protect against abrasion by several wrappings of rubber tape at all points where cable leaves concrete in exposed areas.
3. Suitably protect cable against damage during construction.
4. Replace or suitably repair cable if damaged by anyone before final acceptance.
5. All Connections to be metal to metal. Remove all paint, grease, dirt, etc. before making connections.

6. In Exposed Installations
    a. Route runs as indicated.
    b. Route along the webs of columns and beams, and in corners where possible for maximum physical protection.
    c. Support at intervals of 3 feet or less with nonmagnetic clamp-type supports.
    d. Where exposed and no natural protection available, provide physical protection as required to protect ground conductor.
7. In Buried Installations
    a. Lay in bottom of trench or in other excavations at least 30 inches below finished grade.
    b. Maintain clearance of at least 12 inches from all underground metal piping or structures, except where connections thereto are specifically indicated.
    c. Backfill as specified in DIVISION 2.

B. Ground Rods
1. Install rods as indicated by driving and not by drilling or jetting.
2. Drive rods into undisturbed earth where possible.
3. Where rods must be installed in excavated areas, drive rods into earth after compaction of backfill is completed.
4. Drive to a depth such that top of rods will be approximately 18 inches below final grade or subgrade and connect main grid ground cable thereto.

C. Connections
1. Conform to manufacturer's instructions.
2. Chemically degrease and dry completely before welding.
3. Apply one coat of coal tar coating at 15 mils dry film thickness to all exothermic-welded connections to be buried.
4. Make connections to equipment as follows:
    a. Make up clean and tight to assure a low-resistance connection with resistance not exceeding 1 ohm.
    b. Install so as not to be susceptible to mechanical damage during operation or maintenance of equipment.
    c. Provide direct copper connection to buried ground grid system.
    d. Prior to making connections remove all paint, grease, etc. from connection location.

D. Metallic Conduit Grounds
1. Adequately and properly ground at all terminal points and wherever isolated from equipment or grounded steel.
2. Where extending into floor-mounted equipment from below, connect to equipment ground bus or frame.
3. Where extending into manholes, handholes, or cable trenches, connect to the ground riser or cable at that structure using grounding bushings.

E. Rack Grounds
   1. Ground at intervals not to exceed 20 feet.
   2. Ground all continuous runs as well as isolated sections at least at one point.

F. Box Grounds: Unless grounded by conduit system, ground all boxes by direct copper connection to the buried ground grid system.

G. Motor Grounds: Ground all motors with "identified" ground conductor in addition to conduit system. Route in conduit with phase conductors unless external ground is indicated.

3.3 Field Testing: Specified in Section 16950.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

** END OF SECTION 16450 **

SECTION 16462
PANELBOARDS

PART 1 - GENERAL

1.1 Summary

A. This Section includes:

1. Panelboards.

B. Related Work Specified Elsewhere

Circuit Breakers…….Section 16180
Grounding…….Section 16450
Field Testing……..Section 16950

2.2 References

1. Federal Specifications
   W-P-115b - Panelboards.
   W-C-375b - Molded-Case Circuit Breakers.
2. National Fire Protection Association (NFPA)
3. National Electrical Code (NEC)
4. National Electrical Manufacturers Association (NEMA)
   AB1 - Molded-Case Circuit Breakers.
   ICS - Industrial Control and Systems.
   PB1 - Panelboards.
   ST20 - Dry-Type Transformers for General Applications.
5. Underwriters' Laboratories, Inc. (UL)
   50 - Electrical Cabinets and Boxes.
   67 - Electric Panelboards.
   508 - Electric Industrial Control Equipment.
6. National Electrical Safety Code
7. Standard for Electrical Safety in the Workplace – NFPA 70E
8. Occupational Safety and Health Administration, OSHA.
9. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor’s responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

2.3 Submittals

A. Submit as specified in Section 1330.

B. Includes, but not limited to, the following:

1. Physical size, number of poles, ratings and nameplate information on panelboards.
2. Overall dimensions, weight, ratings, impedance and taps on transformers.
3. Schematic diagrams.
4. Factory test data if required.
5. Coating system.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Power Distribution Panelboards:
   1. Square D Company.

B. Lighting Panelboards:
   1. Square D Company.

2.2 Lighting and Power Distribution Panel-boards

A. Required final arrangement of breakers determined by system design.

B. Provide required components with ratings and voltages as indicated on the plans.

C. Heavy-duty type with size, number of poles, and quantity of breakers as indicated.

D. Enclosure:
   1. NEMA Type 3R or as indicated on drawings.
   2. Code gauge, hot-galvanized sheet steel boxes for surface and flush mounting.
   3. Code gauge steel trim.

E. Wiring trough at top and bottom.

F. Hinged door with lock and latch combination in the front trim.

G. Phenolic nameplate approximately 1-inch x 3 inches on front of panel engraved with the panelboard title and designation such as shown on the project documentation.

H. Spare space filler plate if required for panel symmetry.

I. Minimum symmetrical interrupting rating of as indicated on the plans.

J. Circuit directory in each panelboard filled in by typed lettering identifying the loads connected to each breaker.

K. Bus bar material to be copper

2.3 Painting

A. Paint all items this section with manufacturers standard system suitable for the service intended. System shall include surface preparation, prime and finish coats.

B. Submit with Submittals the type, color, and manufacturer of paint system used.

PART 3 - EXECUTION

3.1 Panelboard Installation

A. Install at locations indicated.

B. Surface-mount on wall (or equipment rack), as indicated, at an elevation 6’-6” to top of panel.

C. Arrange with proper clearances from other equipment and material to obtain good accessibility for operation and maintenance.

D. nstall circuit directory in each panelboard.

E. Ground all neutral buses to the building ground system.

F. Connect feeder circuits as indicated in the panel schedules to obtain best balance of load between phases.

3.2 Field Painting

A. Preparation of surfaces and touch-up of scratched or damaged painted surfaces is specified in Section 9900.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

** END OF SECTION 16462 **

SECTION 16482

SOLID STATE MOTOR CONTROLLERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes
   1. Solid state motor controllers (SSMC) for use with NEMA Design "B" 460 VAC motors to reduce the current inrush as well as mechanical shocks that can result from starting or stopping a motor across the line.
   2. This section pertains to stand-alone solid state motor controllers in addition to those provided as part of a Motor Control Center.
   3. Provide SSMC fully assembled as part of a Motor Control Center or as a standalone controller, ready for field installation, testing, and startup.

B. Related Sections include but are not necessarily limited to:
   1. Section 16000 Electrical: Basic Requirements.
   2. Section 16901 Control Panels.
   3. Section 16450 Grounding.
   4. Section 16180 Starters, Relays, Switches, Circuit Breakers, TVSS

1.02 SUBMITTALS

A. Submit the following in accordance with Specification 16000:
   1. Complete electrical data on the SSMC and all accessories.
   2. Dimensional and weight information on the enclosure (if applicable).
   3. Fully developed ladder style elementary diagrams complete with terminal and wire designations. Label or tag all control devices.
   4. Comprehensive bill of material for all components used to assemble the finished product.
   5. Anticipated heat load for sizing of building HVAC system.
   6. Verification that unit is listed by an independent testing laboratory in accordance with Electric Industrial Control Equipment Specification UL508.
   7. List of recommended spare parts for 1 year operation.

1.03 QUALITY ASSURANCE

A. Final assembly to be provided with a UL508 label installed at the point of manufacturer.

B. The manufacturer shall be a certified ISO 9002 facility.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Package unit to protect against shipping damage.

B. Store unit in a clean, dry, controlled environment until scheduled installation.

C. Handle units in accordance with manufacturer's recommendations and in such a manner as to prevent damage.

D. Replace any unit damaged as a result of improper shipping, storage, or handling.

1.05 PROJECT/SITE CONDITIONS

A. Unit shall be designed specifically for the environment into which it will be installed.

B. Provide weather protection, space heating to prevent condensation, and cooling or ventilation as recommended by SSMC manufacturer and/or as shown on drawings.

C. Provide sufficient clearance and housekeeping pads to allow air circulation and to prevent damage from standing water.

1.06 WARRANTY

A. Provide a 2 year warranty on materials and workmanship from date of startup.

PART 2 - PRODUCT

2.01 MANUFACTURERS

A. Eaton/Cutler Hammer

B. Allen-Bradley

C. Engineer and Owner approved equal.

2.02 GENERAL DESCRIPTION

A. Provided in a configuration suitable for panel mounting.

B. Uses a thyristor bridge consisting of at least two SCRs per phase to control the starting and stopping of industry standard motors. A soft start/current limit will be obtained by a timed voltage ramp of the thyristors. The thyristors will be controlled in such a manner that a smooth and stable acceleration ramp is ensured, independent of motor load.

C. Controlled by a microprocessor that continuously monitors the current and thyristor phasing of the starter.

D. All soft start power ratings shall use the same control module.

2.03 RATINGS

A. Designed to operate in an ambient temperature of 0º to 50 º C.

B. Storage temperature range shall be -25 º to 70 º C.

C. Maximum relative humidity shall be 93% at 40 º C, non-condensing.

D. Designed to operate in attitudes up to 3300 feet. For higher altitudes, derate by 1.2% for each additional 330 feet.

E. Capable of operation within -15% to +10% of nominal voltage rating and automatically adapt for 50 or 60 Hz.

F. Capable of supplying 300% of rated full load current for 60 seconds at maximum ambient temperature.

G. The SCRs shall have a minimum P.I.V. rating of 1400V. Lower rated SCRs with "protection" by MOVs will not be acceptable.

2.04 ADJUSTMENTS AND CONFIGURATIONS

A. All dialog functions, display units, remote functions, terminal blocks, configuration switches and adjustment potentiometers shall be accessible on the front of the control module. Exposure to control circuit boards or electrical power devices during routine adjustments shall be prohibited.

B. Dialog indication shall provide, as a minimum, the following conditions:
1. Soft start ready for start.
2. Soft start starting/stopping motor.
3. Soft start running at full voltage.
4. Thermal pre-alarm condition.
5. Thermal fault.
6. Soft start internal fault.
7. Power supply fault.

C. Dip switches shall be used for configuring the soft start and will select:
1. Manual or automatic reset.
2. Freewheel or controlled stopping.
3. Stop by deceleration ramp or DC injection braking.
4. Full voltage boost on start (on or off).

D. Potentiometers or keypads shall be used for adjusting the operating parameters and will provide:
1. Motor full load amps adjustable from 50 to 100% of the controller's current rating.

2. Current limitation on starting adjustable from 2 to 5 times rated motor current.
3. Voltage ramp adjustable from 1 to 30 seconds.
4. Deceleration ramp or DC injection time adjustable from 2 to 60 seconds.

E. Output relays shall provide the following status indications:
1. Fault trip or soft start: one form A and one form B minimum.
2. Thermal pre-alarm: one form A and one form B or one form C minimum.
3. End of start (voltage ramp complete and current below 130% motor FLA): one form A.
4. Brake (for control of braking contactor if this function is specified): one form A.
5. Relay functions listed above must be isolated with respect to common.

2.05 PROTECTION

A. A microprocessor controlled thermal protection system shall be included which continuously calculates the temperature-rise of the motor and soft start and provides:
1. An overload pre-alarm which indicates by relay contact that the motor has exceeded its rated temperature rise by 100%. This function shall be annunciated only without resulting in fault trip of the motor.
2. A thermal fault condition which stops the motor if the temperature-rise exceeds 120% of the motor thermal capability.
3. An analog electronic circuit with a time constant adjustable to the motor's thermal cooling time constant ensuring the memorization of the thermal state even after power supply disconnection or shorting out of the power semiconductors.

B. The soft start shall have phase loss, phase unbalance and undervoltage protection.

2.06 CONTROL OPTIONS

A. Provide lockable disconnecting means to isolate the SSMC from incoming power. Disconnect may be either fused or circuit breaker style as shown on the contract drawings.

B. Provide lights, pushbuttons, selector switches, indicators, run time meters, and other accessories as shown on the contract documents. These accessories are to be full size, NEMA 4 rated, heavy duty type. Lights are to be 120 VAC, transformer style, LED, with push-to-test feature.

C. Control relays are to be plug in style, 120 VAC, provided with DIN rail mounting sockets and shall have an indicating light to show when relay is energized. Contact sets to be rated at minimum 5 amps, 250 VAC.

D. Provide a control power transformer, 480-120V, sized to accommodate all the control circuit requirements in addition to 25% spare capacity.

E. The soft start shall accept control logic either by operator devices (push buttons, selector switches, etc.) wired directly into the unit or from external relay logic.

F. Provide warning label in accordance with the NEC if power is available from more than one source.

G. Provide nameplates identifying all panel mounted equipment and operator controls.

2.07 SHORTING CONTACTOR

A. A microprocessor shall control the operation of the shorting contactor via an output relay.

B. The shorting contactor shall close, shorting the thyristors after the motor current is below 130% of motor FLA and voltage is below nominal voltage (indicating the acceleration ramp is complete), and open on a stop command to allow a deceleration ramp or DC injection stop.

C. Overload protection shall continue to protect the motor when shorting is used.

2.08 BRAKING CONTACTOR

A. If required by contract drawings, a microprocessor shall control the operation of the braking contactor via an output relay.

B. If an overload condition occurs during the injection brake period, braking shall continue as set. When braking is complete, restart shall be prohibited until the motor has cooled.

2.09 ISOLATION AND BYPASS CONTACTORS

A. If required by contract drawings or recommended by manufacturer, provide NEMA rated three-pole isolation contactor to completely isolate the SSMC from the incoming power in the event of a shorted SCR or another defined fault condition.

B. If required by contract drawings, provide NEMA rated three-pole reversing style contactor to both isolate the output of the SSMC as well as allow across-the-line starting of the motor.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Mount the SSMC in accordance with manufacturer’s recommendations.

B. Provide sufficient clearance for air circulation and operation of any vent fans or cooling equipment.

C. Install conduit, pull and terminate all power and control conductors.

3.02 TESTING

A. Test in accordance with Specification 16920 - ELECTRICAL ACCEPTANCE TESTING.

END OF SECTION

SECTION 16500
LIGHTING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified and required to furnish and install lighting fixtures.
B. Interior and exterior lighting shall use LED technology unless otherwise shown on the drawings or in the specifications.

1.02 QUALITY ASSURANCE

A. LED lighting products shall comply with the following reference standards:
   1. National Electrical Code (NEC)
   2. UL Standard 844, Standard for Luminaires for Use in Hazardous (Classified) Locations
   3. ANSI/UL 8750, Safety Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products
   4. UL Standard 1571, Incandescent Lighting Fixtures
   5. UL Standard 1598, UL Standard for Safety Luminaires
   6. Illuminating Engineering Society (IES) Light Measurement LM-79: Electrical and Photometric Measurements of Solid-State Lighting Products.
   7. IES LM-80: Measuring Lumen Maintenance of LED Light Sources.
   8. IES Technical Memorandum TM-21: Projecting Long Term Lumen Maintenance of LED Light Sources.
   9. IEEE C62.41.2: Recommended Practice on Characterization of Surges in Low-Voltage (1,000 V and Less) AC Power Circuits.
   10. All applicable local lighting ordinances.

B. Miscellaneous:
   1. Lamps are identified for each luminaire in the Lighting Fixture Schedule on the Drawings.
   2. Lighting fixtures and electrical components:
      a. UL labeled, complete with lamps.
      b. Rated for area classification as indicated.
   3. Location of lighting fixtures on Drawings are intended to be used as a guide.
      a. Field conditions may affect actual locations.
      b. Coordinate with other trades to avoid conflicts in mounting of fixtures and other equipment.
   4. The quality standard is established by the fixture listed in the Lighting Fixture Schedule.
      a. This quality standard includes, but is not necessarily limited to construction features, materials of construction, finish, and photometrics.
   5. LED lighting systems manufacturer shall have a minimum of 10 years' experience producing LED lighting systems.

1.03 SUBMITTALS

A. The following shall be submitted to the Engineer for review for each type of luminaire:
   1. Documentation proving that products submitted meet requirements of standards referenced in Section 1.02.A and B above.
   2. Submit test report on manufacturer's standard production model luminaire. Submittal shall include all photometric and electrical measurements, as well as all other pertinent data outlined under "14.0 Test Report" in IES LM-79.
   3. Manufacturer's technical information on products to be used including photometric performance curves for the fixture and ballast data.
   4. Life, output (lumens, CCT, and CRI), Kelvin temperature, and energy-efficiency data for LED light bars.
   5. Acknowledgment that products submitted are UL or ETL listed.
   6. When general data sheets constitute part of the submittal, identify the products to be used on this project.
   7. Manufacturer's installation instructions.
   8. Identification of fixtures by Lighting Fixture Schedule.
   9. UL nameplate data (Voltage, wattage, etc.).
   10. Finishes, colors, and mounting type.
   11. Pole, fixture, and accessories.
   12. Pole wind loading.

B. Contractor shall submit shop drawings, manufacturer's data sheets, and a complete wiring diagram detailing all connections to the electrical system in accordance with Section 16000, and other requirements of the Contract Documents.

C. Submit warranty: Products specified herein shall have a 5 years warranty on complete mechanical assembly, electrical components of LED lamps, drivers, and fixture body.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Luminaires, fixtures, and lamps shall be manufactured by Eaton, General Electric, Lithonia, Phillips, or equal.

B. Lighting fixtures shall be provided as indicated on the Lighting Fixture Schedule on the Drawings.

C. Light poles shall be as indicated on the Drawings. Include base template, anchor bolts, cadmium-plated hardware and pole grounding lug, handhole, anchor base and bolt covers. Pole foundations shall be as indicated on the Drawings.

2.02 MATERIALS

A. General:

1. Lamps:
   a. See lighting fixture schedule on Drawings for wattage, voltage and number required.
2. All Fixtures:
   a. There shall be no live parts normally exposed to contact.
   b. LEDs shall be high efficiency with minimum output of 100 lumens per watt.
   c. LEDs and driver system lifespan shall be greater than 50,000 hours.
   d. LED color temperature shall be warm white in the range of 2700-3500 Kelvin. Mixing of color temperatures with different LEDs is not permitted.
   e. LED drivers or fixtures shall have inrush current limiting circuits or devices to prevent tripping of breakers on startup or switching of LED lighting loads.
   f. Outdoor LED systems shall be protected by UL 1449 listed surge-protection devices.
   g. LED drivers shall be electronic, labeled as compliant with radio frequency interference (RFI) requirements of FCC Title 47 Part 15, comply with NEMA SSL 1, have a sound rating of "A," and be rated for a THD of less than 20% at all input voltages with a minimum power factor of 0.90.
   h. When intended for use in wet area mark fixtures "suitable for wet locations."
   i. When intended for use in damp areas mark fixtures "suitable for damp locations" or "suitable for wet locations."
   j. In wet or damp area, install fixtures so that water cannot enter or accumulate in the wiring compartment, lamp holder or socket, or other electrical parts.
   k. Gasket seals: Urethane foam
   l. Diffusers: UV stabilized acrylic plastic
3. Underground wiring:
   a. Provide all wiring runs with separate green grounding conductor.
   b. Ground all pole bases.

B. Furnish a minimum of 2 lamps, or ten percent spare lamps of each type and wattage, whichever is greater.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install, test, and commission lighting contactor controls, motion sensors, photocell controls, astronomical time clock controls, and switches as shown on the Drawings.

B. Replace all failed lamps with new lamps prior to final acceptance by Owner.

C. Surface and flush mounted fixtures shall be solidly connected to a junction box. Suspended fixtures shall be hung utilizing pendant mounting or stainless-steel chains and hooks. Each suspended fixtures, shall be electrically connected by a length of Type SO flexible cord. 3 conductor No. 14 AWG, minimum, with a twist-lock receptacle mounted in an individual junction box. Plugs and receptacles shall be as manufactured by Hubbell, General Electric Company, or equal.

D. Provide mounting brackets and/or structural mounting support for fixtures.
   1. Do not support fixture from conduit system.
   2. Do not support fixture from outlet boxes.

E. Install with approved mounting hardware following manufacturer's recommendations.

F. Pole mounted fixtures shall be mounted on steel or aluminum poles as indicated on the Drawings. All metal poles shall be bonded to the facility ground system. Poles shall have adequate handholes and weatherproof receptacles where indicated.

G. All anchor bolts and nuts shall be stainless steel and insulated to prevent galvanic corrosion between dissimilar metals.

H. Fixture mounting heights and locations indicated on the Drawings are approximate and are subject to revision in the field where necessary to avoid conflicts and obstructions.

3.02 ADJUSTING AND CLEANING

A. Wipe all lighting fixture reflectors, lenses, lamps, and trims clean after installation and prior to acceptance of Project by Owner.

*** END OF SECTION ***

SECTION 16900

GENERAL REQUIREMENTS - INSTRUMENTS AND CONTROLS

PART 1-GENERAL

1.1 Description

A. This Division includes instruments, meters, control devices. and control panels as specified in each Section.

B. Related Work

1. Section 11315 – Submersible Sewage Pumps.
2. Section 16901 - Control Panels (including Sewage Lift Station Pump Control.)
3. Section 16902 – Measuring and Controlling Instruments and Loops
4. Section 16924 – Programmable Logic Controller (PLC) and accessories. (including Supervisory Control and Data Acquisition SCADA RTU.)
5. Section 16950 – Field Testing

1.2 References

1. Instrument Society of America (ISA)
   S20 - Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
2. Others as specified in applicable Sections.
3. National Fire Protection Association
   National Electrical Code, NFPA 70
   Standard for Electrical Safety in the Workplace, NFPA 70E
4. National Electrical Safety Code, IEEE C2.
5. Occupational Safety and Health Administration, OSHA.
6. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor’s responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Work Progress Reports and Photographs

A. Conform to DIVISION 1.

1.4 Submittals

A. Compliance Submittals

1. Submit as specified in Section 1330.

2. Manufacturer with prime responsibility shall assume responsibility for all Compliance Submittals.

3. Includes, but not limited to, the following:

a. Fabrication drawings, front elevation, wiring, diagrams, and bills of material for control panels.

b. Engraving schedule and physical dimensions for nameplates and phenolic overlays.

c. Electrical and mechanical connection diagrams for all separately mounted instruments.

d. Individual specification or descriptive sheets for instruments, annunciators, and similar major system components to conform to ISA S20.

e. Instruction Books

For all instruments, transducers, and similar major system equipment.

In addition to the requirements as specified in DIVISION 1, submit single-page specification sheets for each instrument which lists the type, model number, function, scale, input, actuation, output and other specific features of that instrument.

1.5 System Responsibility – System Integrator

Systems may utilize equipment of different manufacturers but one System Integrator is to assume overall responsibility for the complete system.

A. Approved System Integrator
   1. Alliance Service and Control Specialists, Inc. Contact Rod Robertson, Vice President. Email: rodrobertson@as-cs.com. Cell: 602-920-7078.
   2. Primex Controls. Contact Jeremy Drinkwine, Business Development Manage. Email: Jeremy.Drinkwine@sjeinc.com. Phone: (218)844-8733. Cell: (218)850-2491. Address: 22650 County Highway 6, Detroit Lakes, MN 56501.
   3. Engineer prior approved equal.

1.6 System Integrator Pre-Qualification

A. System Integrator shall be provided by a firm specializing in control panel construction. Request for approval shall be submitted to engineer a minimum of 10 days prior to bid.

PART 2 - MATERIALS - Specified in applicable sections, SECTIONS 16900-16950.

PART 3 - EXECUTION

3.1 Factory Tests

A. As a minimum, the manufacturer's standard tests and calibration procedures shall be conducted on all instruments.

B. All field devices to be calibrated at factory prior to shipment to site. Applicable test reports to be shipped with field device.

3.2 Lightning and Surge Protection

A. Provide lightning and surge protection to all instruments, power supplies, electronic equipment and input and output control and signal lines specified in this Section. This protection shall be in accordance with the applicable standards and shall be suitable to protect the equipment during electrical storms which occur in the area of the project.

3.3 Installation: Specified in applicable Sections, SECTIONS 16900-16950.

3.4 Manufacturer's Field Services

A. Provide as specified in Section 1750.
B. Provide supervision for a minimum of three working days, with days in excess of this as required during the test and start-up period by the prime responsibility manufacturer.
C. Test and start-up supervision shall continue until the system is in proper operating condition as determined by the Engineer.
D. Provide manufacturer's supervision during Work to correct deficiencies in equipment manufactured by them and to correct deficiencies in the installation and wiring of equipment. Corrections shall be at no increase in the contract price.
E. Also provide supervision for a minimum of three working days to instruct Owner's personnel in proper operation and maintenance of the equipment. Instruction shall take place after equipment start-up is complete.
F. Manufacturer's field services required for all instruments, control devices, and other devices furnished as a part of the control panel or instruments and associated control devices separately mounted to assure proper installation, setting, connection. and functioning.

3.5 Field Testing - Instrument and Control Systems

A. General Requirements
    1. Conform to requirements as specified in DIVISION 1.
    2. Conduct all tests in the presence of Engineer or Owner under the supervision of equipment manufacturer's field engineer.
    3. Notify Engineer two weeks prior to the commencement of all tests.
    4. Include all tests recommended by the equipment manufacturer unless specifically waived by Engineer.
    5. Include all additional tests recommended by Engineer that he deems necessary because of field conditions, to determine that equipment and material and systems meet requirements of Contract Documents.
    6. Be responsible for all damage to equipment and material due to improper test procedures or test apparatus handling.
B. Test Reports
    1. Submit as specified in DIVISION 1.
    2. Maintain a written record in quadruplicate of all tests showing date, personnel making tests, equipment or material tested, tests performed, and results.

3.6 Coordination and Scheduling: Coordinate installation of equipment and materials with construction schedule.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

*** END OF SECTION 16900 **

SECTION 16901
CONTROL PANELS - INSTRUMENTS AND CONTROLS

PART 1 - GENERAL

1.1 Description

A. This Section includes the furnishing and installation of the Pump control panels and other control enclosures for the pumps and instruments for the pumping Project.

B. The SCADA System will interface with the new base system. The main operators stations for the system are located at the Island Wastewater Treatment Plant or as directed by owner.

C. The Contractor shall have overall responsibility for providing a complete operable system and shall have sole responsibility for the functioning of every piece of equipment in the pump control, air compressor and radio telemetry panels.

D. The Contractor having overall responsibility for providing a complete operable system shall have sole responsible for the following work:

1. Pump motor starting, protection, and control (motor starting to utilize soft start motor starters).
2. Provision of and installation of a PLC, with analog and digital input/output for local pump station control.
3. New SCADA telemetry equipment including coordination of equipment programming and modifications to the existing SCADA Programming. Programming shall be by others.
4. Coordination of all necessary programming to the main machine interface (MMI) to incorporate this project into the SCADA System. Programming shall be by others.
5. Integrate all motor starters into the control system.
6. Provide, install and calibrate all site instrumentation.

1.2 References

1. American Society for Testing and Materials (ASTM)
   ASTM D1248 - Polyethylene Plastics Molding and Extrusion Materials.
2. National Electrical Manufacturers Association (NEMA)
   ICS - Industrial Controls and Systems.
3. As specified in each applicable section, this Division.
4. National Fire Protection Association
   National Electrical Code, NFPA 70
   Standard for Electrical Safety in the Workplace, NFPA 70E
5. National Electrical Safety Code, IEEE C2.
6. Occupational Safety and Health Administration, OSHA.

7. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Submittals: Submit as specified in Section 01330.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Prefabricated Control Panel and Console Enclosures
   1. Hoffman Engineering Company (Hoffman).
   2. Engineer approved equal.

B. Wire Terminals and Connectors
   1. Alpha Wire Corporation (Alpha).
   2. Amp, Inc.
   3. Belden Corporation (Belden).
   4. General Electric Company (General Electric).
   5. Thomas and Betts.

C. Wire Markers
   1. Brady.
   2. Electrovert.
   3. Floy Tag & Manufacturing, Inc. (Floy Tag).
   4. Panduit Corporation.

D. Terminal Blocks and Test Switches
   1. Allen-Bradley.
   2. Phoenix Contact.

E. Circuit Breakers
   1. Allen Bradley
   2. Square D
   3. IDEC

   Or Equal.

F. Interior Illumination (LED)
   1 Lithonia or Equal.

2.2 Control Panels

A. Pre-Fabricated Panel Design Requirements
   1. Totally enclosed cabinet with front door and continuous hinge.
   2. Formed and welded construction, 14 gauge minimum steel.
   3. NEMA type 3R enclosure outdoors, type 4 enclosure corrosive areas.
   4. Interior 12-gauge minimum steel mounting panel.

5. Sized to house all equipment and devices indicated.
6. Provide lockable design.
7. Wall-mounted or floor mounted design as required.
8. Furnish Hoffman vapor action corrosion inhibitor sized for enclosure volume
9. Prepare all surfaces and paint as specified in SECTION 09900.
10. Painting
    a. Paint system shall be manufacturer's standard system, suitable for service intended.
    b. Prepare all surfaces prior to painting.
    c. Provide special color finish of light gray.
    d. Provide one pint of touch-up paint of each color.
11. Manufactured by Hoffman Engineering Company.

2.3 Control Panel and Recording and Indicating Instruments Nameplates

A. Fabricate from laminated phenolic sheeting with white core and satin finish melamine overlay.
B. Color shall be Manufacturers standard (if not specified designate black).
C. Thickness: 1/16-inch nominal.
D. Bevel edges to expose white core on perimeter.
E. Engraved legend through overlay to expose core.
F. Attach to panels and instruments with contact cement or double-faced tape.

2.4 Pump Control Panel and Pump Control

A. Pump control will be implemented using a PLC with inputs and outputs as required to complete the control system as described. Pump control starters will be provided as separate standalone panels, containing the pump starter and primary logic control scheme.
B. I/O configuration and tag names shall be compatible with the existing established standards established by the City. This is necessary so as to eliminate duplication of tag names with other existing lift stations connected to the common SCADA system.
C. Provide the necessary inputs/outputs as shown on the drawings.

2.5 Radio Telemetry SCADA

A. Provide extension of existing SCADA System. Provide new Remote Telemetry Unit. See Sections 16924-2.5.

2.6 Electrical System

A. Wiring
    1. Belden 600V, 105°C, UL style 1015 wire or equal. Dc signal wiring shall be as specified in this Division. Single conductor wiring shall be flexible, stranded, with copper or tinned copper conductors.

Insulation shall be 300 volt MTW, SIS, or equal. THHN or THWN style insulation is not allowed.

2. Wire Sizes
   a. No. 14 AWG, 41 strand, for all convenience outlets, interior lighting, and other similar loads.
   b. No. 16 or 18 AWG, 16- to 41-strand, for low power loads of 115V or lower voltage.
3. Wire Markers
   a. UPDATE TO BE BRADY OR PHOENIX CONTACT, HEAT SHRINK STYLE
   b. Identify both ends of wire with the same unique wire number.
   c. Assign wire numbers where specific designations are not indicated.
4. Wiring Methods
   a. Route main groups of wires in plastic nonflammable wiring duct.
   b. Smaller groups of wire shall be cabled and secured with nylon cable clamps and ties or plastic spiral wraps.
   c. Route instrument dc signal wiring in separate ducts or groups from ac power and control wiring.
   d. Equipment and Terminal Block Connections
      (1) Make all connections with insulated locking spade lug terminals except where devices specified are available only with solder type terminals, or tubular clamp terminals.
      (2) Install terminals with tool as recommended by manufacturer to apply required amount of pressure correctly.
   e. Solder Connections: Soldering iron used shall not exceed 100 W.
   f. Provide terminal blocks for all external connections.

B. Terminal Blocks
   1. 600V, sectional type nylon polypropylene blocks.
   2. Tubular clamp contacts.
   3. Slide-in vinyl marking strip for terminal identification.
   4. Provide a minimum of 10% spare terminals.

C. Switch Action Fuse Blocks
   1. Rated 600V, 30-A.
   2. Sectional type nylon or polypropylene blocks.
   3. Tubular clamp contacts.
   4. Pressure sensitive marking tape for terminal identifications.

D. Circuit Breakers

1. Eaton, Square D, Allen Bradley or equal.
2. Type and Trip rating as indicated or recommended by manufacturer of equipment being protected.
3. Necessary space on panel for a minimum of three future circuit breakers.
4. Mounted on a panel inside control panel in a readily accessible location.

E. Push Buttons and Selector Switches
1. Heavy-duty oiltight units with contacts rated 10-A continuous at 120Vac.
2. Provide the number of contacts and contact development as indicated.
3. Start or On push buttons shall have a black operator.
4. Stop or Off push buttons shall have a red operator.

F. Illuminated Push Buttons
1. Heavy-duty oiltight units with contacts rated 10-A continuous at 120Vac.
2. Provide the number of contacts and contact development as indicated.
3. Color caps as indicated above.

G. Multilight Oiltight Controls
1. Honeywell Type CMC.
2. Provide with four lighted quadrants.
3. Provide number of contacts, arrangements, and positions as indicated.
4. Provide cover plates, legend plate and color inserts; color and engraving to be Manufacturers Standard.
5. Provide with four transformers and No. 755 lamps.
6. Provide all mounting hardware and mount on the control panels as indicated.

H. General-Purpose Control Relays
1. IDEC, Allen Bradley, Square D or Equal.
2. Provide with coil voltage as indicated with a neon coil energization indicator on 120Vac coils.
3. Number of contacts required rated at 10-A at 120VAC.
4. Provide plug-in relay with socket.

I. Time Delay Relays
1. IDEC, Allen Bradley, Square D or Equal.
2. Solid-state timing relay, plug-in type with matching socket.
3. Time range and voltage as required or indicated.
4. Contact rating of 10-A at 120Vac.
5. Contact action as required or indicated.

J. Pilot Lights
1. Heavy-duty oiltight units.
2. High intensity LED Type
3. Color caps as follows:

Red – motor running
Green – motor stopped
Amber – motor overload

4. Push-to-test type.

K. Interior Illumination
1. One foot LED strip light, rated 6W minimum, cool white color temperature.
2. Single-pole switch mounted in handy box.
3. Includes the following panels
a. ump Controller Panels.
b. Pump Control Panel/Section

L. Mounting of Relays and Control Devices
1. Complete accessibility to all terminals, relay sockets, and other devices without dismantling of panel equipment.
2. Do not block access to any instruments or control devices mounted on face sheet.
3. Installed on swing-out panels if necessary.
4. Mount all diodes, resistors and similar equipment between terminal points on terminal blocks.

PART 3 - EXECUTION

3.1 Installation

A. Control Panels
1. Seal all unnecessary openings in enclosures and cast or drilled in the housekeeping pad.
2. Mount to equipment rack as indicated using compatible metal nuts and bolts.
3. Shim plumb and level.
4. Install all electrical connections to remote mounted controls as specified in DIVISION 16.
5. Close all unnecessary and unused openings in the enclosures with Dow Corning 3-6548 silicone RTV or General Electric RTF762 foam after piping and wiring are installed to prevent dirt from entering the panel.

B. Electrical Connections
1. Install wire and cable as specified in Section 16120.
2. Install circuits to field-mounted equipment as indicated and required.
3. Connect all lightning and surge arresters to panels and ground system.

C. Commissioning and Start-Up Services
1. Install pump control and air compressor control panels, PLC, and connection to the new SCADA RTU per the design requirements. Coordinate I/O checks with the system integrator and ensure all I/O functionality as required per design requirements.

Coordinate start up and commissioning procedures, operational tests, relay settings and PLC program adjustments with Owner. Programming and startup shall be by others.

2. At a minimum, provide 4 days of Field Commissioning Services under 2 separate trips. Failed start-up procedures shall be corrected, re-tested at no additional costs, and shall not count towards the minimum field commissioning days.

D. Training of the Owner's Personnel The system manufacturer's factory trained representative shall provide start-up services and training for the Owner's personnel. Provide a minimum of One day for instructing the Owner's operating personnel in the operation and maintenance of the control equipment.

3.2 Field Quality Control

A. Manufacturer's Field Services: Provide as specified in Section 01750.
B. Factory Tests: Specified in Section 16900.
C. Field Tests: Specified in Section 16902.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

** END OF SECTION 16901**

SECTION 16902

MEASURING AND CONTROLLING INSTRUMENTS AND LOOPS

PART 1 - GENERAL

1.1 Summary

A. This Section includes the following

1. Indicators.
2. Controllers.
3. Transducers and function modules.
4. Float Switches.
5. Instrument loops.

1.2 References

1. American National Standards Institute (ANSI)
   ANSI B16.1 - Cast-Iron Pipe Flanges and Flanged Fittings.
2. National Electrical Manufacturers Association (NEMA)
3. As specified in each applicable section, this Division.
4. National Fire Protection Association
   National Electrical Code, NFPA 70
   Standard for Electrical Safety in the Workplace, NFPA 70E
5. National Electrical Safety Code, IEEE C2.
6. Occupational Safety and Health Administration, OSHA.
7. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Submittals: Submit as specified in Section 1330.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Digital Panel Meters

1. Newport Electronics, Inc.
2. Dixson, Inc.
3. Triplett Corp.

B. Controllers

1. Bristol Babcock Incorporated (Bristol).
2. Fischer & Porter Company.
3. The Foxboro Company (Foxboro).
4. Honeywell Process Control Division (Honeywell).
5. Leeds & Northrup Unit of General Signal (Leeds & Northrup).
6. Rosemount Inc. (Rosemount).
7. Taylor Instrument Company Division, Sybron Corporation (Taylor).

8. Great Lakes Instruments
Transducers and Function Modules
9. Acromag Inc.
10. Bristol Babcock Incorporated (Bristol).
11. Fischer & Porter Company (Fischer & Porter).
12. The Foxboro Company (Foxboro).
13. Honeywell Process Control Division (Honeywell).
14. Leeds & Northrup Unit of General Signal (Leeds & Northrup).
15. Rochester Instrument Systems (RIS).
16. Rosemount Inc. (Rosemount).
17. Taylor Instrument Company Division, Sybron Corporation (Taylor).
18. Transmation Inc.
19. Great Lakes Instruments

C. Float Switches (High & Low Level Backup)
1. Consolidated Electric Co.
2. Engineer approved equal.

D. Magnetic Flowmeters
1. Rosemount Inc. (Rosemount) Model 8750.

E. Level Transmitters
1. Endress + Hauser
2. Approved Equal

F. Pressure Transmitters
1. Endress + Hauser
2. Approved Equal

G. Pressure Switches
1. Mercoid DAW series
2. Approved Equal

H. Electrode Level Control
1. Gem Sensors and Controls (Warrick)
2. Approved Equal

2.2 General

A. Transmitters shall have an output signal of 4 to 20 mA dc into a minimum load range of 0-500 ohms at 24Vdc.

B. All analog indicating and recording receivers shall have evenly graduated scales.

C. Provide all mounting brackets, pipe stands and accessories required to install all field-mounted instruments.

D. Furnish and install all accessories required for complete and working systems as specified and indicated.

2.3 Indicators

A. Digital Panel Meters

1. 7-segment light emitting diode (LED) display.
2. 0.5-inch high digits, number as specified.
3. Input signal shall be 4-20 mA dc (or BCD from PC output module).
4. Readout shall be in engineering units specified.
5. A/D conversion shall be dual slope integration method.
6. Zero offset and span adjustments shall be factory set as specified and shall be field adjustable.
7. Shall operate from a 120Vac, 60 hertz power supply.
8. Field selectable decimal point.
9. Normal Mode Rejection Ratio shall be 40 db or greater at 60 hertz and Common Mode Rejection Ratio shall be 80 db or greater from dc to 60 hertz.
10. Provide barrier terminal strips for external connections.
11. Furnish with mounting brackets and trim strips.

2.4 Controllers

A. Controllers

1. Control modes as follows: Hand/Off/Auto.
2. Control Ranges (minimum):
   a. Proportional gain: 0.2 to 50.
   b. Integral (reset): 0.02 to 50 repeats/minute.
3. Provide with anti-reset wind-up control.
4. Provide high and low output signal limiting on automatic control. Limiting set points shall be adjustable from 2 to 22 mA dc.
5. Switching between automatic and manual control shall be bumpless and not require balancing.

B. Electrical Requirements

1. Unit shall operate from a 120Vac power source.
2. Input signals shall be 4-20 mA dc.
3. Input impedance shall be 250 ohms maximum for current inputs.
4. Isolated output signal shall be 4-20 mA dc at 24V into a minimum load range of 0 to 600 ohms. Provide individual isolated signals, for each pump.

2.5 Transducers and Function Modules

A. Solid-state design.

B. Housed in a NEMA 1 enclosure designed for surface mounting on control panel interior.
Provide with terminals for external connections.

C. Designed to operate from a 120Vac power source.

D. Signal Transducers

1. Input/output signal ranges shall be standard 1-5Vdc, 4-20 mA dc, or 3-15 psi as indicated.

2. Provide where required, indicated, or specified to change signal to one compatible with the equipment furnished.

2.6 Float Switches

A. Rigid, high-density polyurethane tear-drop-shaped float.
B. Two internal independent mercury switches, one NO and one NC, rated 10 amps at 150Vac, noninductive.
C. Furnished with necessary length of cable and weight kit for cable suspension.
D. Model LS, Consolidated Electric Co. or equal.

2.7 Magnetic Flowmeters

A. Flowmeter system shall consist of a flow element and an indicating transmitter mounted remotely from the meter tube assembly.
B. System shall be accurate to within (1% of flow rate for velocities between 3 and 30 feet per second.
C. Meter Body
   1. 304 stainless steel tube with flanged ends.
   2. 150-pound steel with flange that matches the piping provided.
   3. Electrodes shall be 316 stainless steel and conical shaped for self-cleaning action.
   4. Liner shall be polyurethane.
   5. Size as specified in this Section.
D. Transmitter
   1. Magnetic flowmeter shall have "DC" excited coils.
   2. The transmitter electronics shall be microprocessor based.
   3. Shall accept the millivolt input from the meter and provide a (4-20 mA) linear output signal proportional to flow.
E. Accessories
   1. Provide a stainless-steel grounding ring on the inlet and outlet. Ensure bonded/grounded per manufacturers recommendations.

2.8 Level Transmitter

A. NEMA 4X housing.
B. Output of transmitter shall be 4-20 ma (loop powered) capable of driving a minimum of a 500-ohm loop load.
C. Local LCD display scaled to display level in feet.

2.9 Pressure Transmitter

A. NEMA 4 rated.
B. Output of transmitter shall be 4-20 ma (loop powered) capable of driving a minimum of a 500-ohm loop load.
C. Provide with ½-inch NPT process connection, block and bleed valve, and local LCD display scaled in engineering units.
D. Diaphragm Seals
   1. Provide fill/bleed screw to permit filling of instrument and

diaphragm seal.

2. Process Connection: ½-inch NPT.
3. Filling fluid: Silicone
4. Provide a clean-out ring which holds the diaphragm captive in the upper housing to allow the upper housing assembly to be removed for recalibration or cleaning of the process side housing without the loss of filling liquid or change in calibration.
   a. ¼-inch NPT flushing connection.
5. Top housing shall be type 316 stainless steel.
6. Complete diaphragm seal assembly, including gage, transmitter, shall be factory assembled, filled and calibrated to the ranges specified prior to shipment.
7. System supplier shall be responsible for assuring that fill volumes and sensitivities of the supplied seals and diaphragms are suitable to provide the required gage or transmitter accuracy over the specified measurement range.
8. Diaphragm seals shall be as manufactured by Ashcroft or equal.

2.10 Pressure Switches

A. Pressure switches shall be enclosed in a NEMA 4 or weatherproof housing.

B. Operating pressures and set points shall be determined in the field, unless otherwise indicated on the Drawings.

2.11 Set points shall be fully adjustable and shall be in the middle of the working range. Set point adjustments shall be made with adjustment screws or thumbwheels. Accuracy shall be plus or minus one percent of adjustable range.

A. For pressures up to 150 PSIG pressure sensing element shall be of the diaphragm or bourdon tube type, and shall have a proof pressure of at least twice the maximum working pressure. For pressures above 150 PSIG, sensing element shall be bourdon tube type. Diaphragms or bourdon tubes shall be stainless steel.

B. Pressure switches shall be installed with individual ball valves for isolation. Valve material shall be compatible with the process piping and process fluid. In addition, process piping up to the sensor shall be insulated to protect against freezing.

C. All wetted parts shall be rated for fluid being measured.

D. Diaphragm Seals
   1. Provide fill/bleed screw to permit filling of instrument and diaphragm seal.
   2. Process Connection: ½-inch NPT.
   3. Filling fluid: Silicone
   4. Provide a clean-out ring which holds the diaphragm captive in the upper housing to allow the upper housing assembly to be removed for recalibration or cleaning of the process side housing without the loss of filling liquid or change in calibration.
      b. ¼-inch NPT flushing connection.

5. Top housing shall be type 316 stainless steel.
6. Complete diaphragm seal assembly, including gage, transmitter, shall be factory assembled, filled and calibrated to the ranges specified prior to shipment.
7. System supplier shall be responsible for assuring that fill volumes and sensitivities of the supplied seals and diaphragms are suitable to provide the required gage or transmitter accuracy over the specified measurement range.
8. Diaphragm seals shall be as manufactured by Ashcroft or equal.

2.12 Electrode Level Control

A. Rigid electrodes shall be 316 stainless steel rods, 1/4-inch diameter and length as required. They shall be threaded at one end to fit the electrode holder threads and insulated with 1/32-inch poly vinyl chloride sheath down to 1 inch from their other end. It shall have the number of probe relays and transformers required for the use indicated and the probes therein.

B. The electrode holder shall be provided with a standard pipe flange to mate with a companion flange on the mounting surface. The holder shall accept 1/4-inch diameter rod electrodes or wire suspended electrodes, with a suitable adapter. The holder body shall be 316 stainless steel, with teflon insulation sleeves. The holder shall be sized to accommodate the number of electrodes indicated on the Drawings. The terminal housing shall have a NEMA 4 rating and an NPT style attachment to vessel. The electrode holder shall be as manufactured by Gems Sensors and Controls (Warrick) series 3R or approved equal.

C. Control relays shall be solid state, plug-in type. Relay sensitivity shall be selected for the type of fluid, as recommended by the manufacturer. Relay sensitivity shall be available from 4.7K to 1 million OHMS per centimeter. Relay contacts shall be rated for 5 amps, minimum for DPDT units, and 10 amps for SPDT units. Relay sockets shall mount on standard DIN rail and shall be rated for 300V, minimum. Relays shall be capable of single-level, or differential level service. Relays shall have time delay on increasing or decreasing level as indicated on drawings. Relays shall be Gem Sensors and Controls (Warrick) series 16M or approved equal.

D. The Contractor shall provide a complete and functioning electrode level control system with ground to tank or grounding electrode, as required by installation.

PART 3 - EXECUTION

3.2 Installation

A. Panel Mounted Devices: As specified in Section 16901.

B. Field Mounted Devices
1. Install as follows
a. Mount on floor or wall as required using 2 inch pipe mounts.
b. Mount plumb and level.
c. Mount on walls with bottom of box or instrument 4 feet above floor unless indicated otherwise and instrument case spaced at least 1/2-inch away from wall.
d. Install supports as specified in this Division.
e. Provide sunshade for all instrument displays located outdoors to prevent UV damage to instrument displays.
2. Connect inputs and outputs as indicated on the manufacturer's shop drawings and as follows:
a. Transmitters requiring electric power are supplied from the control panels.

3.3 Manufacturer's Field Services: As specified in Section 16900.

3.4 Field Testing
A. Instrument Tests and Adjustments
1. All instruments to be calibrated at factory, where possible, prior to installation.
2. With each system variable transmitter disconnected from its normal source of input signal, apply an input with manometer, instrument potentiometer, or other device and adjust span and zero on all instruments transmitting, receiving, or retransmitting the resulting variable current or voltage signal and on all final control devices. Check instruments and final control devices at several points over the instrument measuring or control device span.
3. Apply manually adjustable time duration or current signals directly to receivers where required to adjust zero and span and to check operation of the instrument over the measuring span.
4. Accurately measure variable current and voltage signals as required to adjust all receivers, transmitters, transducers, and final control devices.
5. With input signals as specified in 1 above, adjust zero and span of each controller; check operation of controller with various set points and system variable inputs; adjust controller proportional band, reset, and rate to conform to instructions from manufacturer's representative and Engineer.
6. Check operation of each instrument with system in actual operation.
7. Readjust controller settings as required to obtain desired control of the associated system variables.

B. Functional Testing of Controls
   1. Perform before equipment is placed in service.
   2. Include operating control system from each control point.
   3. Completely check each annunciated point and equipment alarm.
   4. Operate by hand all relays and other system components that cannot be operated in normal manner with plant not in service.
   5. Repeat with plant in operation.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

** END OF SECTION 16902 **

SECTION 16903
SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM
(Extension of Existing System)

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. Provide an extension to the existing PLC based SCADA System. This shall include Remote Telemetry Units, and modifications and interface to existing MTU and personal computer operator interface.

B. Radio communication telemetry between the Master Telemetry Unit (MTU) and the Remote Telemetry Units (RTU's) shall be via an unlicensed frequency of 4.9GHz. Provide SCADA radio communication to match existing.

C. Provide RTU PLC configuration to accomplish monitoring and control functions as indicated for each RTU.

D. Modify Wonderware graphics software and configuration to display the additional SCADA system information. Configure software and graphics at direction of Owner and Engineer. Utilize Contractor Wonderware development package to make changes to Owners system. Provide complete update of system changes for O&M Manuals.

E. Provide installation of system. Provide all documentation and O&M Manuals for hardware. Provide electronic and hardcopy printouts of software configuration. Programming and commissioning is by others.

1.2 QUALITY ASSURANCE

A. All Wonderware programming and integration shall be performed by a company certified in Wonderware software.

B. All PLC programming and radio interface shall be performed by owner.

C. All Work completed according to the latest edition of the National Electric Code.

D. All material to be U.L. listed.

E. All equipment to conform to ANSI and NEMA standards.

1.3 QUALIFICATIONS OF BIDDERS

A. To ensure a complete and totally integrated system, a single system supplier (Systems Integrator) who has had at least five years experience in furnishing similar microcomputer-based control and telemetry systems shall supply all specified equipment and

services. This shall include hardware, software, communications equipment, training, installation coordination, startup and warranty services as required. To ensure an integrated and operational system it is required that one supplier be the manufacturer of remote telemetry units and be responsible for all application software and thus have overall responsibility of the system. The supplier shall supply all necessary control equipment and employ the personnel necessary to provide and support the system.

B. Hardware: Include product literature and installation literature.

C. Software Configurations: Include printouts of proposed PLC programming and color printouts of graphics screen displays for Owner and Engineer review.

1.4 APPROVAL SUBMITTAL

A. Provide shop drawings of Hardware separate from software to allow delivery and fabrication of hardware while software configuration is being developed.

B. Provide shop drawings for software and software configuration. Coordinate software configuration with Owner and Engineer. Include color printouts for initial shop drawing submittal. Provide "live" software configuration during review of second submittal.

1.5 EXISTING CONDITIONS

1. Visit the site and become familiar with existing conditions and limitations.

PART 2 PRODUCTS

1.6 CONTROL PANELS

A. Manufacturer: Alliance Service and Control, Primex, OR by engineer approved equal.

B. Control panels, including Remote Telemetry Units and PLC's are to be completely factory assembled, wired and tested prior to shipment. Factory testing shall include software configuration and telecommunication techniques

1.7 PROGRAMMABLE LOGIC CONTROLLER (PLC)

A. Remote Telemetry Unit (RTU) shall be PLC based.

B. Remote Telemetry Unit :

RTU shall be PLC based and shall include Allen-Bradley – Compact Logix 5380 series and the following components.

5069-L330ER Controller Module
1769-IF4 4 Channel Analog Input Card (As Needed)
1769-IQ16 16 Channel 24V DC Digital Input (As Needed)
1769-OW8I 8 Point Isolated AC/DC Relay Output (As Needed)
1769-ECR Right End Cap (as Needed)
1769-ECL Left End Cap (as Needed)
1769-PA2 120VAC Power Supply

C. RTU Components and PLC Accessories.

Surge Protection: ASCO 331
Power Supplies: IDEC PS6R-G24, IDEC PS9Z-6RM2 (1 ea required per RTU)
Relay Allen-Bradley 700-HB33A1
Relay Socket Allen-Bradley 700-HN154
Fuses: Littlefuse FLM Series
Fuse holders & accessories: Allen-Bradley 1492 Series
Radio Modem: Esteem Horizon 4.9. See Section 16901
Isolation Transformer: Quality QTC2517 250VA 120-120v
Batteries: Interstate DCS-33 (Note 2 per each power supply)
Lighting Protector: Polyphaser LSXL RF Surge Protector 1.8GHz-6GHz.

1.8 REMOTE TELEMETRY UNITS (RTU)

A. The basic function of the RTU shall be to transmit and receive data from the MTU.

1. Communication shall be over Radio unlicensed frequency at 4.9GHz..
2. A Self-diagnostic program with LED indicators shall be provided to indicate:
    a. CPU Power-On, indication of all RTU inputs and outputs communicating properly including analog signals.
    b. Communication operation shall be via Ethernet/IP protocol.
3. Provide a 24 VDC power supply and 12 VDC power supply (for radio). Uninterruptable power supply (UPS) with minimum rating of 4.0 amp/hours. UPS shall be DIN rail mount type. Sola SDU500A with SDUCRELAYCARD or equal.

4. All wiring shall be marked with wire labels numbered at both ends as referred to on the system schematics.
5. All wiring diagrams shall be prepared in ladder logic format with individual prints for each panel. Diagrams shall be laminated and affixed to the inside of the door on all panels. Diagrams shall be prepared utilizing AutoCAD and also be provided electronically to the engineer and the owner.

1.9 TELEMETERY RADIOS

A. Manufacturer: ESTEEM Horizon 4.9.
B. Communication RF Data Rate shall be 6Mbps minimum. Provide necessary modem and interface between radio and PLC.
C. Provide radio self diagnostic software. Software to log the following information:
   Frequency
   Bandwidth
   Rx Signal Strength
   RF Data Rate

1.10 ANTENNA AND COAXIAL CABLE

A. Antenna shall be provided for each RTU. See individual station for antenna type. Provide antenna type as determined by radio path study.

PART 3 CONSTRUCTION REQUIREMENTS

1.11 RTU's

A. Install and commission each RTU one at a time.

1.12 EXISTING SCADA SYSTEM

A. The existing SCADA system shall remain in operation throughout the entire construction process.

PART 4 EXECUTION

1.13 INSTALLATION

A. Securely mount equipment where shown on the Drawings.
B. Complete all conductor connections to remote sensing devices, control relays and monitor relays as shown on the Drawings. Use same color coding of conductors throughout.
C. Securely mount equipment where shown on the Drawings.

1.14 STARTUP PROCEDURES

A. Provide a certified technical representative from the system integrator for the purpose of final connections, testing, calibration and startup.
B. Prior to startup, the system shall be factory tested for proper connections and installation to assure that the monitoring system is properly installed. This factory test may be inspected by the Engineer.
C. The system integrator shall test and verify that all software is running properly and that all alarms and status changes are being
D. The system integrator shall submit a letter of certification starting that the system is fully operable as verified by field test results.

1.15 SPARE PARTS

A. Provide the following Spare Parts. Turn over to Owner upon completion of project.
B. RTU Power Supplies. (qty 1 each)
C. Telemetry Radios. (qty 1 each)
D. Lightning Protector (qty 1 each)
E. Intrinsic Barriers. (qty 1 each)

1.16 SYSTEM WARRANTY

A. Provide a full ONE-YEAR parts, labor and software support warranty for all materials, work and software associated with the system.
B. Replace all defective material, work, and software during this period at no cost to the Owner.

** END OF SECTION 16903 **

SECTION 16950
FIELD TESTING

PART 1 - GENERAL

1.1 Description

A. This Section covers field testing of all wire, cable, and electrical equipment.
B. Related Work Specified Elsewhere
Grounding ..... Section 16450

1.2 References

1. American Society For Testing and Material (ASTM):
ASTM D877 - Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.
2. Insulated Cable Engineers Association (ICEA):
S-19-81 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
S-66-524 - Cross-Linked Thermosetting Polyethylene - Insulated Wire and Cable for the Transmission and Distribution of Electric Energy.
S-68-516 - Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
3. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE):
C37.20 - Switchgear Assemblies, Including Metal-Enclosed Bus.
4. National Electrical Code (NEC).
5. National Electrical Manufacturers Association (NEMA).
6. International Electrical Testing Association (NETA)
7. National Fire Protection Association
8. Standard for Electrical Safety in the Workplace, NFPA 70E
9. National Electrical Safety Code,.IEEE C2.
10. Occupational Safety and Health Administration, OSHA.
11. As specified in each applicable section, this Division.

1.3 Quality Assurance

A. Test Reports
1. Submit as specified in Section 1330.
2. Maintain a written record of all tests showing date, personnel making tests, equipment used, equipment or material tested, tests performed, and results.
3. Notify Engineer two weeks prior to commencement of all testing except for megger tests.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Ground Test Set
   1. Associated Research, Inc.
   2. James G. Biddle Company.

B. Multimeter
   1. Simpson Electric Company.

C. Insulation Test Set
   1. Associated Research, Inc.
   2. James G. Biddle Company.

2.2 Provide all testing equipment required which includes all or some of the following

A. Wet- and dry-bulb thermometer.

B. 500V meggers.

C. Battery-powered portable telephone sets and portable radios.

D. One Multimeter (Volt-Ohm-Milliammeter) rated 20 K ohms per volt (dc) or better, or digital readout multimeter.

E. One phase rotation meter, 60-Hz.

F. Commercial model three-point ground test set, James G. Biddle Company "Megger" Ground Tester or Associated Research, Inc., "Vibroground" tester.

G. Miscellaneous cable, test lights, buzzers, bells, switches, receptacles, plugs, and other equipment as required.

PART 3 - EXECUTION

3.1 General Requirements

A. Test all wire, cable, and electrical equipment installed or connected by Contractor to assure proper installation, setting, connection, and functioning as indicated or to conform to Contract Documents and manufacturer's instructions.

B. Conduct all tests except megger insulation testing in the presence of Engineer or Owner and under the supervision of equipment manufacturer's field engineer.

C. Include all tests recommended by the equipment manufacturer unless specifically waived by Engineer.

D. Include all additional tests issued by Engineer that he deems necessary because of field conditions to determine that equipment and material and systems meet requirements of Contract Documents.

E. Be responsible for all damage to equipment or material due to improper test procedures or test apparatus handling.

F. Provide written reports of all testing to engineer within five (5) days of completion of test and prior to energizing.

3.2 Execution

A. Molded Case Circuit Breaker Tests
   1. Visually inspect and manually operate each breaker, to insure proper alignment and smooth operation note any defects or operational problems.
   2. Check nameplate data to drawing and specifications.
   3. Check adjustable magnetic trip settings against values furnished by Engineer.
   4. Megger each pole for freedom from grounds.
   5. For breakers provided with shunt trips, check operation of shunt trip circuit.
   6. Check all connections.
   7. Check for proper current rating for circuit to which breaker is connected.

B. Motor Tests on All Motors
   1. Check equipment ground to assure continuity of connections as specified in this Division.
   2. Measure the insulation resistance of the stator winding before applying voltage. Compare this measured value against the manufacturer's value. If there is no insulation resistance value furnished by manufacturer, use the following:

Motor Voltage	Insulation Resistance
600 volts and below	5 megohms

      If measured resistance values are lower than above, record room temperature and humidity and submit readings to Engineer before energizing. Dry out motors as required by accepted method of application of external heat, and do not apply voltage to motor until substandard resistance condition is corrected. Megger readings are to be one-minute duration, using a 500V megger for all motors 600V and below.
   3. Prior to final equipment alignment, disconnect motor from driven equipment where necessary to check lubrication, starter, and control circuits. If motor is free of dirt and dust, rotate rotor by hand to determine that motor turns freely. Clean out motor if necessary. Apply voltage momentarily and note direction of rotation. Correct rotation if necessary. Reconnect motor to driven equipment.
   4. After the motor is placed in operation, observe the motor for heating at the bearings or windings. If the motor appears to be running hot, notify Engineer. Note: General purpose motors may reach temperatures up to 176 degrees F with a room temperature of 104 degrees F.

5. If motor is controlled by a VFD, Take motor load ampere readings (on all three legs of three-phase motors) at 60%, 70%, 80%, 90% and 100% of full speed. Submit results to Engineer.

C. Power Switches (Disconnects and Safety)
1. Inspect contacts and clean if required.
2. Inspect arc chutes if provided on switch.
3. Inspect fuses for proper rating if furnished on switch.
4. Operate switches (de-energized) for proper functioning.

D. Float Switches
1. Inspect and test switches to conform to manufacturer's recommended field tests.
2. Adjust switches to perform the design function for proper equipment operation.

E. Wire and Cable Tests: (Feeders and Control Circuits Only)
1. Megger all 600V insulated wire with a 500V megger for one minute, and values must be approximately as follows:

Conductor Capacity Amperes	Resistance Ohms
0-24	1,000,000
25-50	250,000
51-100	100,000
101-200	50,000
201-400	25,000
501-800	12,000
Over 800	5,000

Determine the values with all switchboards, panelboards, fuse holders, switches, and overcurrent devices in place. Do not connect motors and transformers during meggering. Megger wire and cable after installation and not on the cable reel.

2. Check all control cable by megger tests similar to those described for 600V insulated wire. Check all control wiring for tightness of terminal contacts and continuity (especially of current transformer leads) through each "run" of control circuiting. Thoroughly verify all wiring by means of battery-powered lights, buzzers, bells, or telephones.

After completing these checks and tests on a given control circuit, attach a temporary cardboard tag on each end of cable tested which bears date and name of Contractor's representative responsible for checking. Follow this procedure for each control circuit cable. Provide all phasing tests and make all changes necessary to assure proper rotation of all motors, the correct phasing and phase sequence of all circuits susceptible to being paralleled, the proper polarity on all instrument transformer wiring, and such other phasing tests as may be required for the equipment being connected under this Contract.

Do not test cable with an ac test set. Disconnect cables from all equipment during testing. Testing cable on reel will not be acceptable. Make testing after installation but before final connection of equipment. Make high-potential tests phase-to- ground on each individual conductor.

F. Control Schemes Tests

1. Test all electrical controls by trial operation of control equipment after all wiring is completed to see that each interlock and control function operates to conform to the description of operation, as well as with the manufacturer's operating instructions.

G. Miscellaneous Equipment Tests

Test all miscellaneous equipment furnished by equipment manufacturer as recommended by manufacturer.

H. Lighting Tests

1. Test all systems for proper operation and correct phasing prior to final acceptance.

I. Grounding Tests

1. Measure resistance of ground system at each ground riser.
2. Record results and notify Engineer if any reading exceeds 1 ohms.
3. Test at least three of each type of ground connections and not less than 25 percent of all ground connections.
4. Test by one of the following methods for resistance measurement:
   a. Three-point method using an ammeter and voltmeter with ac or dc power supply.
   b. Commercial instrument method using equipment as specified in this Section.

J. SCADA SYSTEM TESTING

1. Activate each monitored point in the new pump station and verify that the associated signal is received at the Central Monitoring Station and the Island Wastewater Treatment Plant.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

** END OF SECTION 16950 **