
**CITY OF CRESTVIEW
DEPARTMENT OF PUBLIC SERVICES**

**PROJECT MANUAL
for**

FY-2021

Antioch Elevated Storage Tank

Bid No. 21-04-20

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Director of
Public Services**

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City Engineer**

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Pensacola, FL 32502**

Bid No. 21-04-20
Antioch Elevated Storage Tank

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ADVERTISEMENT FOR BIDS
FOR
CITY OF CRESTVIEW
FY-2021 Antioch Elevated Storage Tank
BID NO. 21-04-20

NOTICE IS HEREBY GIVEN: That sealed bids will be received by the City of Crestview, at the City Clerk's Office 198 N. Wilson Street, Crestview, Florida 32536; until **Tuesday, April 20, 2021 at 2:00 p.m.**

Any bids received after the above time will not be accepted under any circumstances. Any uncertainty regarding the time a bid is received will be resolved against the bidder.

Bid opening will be promptly at **2:00 p.m. on April 20, 2021** at the City Hall Council Chambers, 198 N. Wilson Street, Crestview, Florida 32536, at which time all bids received will be publicly opened and read aloud.

A pre-bid meeting will be held on March 31, 2021, at 9:00 am local time at the City of Crestview City Hall, 198 North Wilson Street, Crestview, FL 32536. The pre-bid meeting shall be mandatory.

DESCRIPTION OF WORK: All work for the Project shall be done in accordance with the Drawings and Specifications and shall be awarded and constructed, if award is made, under one Contract. Bids shall be submitted for furnishing, delivering, and installing all materials, equipment, and services, including labor for the Work described:

This project is to furnish and install a new 500,000 gallon composite elevated water storage tank. The project generally includes site clearing, construction of the new elevated tank including delegated engineering design, installation of potable water main and connection to the existing system, electrical work including site lighting and tank controls, and site work and restoration. The contractor shall provide the new elevated storage tank in accordance with the plans and specifications and shall include all materials and labor to provide a fully functioning water storage tank.

Bidders are urged to visit the site prior to submitting a bid. If you have any questions, **contact Jacobs Engineering Group, 25 West Cedar Street, Suite 350, Pensacola, FL 32502. The project engineer is Scott Jernigan, PE, and can be reached at 850-941-7282 or scott.jernigan@jacobs.com**

BIDDING DOCUMENTS can be obtained on the city website: www.cityofcrestview.org and reviewed at:

Department of Public Services
715 N. Ferdon Blvd.
Crestview, FL 32536
(850) 682-6132

The City of Crestview reserves the right to accept or reject, in part or total, any or all bids and to waive any informalities as deemed in the best interest of the City. All bids must be marked on the outside of the envelope with the bid name, the time and date of opening. It shall be the Bidder's responsibility to ensure that bids are delivered to the above address by the appointed time.

Bids shall be prepared from complete Bidding Documents.

BID SUBMITTAL: A single bid shall be submitted for the work. The contract will be awarded pursuant to the requirements of applicable state and federal laws and regulations.

Award will be made to the lowest responsible and responsive bidder. The City of Crestview will in no way be liable for any costs incurred by any bidder in the preparation of its Bid in response to this Invitation to Bid.

The City reserves the right to waive technicalities or irregularities, to reject any or all bids, and to accept that Bid which is in the best interest of the City.

The CITY OF CRESTVIEW, FLORIDA does not discriminate on the basis of race, color, national origin, sex, religion, age, and handicapped status in employment or provision of service.

CITY OF CRESTVIEW, FLORIDA
Office of the City Clerk
198 N. Wilson Street
Crestview, Florida 32536

END OF SECTION

INSTRUCTIONS TO BIDDERS

General

BIDS will be received by the City of Crestview (herein called the "OWNER") as specified in the Invitation to Bid. The BIDS will be publicly opened and read aloud at the designated time and place.

Each BID must be submitted in a sealed envelope addressed to the City of Crestview. Each sealed envelope containing a BID must be plainly marked on the outside with the name and the number of the project for which the BID is submitted; and the envelope should also show on the outside, the BIDDER's name and address.

BIDDERS must satisfy themselves as to the required quantities for the work by examination of the site and a review of the drawings and specifications including any addenda. After BIDS have been submitted the BIDDER shall not assert that there has been any misunderstanding concerning the quantities of work or of the nature of the work to be done.

All BIDS must be made on the required BID form. All blank spaces for BID prices must be filled in, in ink or typewritten, and the BID form must be fully completed and executed when submitted. Only one copy of the BID form is required. The Bid form is the only document to be completed and signed at the bid opening.

A BIDDER may not modify its BID after BID opening. Errors in the extension of unit prices stated in a BID or in multiplication, division, addition, or subtraction in a BID may be corrected by the Director of Public Services prior to award. In such cases, unit prices shall not be changed.

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 after the actual date of the opening thereof.

The OWNER may waive any informalities or minor defects or reject any and all BIDS. A conditional or qualified BID may not be accepted.

BID tabulations will be posted for review on the city website: www.cityofcrestview.org

The OWNER may make such investigations as deemed necessary to determine the ability of the BIDDER to perform the work, and the BIDDER shall furnish to the OWNER all such information and data for this purpose as the OWNER may request. 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 AGREEMENT and to complete the work contemplated herein. The low BIDDER will be required to perform at least fifty percent (50%) of the contract work with his/her own employees. The BIDDER to whom the contract is being awarded shall supply the names and addresses of major material suppliers and subcontractors when required to do so by the OWNER.

A PERFORMANCE BOND and PAYMENT BOND each in the amount of 100 percent of the contract price, with a corporate surety approved by the OWNER, will be required for the faithful performance of the contract, when the AGREEMENT is executed. Attorneys-in-fact who sign PAYMENT BONDS and PERFORMANCE BONDS must file with each BOND a current certified copy of their power of attorney.

INSTRUCTIONS TO BIDDERS

Certificate of Insurance, as specified herein, shall be submitted at the time of signing the AGREEMENT.

The BIDDER to whom the contract is being awarded will be required to execute the AGREEMENT and obtain the PERFORMANCE BOND, PAYMENT BOND and Insurance on or before ten (10) calendar days following delivery of the notice of award to the BIDDER. If the BIDDER fails to properly execute the AGREEMENT or obtain the required PERFORMANCE BOND, PAYMENT BOND, or Insurance within the allotted time, the OWNER may consider the BIDDER in default.

The OWNER within ten (10) days of receipt of acceptable PERFORMANCE BOND, PAYMENT BOND, INSURANCE CERTIFICATES and the AGREEMENT signed by the CONTRACTOR to whom the contract is being awarded shall sign the AGREEMENT and return to such CONTRACTOR an executed duplicate of the AGREEMENT. Should the OWNER not execute the AGREEMENT within such period, the BIDDER may by written notice withdraw the signed AGREEMENT.

The CONTRACTOR shall thereupon record the PAYMENT and PERFORMANCE BONDS at the Okaloosa County Courthouse and return the recorded originals to the OWNER within seven (7) days.

The NOTICE TO PROCEED shall be issued within ten (10) days of the receipt of the recorded bonds by the OWNER. Should there be reasons why the NOTICE TO PROCEED cannot be issued within such period, the time may be extended by agreement between the OWNER and CONTRACTOR. If the NOTICE TO PROCEED has not been issued within the ten (10) day period or within the period mutually agreed upon, the CONTRACTOR may terminate the AGREEMENT by written notice to the OWNER.

Bid Protest Procedure

Any person whose substantial interests are directly and adversely affected by the award or intended award of a purchase order or contract or by plans or specifications contained in an invitation to bid or request for proposals may file a protest.

Notice of protest of plans, specifications or other requirements contained in an invitation to bid or in a request for proposals shall be filed not later than 5:00 P.M. of the third business day following receipt of the plans or specifications. Notice of protest of the rejection of a bid or proposal as non-responsive shall be filed not later than 5:00 P.M. of the third business day following notice to the bidder of the rejection. Notice of protest of the award or intended award of a purchase order or contract to the lowest bidder shown on a posted bid tabulation shall be filed not later than 5:00 P.M. of the third business day following the posting of the bid tabulation. Notice of protest of the award or intended award of a purchase order or contract to a bidder other than the lowest bidder shown on a posted bid tabulation shall be filed not later than 5:00 P.M. of the third business day following notice of the award of a purchase order or contract.

A notice of protest shall be in writing and shall state the subject matter of the protest.

A formal written protest shall be filed within seven (7) business days after the filing of notice of protest. A formal written protest shall state with particularity the facts and the law on which the protest is based.

Notice of protest and formal written protest of plans or specifications for or the award or intended award of a contract shall be filed with the city clerk or her designee.

Failure to file a notice of protest or failure to file a formal written protest within the times permitted shall constitute a waiver of proceedings.

END OF SECTION

PUBLIC ACCESS

Contractor shall comply with the requirements of Florida's Public Records law. In accordance with Section 119.0701, Florida Statutes hereby certifies that shall:

- a. Keep and maintain public records that would be required by the public agency to perform the service.
- b. Upon request from the public agency's custodian of public records, provide the public agency with a copy of the requested records or allow the records to be inspected or copied within a reasonable time at a cost that does not exceed the cost provided under Florida's Public Law or as otherwise provided by law.
- c. Ensure that public records that are exempt or confidential and exempt from public records disclosure requirements are not disclosed except as authorized by law for the duration of the contract term and following completion of this contract if Contractor does not transfer the records to the public agency: and
- d. Upon completion of the contract, transfer, at no cost, to the public agency all public records in possession of Contractor or keep and maintain public records required by the public agency to perform the service. If the Contractor transfers all public records to the public agency upon completion of the contract, Contractor shall destroy any duplicate public records that are exempt or confidential and exempt from public records disclosure requirements. If Contractor keeps and maintains public records upon completion of this contract, the Contractor shall meet all applicable requirements for retaining public records. All records stored electronically must be provided to the public agency, upon request from the public agency's custodian of public records, in a format that is compatible with the information technology systems of the public agency.

e. If Contractor has questions regarding the application Chapter 119, Florida Statutes, to Contractor's duty to provide public records relating to this Agreement, Contractor shall contact the Custodian of Public Records at:

**City Clerk, City of Crestview
198 North Wilson Street
P.O. Box 1209
Crestview, Florida 32536
(850) 682-1560 Extension 250
cityclerk@cityofcrestview.org**

- f. In the event the public agency must initiate litigation against Contractor in order to enforce compliance with Chapter 119, Florida Statutes, or in the event of litigation filed against the public agency because Contractor failed to provide access to public records responsive to a public record request, the public agency shall be entitled to recover all costs, including but not limited to reasonable attorneys' fees, costs of suit, witness, fees, and expert witness fees extended as part of said litigation and any subsequent appeals.

SECTION 00300

BID FORM

SUBMITTED: _____
Date

PROJECT IDENTIFICATION: **CITY OF CRESTVIEW**
Antioch Elevated Storage Tank

NAME OF BIDDER: _____

BUSINESS ADDRESS: _____

Phone No.: _____ Fax No.: _____

E-Mail Address: _____

CONTRACTOR'S FLORIDA LICENSE NO.: _____

THIS BID IS SUBMITTED TO: City of Crestview, Florida (hereinafter called Owner) acting through its City Commission.

1. The undersigned Bidder offers and agrees to enter into an Agreement with Owner in the form included in the Bidding Documents, to complete all work for the Contract Price and within the Contract Time, all in accordance with the Contract Documents.
2. Bidder accepts all of the terms and conditions of the Bidding Documents, including without limitation those dealing with the Owner's time for accepting for Bid and the disposition of Bid Bond.
3. In submitting this Bid, Bidder makes all representations required by the Instructions to Bidders and further warrants and represents that:

(a) Bidder has examined copies of all the Bidding Documents and of the following addenda:

No. _____	Dated _____;	No. _____	Dated _____
No. _____	Dated _____;	No. _____	Dated _____
No. _____	Dated _____;	No. _____	Dated _____
No. _____	Dated _____;	No. _____	Dated _____

(Receipt of all which is hereby acknowledged) and also copies of the Advertisement for Bids and the Instructions to Bidders.

(b) Bidder has examined the site and locality where the Work is to be performed and the legal requirements (Federal, State and local laws, ordinances, rules and regulations) and conditions affecting cost, degree of difficulty, progress or performance of the Work and has made such independent investigations as Bidder deems necessary.

- (c) This Bid is genuine and not made in the interest or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; Bidder has not solicited or induced any person, firm or a corporation to refrain from bidding; and Bidder has not sought by collusion to obtain for himself any advantage over any other Bidder or over Owner.
 - (d) Bidder hereby agrees if this Bid is accepted, to commence work under this contract on or before a date to be specified in the Notice to Proceed and to fully complete all work of the Project within the Contract Time stipulated in the Agreement (Section 00500). Bidder further agrees to pay as liquidated damages the amount stated in the Agreement for each consecutive calendar day completion of the work is delayed.
- 4. Bidder submits the following unit prices to perform all the Work as required by the Drawings and Specifications for the City of Crestview. Bid shall be awarded based on Total Base Bid. Estimated quantities may exceed items listed. Payment based on installed quantities.
 - 5. All Bid Items shall include all materials, equipment, labor, permit fees, taxes, tests, miscellaneous costs of all types, overhead, and profit for the item to be complete, in place, and ready for operation in the manner contemplated by the Contract Documents.
 - 6. The following documents are attached to and made a condition of this Bid:
 - (a) **Bid Security (Section 00410 and surety bond or cashier's check).**
 - (b) **Power of Attorney (for surety bond only).**
 - (c) **Public Entities Crime Form (Section 00470).**
 - (d) **Noncollusion Affidavit (Section 00480).**
 - (e) **Trench Safety Affidavit (Section 00490).**
 - (f) **Corporate authority to execute Bid (for any corporate employee other than president or vice president).**
 - (g) **Questionnaire and Subcontractor Listing (Sections 00301 and 00301-A).**
 - (h) **Evidence of Bidder's Certification and License to perform the work.**
 - (i) **Experience and financial statement demonstrating the Bidder's ability to successfully complete the work.**
 - (j) **References (Section 00302).**
 - (k) **Similar Projects (Section 00303).**
 - (l) **Drug Free Workplace (Section 00310).**
 - 7. The terms used in this Bid, which are defined in Article 1 of the General Conditions shall have the meanings assigned to them in the General Conditions as amended by the Supplementary Conditions.
 - 8. **COMPLIANCE WITH FLORIDA TRENCH SAFETY ACT (90-96, LAWS OF FLORIDA)**

Bidder hereby acknowledges that all costs for complying with the Florida Trench Safety Act (90-96, Laws of Florida) are included in the various items of the proposal and in the Total Bid Price. For informational purposes only, the Bidder is required to further identify these costs, to be summarized below:

	Trench Safety Measure Description	Units of Measure (LF, SY)	Unit (Quantity)	Unit Cost	Extended Cost
A	_____	_____	_____	\$ _____	\$ _____
B	_____	_____	_____	\$ _____	\$ _____
C	_____	_____	_____	\$ _____	\$ _____
D	_____	_____	_____	\$ _____	\$ _____
				TOTAL:	\$ _____

THIS IS NOT A PAY ITEM. The purpose of this form is to disclose information on the costs associated with trench safety measures and to insure that the Bidder has considered these costs and included them in the Bid Price. Contractor will not receive additional payment if actual quantities differ from those estimated above or if the Contractor uses a safety measure different than those listed.

Failure to complete the above may result in the Bid being declared non-responsive.

BID SUMMARY

Item No.	Description	Estimated Quantity	Unit	Unit Cost	Item Cost
1	Mobilization/Demobilization	1	LS		
2	General Conditions	1	LS		
3	Site Clearing, Debris Removal/Disposal	1	LS		
4	Elevated Tank, including foundations	1	LS		
5	Water transmission main	1	LS		
6	Electrical Work	1	LS		
7	Site work and restoration	1	LS		

TOTAL BASE BID

(In words)

\$ _____

(In numbers)

Alternate Bid Item 1 – Tank Mural – Contractor shall add the mural as shown in the attachments to these specifications to the southern side of the elevated storage tank. The mural shall encompass approximately 40% of the diameter of the tank. Contractor shall provide a shop drawing mock-up showing proposed dimensions of the mural for review by the Owner and Engineer. The mural shall be applied in accordance with the coating specifications included herein.

(ADD/DEDUCT) _____

NAME OF BIDDER: _____

If Bidder is: (ALL SIGNATORIES MUST HAVE THEIR NAME PRINTED OR TYPED
BELOW THEIR SIGNATURE)

SOLE PROPRIETORSHIP

(Individual's Signature) (SEAL)

(Individual's Name) (SEAL)

Doing Business as: _____

Business Address: _____

Phone No.: _____

Fax No.: _____

E-Mail Address: _____

Florida License No.: _____

A PARTNERSHIP

(Partnership Name) (SEAL)

(General Partner's Signature) (SEAL)

(General Partner's Name) (SEAL)

Business Address: _____

Phone No.: _____

Fax No.: _____

E-Mail Address: _____

Florida License No.: _____

NAME OF BIDDER: _____

A CORPORATION

(Corporation Name)

(State of Incorporation)

By _____
(Name of Person Authorized to Sign)

(Title)

(Authorized Signature)

(Corporate Seal)

Attest _____
(Secretary)

Business Address: _____

Phone No.: _____

Fax No.: _____

E-Mail Address: _____

Corporation President: _____

Florida License No.: _____

NAME OF BIDDER: _____

A JOINT VENTURE

By _____ (SEAL)
(Name)

(Address)

By _____ (SEAL)
(Name)

(Address)

Business Address: _____

Phone No.: _____

Fax No.: _____

E-Mail Address: _____

Florida License No.: _____

(Each joint venturer must sign. The manner of signing for each individual, partnership, and corporation that is a party to the joint venture should be in the manner indicated above).

8. List the following in connection with the Surety which is providing the Bid Bond.

Surety's Name: _____

Surety's Address: _____

Name and address of Surety's resident agent for service of process in Florida:

SCHEDULE OF MANUFACTURERS/SUPPLIERS

The Contract Documents are based upon the equipment or products available from the manufacturers/suppliers denoted as "A", "B", etc. However, the Bidder must indicate in his Bid which Base Bid manufacturer/supplier he intends to use for each item of equipment listed by circling one (1) of the listed manufacturers/suppliers. Should the Bidder fail to circle a named supplier, he hereby agrees to provide the item listed as "A". After receipt of bids, the Bidder may not substitute for any manufacturer or supplier circled.

If the Bidder desires to propose one (1) or more substitution or "or equal" manufacturers/suppliers, he may write in the name of such substitution or "or equal" in the spaces provided on the pages following the lists, but he must, nevertheless, also circle one of the listed manufacturers/suppliers. All substitutions or "or equal" items must be identified at the time of Bid (see Paragraph 6.05 of the General Conditions as amended by the Supplementary Conditions). Substitutions or "or equal" items will **not** be considered when determining the Apparent Low Bidder. Substitutions or "or equal" items will **not** be evaluated or considered until after the "Effective Date" of the Agreement. The Bidder shall base his Bid on providing one of the listed manufacturers and shall assume for bidding purposes that all substitutions or "or equal" items will not be accepted.

If the proposed substitution or "or equal" manufacturer/supplier is determined "not equivalent" by the Engineer, the Bidder must use the circled manufacturer/supplier. If the Bidder fails to indicate which listed manufacturer/supplier he intends to use or if a substitution or "or equal" is rejected, he must use the supplier listed as "A". Also, if the Bidder circles more than one listed manufacturer/supplier, he must use the first manufacturer/supplier circled (unless a substitution or "or equal" is approved).

Each proposed substitution or "or equal" will be evaluated in accordance with Paragraph 6.05 of the General Conditions following the Effective Date of the Agreement.

In addition to the reimbursement required under Paragraph 6.05 of the General Conditions, the Contractor shall also reimburse the Owner for any engineering costs directly attributable to the change in manufacturers/suppliers, caused by the acceptance of proposed substitutions or "or equal" items, such as; additional field trips for the Engineer, additional redesign costs, and additional review costs, etc. Other costs directly attributable to the change in manufacturers/suppliers caused by the acceptance of proposed substitutions or "or equal" items such as increased electrical requirements, larger buildings, modifications to structures, additional pumps, piping or tankage, etc., shall be borne by the Contractor and not by the Owner. Bidder further agrees that the use of substitute equipment offered will not affect the completion date.

The Owner may request, and the Bidder shall supply any additional information on proposed substitutes or "or equal" items prior to Notice of Award.

SCHEDULE OF BASE BID MANUFACTURERS/SUPPLIERS

Item No.	Equipment Item or Material	Specification Section No.	Base Bid Manufacturer/Supplier
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			

SUBSTITUTIONS AND "OR EQUAL"

The undersigned as Bidder agrees that substitutions, or "or equal" items will not be considered until after the "Effective Date of the Agreement" and will be evaluated in accordance with Paragraph 6.05, of the General Conditions as amended by the Supplementary Conditions. If Bidder intends to propose substitutions or "or equal" items after the "Effective Date of the Agreement", it is agreed that these items will be listed on the Substitution List that must be included with the Bid (form provided herein). Only the proposed substitutions or "or equal" items listed on the Substitution List and submitted at the time of Bid will be evaluated by the Engineer in accordance with the General Conditions.

SUBSTITUTION LIST OF
MANUFACTURERS/SUPPLIERS

Bidder proposes the following substitutions and "or equal" items of alternate manufacturers/suppliers for the equipment of material categories so identified:

	<u>Equipment Item Material</u>	<u>Drawing No.</u>	<u>Spec. Section</u>	<u>Substitute/"or equal" Manufacturer/Supplier (List One Only)</u>	<u>Proposed Price Deduct</u>
1.	_____	_____	_____	_____	_____
2.	_____	_____	_____	_____	_____
3.	_____	_____	_____	_____	_____
4.	_____	_____	_____	_____	_____
5.	_____	_____	_____	_____	_____
6.	_____	_____	_____	_____	_____
7.	_____	_____	_____	_____	_____
9.	_____	_____	_____	_____	_____
10.	_____	_____	_____	_____	_____

END OF SECTION

SECTION 00301
QUESTIONNAIRE

DATE: _____

PROJECT IDENTIFICATION: **CITY OF CRESTVIEW, FLORIDA**
Antioch Elevated Storage Tank

NAME OF BIDDER: _____

BUSINESS ADDRESS: _____

_____ Phone No. _____

CONTRACTOR'S FLORIDA LICENSE NO. _____

The undersigned warrants the truth and accuracy of all statements and answers herein contained. Include additional sheets if necessary.

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

2. Describe and give the date and owner of the last project that you have completed similar in type, size, and nature as the one proposed?

Refer to Section 00303 (Similar Projects)

3. Have you ever failed to complete work awarded to you? If so, where and why?

4. Name three (3) municipalities for which you have performed work and to which you refer:

Refer to Section 00302 (References)

5. Have you personally inspected the sites of the proposed work? Describe any anticipated problems with the site and your proposed solutions?

6. Will you subcontract any part of this work? If so, describe which portions:

7. What equipment do you own that is available for the work?

8. What equipment will you purchase for the work?

9. What equipment will you rent for the work?

END OF SECTION

SECTION 00301-A
SUBCONTRACTOR LISTING

List all proposed subcontractors to be used for this project regardless of racial or gender grouping.

****THE BIDDER SHALL SELF-PERFORM AT LEAST 50% OF THE PROJECT****

<u>Firm Name, Address and Telephone Number</u>	<u>Trade</u>	<u>Estimated Dollar Amount</u>
* _____ _____ _____	_____	\$ _____
* _____ _____ _____	_____	\$ _____
* _____ _____ _____	_____	\$ _____
* _____ _____ _____	_____	\$ _____
* _____ _____ _____	_____	\$ _____
* _____ _____ _____	_____	\$ _____

Use additional sheets if necessary.

END OF SECTION

SECTION 00303

SIMILAR PROJECTS

Project Name: City of Crestview, Antioch Elevated Storage Tank

List at least five (5) similar projects completed in the last three years that indicate the experience and qualifications of the Bidder (relative to this project). Information should include Owner's name with contact person; description of work including Bidder's responsibilities; original contract price; final contract price; original contract time; actual time to complete the project; and any relevant circumstances or conditions about the project.

PROJECT NAME: _____

OWNER'S NAME: _____

CONTACT: _____ PHONE: _____

PROJECT DESCRIPTION: _____

ORIGINAL CONTRACT AMOUNT: \$ _____

FINAL CONTRACT AMOUNT: \$ _____

NUMBER AND DOLLAR AMOUNT OF CHANGE ORDERS: _____

ORIGINAL CONTRACT TIME (Substantial Completion): _____

ACTUAL TIME TO COMPLETE (Substantial Completion): _____

OTHER RELEVANT INFORMATION: _____

PROJECT NAME: _____

OWNER'S NAME: _____

CONTACT: _____ PHONE: _____

PROJECT DESCRIPTION: _____

ORIGINAL CONTRACT AMOUNT: \$ _____

FINAL CONTRACT AMOUNT: \$ _____

NUMBER AND DOLLAR AMOUNT OF CHANGE ORDERS: _____

ORIGINAL CONTRACT TIME (Substantial Completion): _____

ACTUAL TIME TO COMPLETE (Substantial Completion): _____

OTHER RELEVANT INFORMATION: _____

PROJECT NAME: _____

OWNER'S NAME: _____

CONTACT: _____ PHONE: _____

PROJECT DESCRIPTION: _____

ORIGINAL CONTRACT AMOUNT: \$ _____

FINAL CONTRACT AMOUNT: \$ _____

NUMBER AND DOLLAR AMOUNT OF CHANGE ORDERS: _____

ORIGINAL CONTRACT TIME (Substantial Completion): _____

ACTUAL TIME TO COMPLETE (Substantial Completion): _____

OTHER RELEVANT INFORMATION: _____

PROJECT NAME: _____

OWNER'S NAME: _____

CONTACT: _____ PHONE: _____

PROJECT DESCRIPTION: _____

ORIGINAL CONTRACT AMOUNT: \$ _____

FINAL CONTRACT AMOUNT: \$ _____

NUMBER AND DOLLAR AMOUNT OF CHANGE ORDERS: _____

ORIGINAL CONTRACT TIME (Substantial Completion): _____

ACTUAL TIME TO COMPLETE (Substantial Completion): _____

OTHER RELEVANT INFORMATION: _____

PROJECT NAME: _____

OWNER'S NAME: _____

CONTACT: _____ PHONE: _____

PROJECT DESCRIPTION: _____

ORIGINAL CONTRACT AMOUNT: \$ _____

FINAL CONTRACT AMOUNT: \$ _____

NUMBER AND DOLLAR AMOUNT OF CHANGE ORDERS: _____

ORIGINAL CONTRACT TIME (Substantial Completion): _____

ACTUAL TIME TO COMPLETE (Substantial Completion): _____

OTHER RELEVANT INFORMATION: _____

PROJECT NAME: _____

OWNER'S NAME: _____

CONTACT: _____ PHONE: _____

PROJECT DESCRIPTION: _____

ORIGINAL CONTRACT AMOUNT: \$ _____

FINAL CONTRACT AMOUNT: \$ _____

NUMBER AND DOLLAR AMOUNT OF CHANGE ORDERS: _____

ORIGINAL CONTRACT TIME (Substantial Completion): _____

ACTUAL TIME TO COMPLETE (Substantial Completion): _____

OTHER RELEVANT INFORMATION: _____

Section 00310

DRUG-FREE WORK PLACE

The undersigned vendor, in accordance with Florida Statute 287.087, hereby certifies that

_____ does:
(Name of Business)

1. Publish a statement notifying employee that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the workplace and specifying the actions that will be taken against employees for violations of such prohibition.
2. Inform employees about the dangers of drug abuse in the workplace, the business’s policy of maintaining a drug-free workplace, any available drug counseling, rehabilitation, and employee assistance programs, and the penalties that may be imposed upon employees for drug abuse violations.
3. Give each employee engaged in providing the commodities or contractual services that are proposed a copy of the statement specified in subsection (1).
4. In the statement specified in subsection (1), notify the employees that, as a condition of working on the commodities or contractual services that are under bid, the employee will abide by the terms of the statement and will notify the employer of any conviction of, or plea of guilty or nolo contendere to, any violation of Chapter 893 or of any controlled substance law of the United States or any state, for a violation occurring in the workplace no later than five (5) days after such conviction.
5. Impose a sanction on, or require the satisfactory participation in a drug abuse assistance or rehabilitation program if such is available in the employee’s community, by any employee who is so convicted.
6. Make a good faith effort to continue to maintain a drug-free workplace through implementation of this section.

As the person authorized to sign this statement, I certify that this firm complies fully with the above requirements.

X

Proposer’s Signature

Date

(THIS FORM MUST BE COMPLETED IF APPLICABLE AND RETURNED WITH YOUR PROPOSAL)

SECTION 00410

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned, _____ as Principal, and _____ as Surety, are hereby held and firmly bound unto the City of Crestview, Florida as Owner in the penal sum of, (five percent (5%) of the Contract Bid) _____ for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, successors and assigns to pay Owner upon default of Bidder the penal sum set forth on the face of this Bond. Signed, this ____ day of _____, 20__.

The condition of the above obligation is such that whereas the Principal has submitted to City of Crestview, Florida, a certain Bid, attached hereto and hereby made a part hereof, to enter into a contract in writing, for the Antioch Elevated Storage Tank.

NOW THEREFORE,

1. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents and Contract Documents.
2. This obligation shall be null and void if:
 - 2.1 Owner accepts Bidder's bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents and Contract Documents, or
 - 2.2 All bids are rejected by Owner, or
 - 2.3 Owner fails to issue a notice of award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by paragraph 5 hereof).
3. Payment under this Bond will be due and payable upon default of Bidder and within thirty (30) calendar days after receipt of Bidder and Surety of written notice of default from Owner which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

4. Surety waives notice of any and all defenses based on or arising out of any time extension to issue notice of award agreed to in writing by Owner and Bidder, provided that the time for issuing notice of award including extensions shall not in the aggregate exceed ninety (90) days from Bid Due without Surety's written consent.
5. No suit or action shall be commenced under this Bond prior to thirty (30) calendar days after the notice of default required in paragraph 3 above is received by Bidder and Surety, and in no case later than one year after Bid Due Date.
6. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
7. Notice required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the part concerned.
8. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent or representative who executed this Bond on behalf of Surety to execute, seal and deliver such Bond and bind the Surety thereby.
9. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of the Bond conflicts with any applicable provision of any applicable statute, then the provision of said statute shall govern and the remainder of the Bond that is not in conflict therewith shall continue in full force and effect.
10. The term "bid" as used herein includes a bid, offer or proposal as applicable.

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

Principal (Print Full Name):

Surety (Print Full Name):

_____(Seal)
Surety's Name and Corporate Seal

By: _____(L.S.)

By: _____
Signature (attach power of attorney)

Title: _____

Title: _____

Attest: _____
Signature and Title

Attest: _____
Signature and Title

IMPORTANT - Surety companies executing bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State of Florida. See Article 5 of the General Conditions as amended by Supplementary Conditions.

END OF SECTION

SECTION 00470

SWORN STATEMENT PURSUANT TO SECTION 287.133(3)(a),
FLORIDA STATUTES, ON PUBLIC ENTITY CRIMES

THIS FORM MUST BE SIGNED AND SWORN TO IN THE PRESENCE OF A NOTARY PUBLIC OR OTHER OFFICIAL AUTHORIZED TO ADMINISTER OATHS.

1. This sworn statement is submitted to _____
(print name of the public entity)
- by _____
(print individual's name and title)
- for _____
(print name of entity submitting sworn statement)

whose business address is

and (if applicable) its Federal Employer Identification Number (FEIN) is _____

(If the entity has no FEIN, include the Social Security Number of the individual signing this sworn statement: _____.)

2. I understand that a “public entity crime” as defined in Paragraph 287.133(1)(g), **Florida Statutes**, means a violation of any state or federal law by a person with respect to and directly related to the transaction of business with any public entity or with an agency or political subdivision of any other state or of the United States, including, but not limited to, any bid or contract for goods or services to be provided to any public entity or an agency or political subdivision of any other state or of the United States and involving antitrust, fraud, theft, bribery, collusion, racketeering, conspiracy, or material misrepresentation.
3. I understand that “convicted” or “conviction” as defined in Paragraph 287.133(1)(b), **Florida Statutes** means a finding of guilt or a conviction of a public entity crime, with or without an adjudication of guilt, in any federal or state trial court of record relating to charges brought by indictment or information after July 1, 1989, as a result of a jury verdict, nonjury trial, or entry of a plea of guilty or nolo contendere.
4. I understand that an “affiliate” as defined in Paragraph 287.133(1)(a), **Florida Statutes**, means:

1. A predecessor or successor of a person convicted of a public entity crime; or
 2. An entity under the control of any natural person who is active in the management of the entity and who has been convicted of a public entity crime. The term "affiliate" includes those officers, directors, executives, partners, shareholders, employees, members, and agents who are active in the management of an affiliate. The ownership by one person of shares constituting a controlling interest in another person, or a pooling of equipment or income among persons when not for fair market value under an arm's length agreement, shall be a prima facie case that one person controls another person. A person who knowingly enters into a joint venture with a person who has been convicted of a public entity crime in Florida during the preceding 36 months shall be considered an affiliate.
5. I understand that a "person" as defined in Paragraph 287.133(1)(e), **Florida Statutes**, means any natural person or entity organized under the laws of any state or of the United States with the legal power to enter into a binding contract and which bids or applies to bid on contracts for the provision of goods or services let by a public entity, or which otherwise transacts or applies to transact business with a public entity. The term "person" includes those officers, directors, executives, partners, shareholders, employees, members, and agents who are active in management of an entity.
6. Based on information and belief, the statement which I have marked below is true in relation to the entity submitting this sworn statement. (indicate which statement applies.)

_____ Neither the entity submitting this sworn statement, nor any of its officers, directors, executives, partners, shareholders, employees, members, or agents who are active in the management of the entity, nor any affiliate of the entity has been charged with and convicted of a public entity crime subsequent to July 1, 1989.

_____ The entity submitting this sworn statement, or one or more of its officers, directors, executives, partners, shareholders, employees, members, or agents who are active in the management of the entity, or an affiliate of the entity has been charged with and convicted of a public entity crime subsequent to July 1, 1989.

_____ The entity submitting this sworn statement, or one or more of its officers, directors, executives, partners, shareholders, employees, members, or agents who are active in the management of the entity, or an affiliate of the entity has been charged with and convicted of a public entity crime subsequent to July 1, 1989. However, there has been a subsequent proceeding before a Hearing Officer of the State of Florida, Division of Administrative Hearings and the Final Order entered by the Hearing Officer determined that it was not in the public interest to place the entity submitting this sworn statement on the convicted vendor list. (attach a copy of the final order.)

I UNDERSTAND THAT THE SUBMISSION OF THIS FORM TO THE CONTRACTING OFFICER FOR THE PUBLIC ENTITY IDENTIFIED IN PARAGRAPH 1 (ONE) ABOVE IS FOR THAT PUBLIC ENTITY ONLY AND, THAT THIS FORM IS VALID THROUGH DECEMBER 31 OF THE CALENDAR YEAR IN WHICH IT IS FILED. I ALSO

UNDERSTAND THAT I AM REQUIRED TO INFORM THE PUBLIC ENTITY PRIOR TO ENTERING INTO A CONTRACT IN EXCESS OF THE THRESHOLD AMOUNT PROVIDED IN SECTION 287.017, **FLORIDA STATUTES** FOR CATEGORY TWO OF ANY CHANGE IN THE INFORMATION CONTAINED IN THIS FORM.

(signature)

Sworn to and subscribed before me this _____ day of _____, 20____.

Personally known _____

OR Produced identification _____ Notary Public - State of Florida

(type of identification) My commission expires _____

(printed, typed or stamped commissioned name of notary public.)

END OF SECTION

SECTION 00480
NONCOLLUSION AFFIDAVIT

STATE OF _____

COUNTY OF _____

_____, being first duly sworn deposes and says that:

1. He (it) is the _____, of _____, the Bidder that has submitted the attached Bid;
2. He is fully informed respecting the preparation and contents of the attached Bid and of all pertinent circumstances respecting such Bid;
3. Such Bid is genuine and is not a collusive or sham Bid;
4. Neither the said Bidder nor any of its officers, partners, owners, agents, representatives, employees, or parties in interest, including this affidavit, have in any way, colluded, conspired, connived or agreed, directly or indirectly, with any other Bidder, firm or person to submit a collusive or sham Bid in connection with the Contract for which the attached Bid has been submitted; or to refrain from bidding in connection with such Contract; or have in any manner, directly or indirectly, sought by agreement or collusion, or communication, or conference with any Bidder, firm, or person to fix the price or prices in the attached Bid or of any other Bidder, or to fix any overhead, profit, or cost elements of the Bid price or the Bid price of any other Bidder, or to secure through any collusion, conspiracy, connivance, or unlawful agreement any advantage against (Recipient), or any person interested in the proposed Contract;
5. The price or prices quoted in the attached Bid are fair and proper and are not tainted by any collusion, conspiracy, connivance, or unlawful agreement on the part of the Bidder or any other of its agents, representatives, owners, employees or parties in interest, including this affidavit.

By _____

Sworn and subscribed to before me this ____ day of _____, 20____, in the
State of _____, County of _____.

_____ Notary Public

My Commission Expires: _____

END OF SECTION

SECTION 00490

TRENCH SAFETY COMPLIANCE

Trench excavations on this Project are expected to be in excess of 5 feet deep. The Occupational Safety and Health Administration excavation safety standards, 29 CFR 1926.650 Subpart P trench safety standards, will be in effect during the period of construction of the Project.

Bidder acknowledges that included in the Bid Price are costs for complying with the Florida Trench Safety Act (90-096, Laws of Florida) effective October 1, 1990, and hereby gives assurance that, if awarded the Contract, the Contractor or Subcontractor performing trench excavation work on the Project will comply with the applicable trench safety standards. The Bidder further identifies the costs as follows:

Trench Safety Item (Description) and Estimated Cost

(Cost in Words)

TOTAL \$ _____

FAILURE TO COMPLETE THE ABOVE MAY RESULT IN THE BID BEING DECLARED NON-RESPONSIVE.

Company Name: _____

Date: _____

By: _____

SECTION 00500

AGREEMENT

THIS AGREEMENT made and entered into this _____ day of _____ 2021, by and between the CITY OF CRESTVIEW, FLORIDA, a municipality organized and existing under the laws of the State of Florida, hereinafter called the OWNER, and _____ hereinafter called CONTRACTOR;

WITNESSETH:

OWNER and CONTRACTOR, in consideration of the mutual covenants hereinafter set forth, agree as follows:

ARTICLE I - SCOPE OF WORK

CONTRACTOR shall complete all work as specified or indicated in the Contract Documents. The Work is generally described as follows:

ANTIOCH ELEVATED STORAGE TANK

BID # 21-04-20

All work for the Project shall be constructed in accordance with the Drawings and Specifications prepared by Tetra Tech and the proposed improvements will be awarded and constructed, if award is made, under one Contract. Bids shall be submitted for furnishing, delivering, and installing all materials, equipment and services, including labor, for the Work described.

This project is to furnish and install a new 500,000 gallon composite elevated water storage tank. The project generally includes site clearing, construction of the new elevated tank including delegated engineering design, installation of potable water main and connection to the existing system, electrical work including site lighting and tank controls, and site work and restoration. The contractor shall provide the new elevated storage tank in accordance with the plans and specifications and shall include all materials and labor to provide a fully functioning water storage tank.

ARTICLE II - ENGINEER

The Engineer, Scott L Jernigan, P.E. (Jacobs), whose address is 25 West Cedar Street, Suite 350, Pensacola FL 32502, hereinafter referred to as ENGINEER and who will assume all duties and responsibilities and will have the rights and authority assigned to the Engineer in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

ARTICLE III - CONTRACT TIME

3.1 The Work will be substantially completed within **240** days after the date when the Contract Time commences to run as provided in Paragraph 2.03 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 14.07 of the General Conditions within **300** days after the date when the Contract Time commences to run.

3.2 Damages for Delay. OWNER and CONTRACTOR recognize that **TIME IS OF THE ESSENCE** in this Agreement and that the OWNER will suffer financial loss if the Work is not completed within the time specified in Paragraph 3.1 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions.

3.2.1 Uniqueness of the Work. The OWNER and the CONTRACTOR expressly acknowledge the unique characteristics of the Work, which cause time to be of the essence in this contract.

3.2.2 Liquidated Damages. OWNER and CONTRACTOR recognize that **TIME IS OF THE ESSENCE** in this Agreement and that Owner will suffer financial loss if the work is not substantially complete in the time specified in Paragraph 3.1 above. The parties also recognize the delays, expense and difficulties involved in proving in a legal proceeding the actual loss suffered by the OWNER if the Work is not substantially complete on time. Accordingly, instead of requiring any such proof, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) CONTRACTOR shall pay OWNER \$1,000.00 (One Thousand Dollars) for each day that expires after the time specified in Paragraph 3.1 for Substantial Completion until the Work is substantially complete, and that the liquidated damages set forth herein bear a reasonable relationship to the estimated actual damages that the OWNER would suffer.

ARTICLE IV - CONTRACT PRICE

4.1 OWNER shall pay CONTRACTOR for performance of the Work in accordance with the Contract Documents in current funds at the lump sum or unit prices as presented in the Bid Form, which is incorporated herein and made a part hereof by this reference.

4.2 OWNER shall pay CONTRACTOR for completion of the work in accordance with the Contract Documents an amount in correct funds equal to the amount below:

Bid Total: _____
(use words)

Bid Total: \$ _____
(use figures)

4.3 The parties expressly agree that the Contract Price is a stipulated sum, except with regard to those items in the Bid which are subject to unit prices.

ARTICLE V - PAYMENT PROCEDURES

5.1 CONTRACTOR shall submit Applications for Payment in accordance with the Contract Documents. Applications for Payment will be processed by ENGINEER as provided in the General Conditions.

5.2 OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR'S monthly Applications for Payment, as approved by the ENGINEER, which shall be submitted by the CONTRACTOR on or before the 10th day after the end of each calendar month for which payment is requested.

5.3 Progress payments prior to Substantial Completion will be made in the following manner:

5.3.1 Prior to Substantial Completion and prior to fifty percent (50%) of the Work being completed, progress payments shall be ninety percent (90%) of the value of Work complete and ninety percent (90%) of the value of materials and equipment not incorporated into the Work, but delivered and suitably stored, less in each case the aggregate of payments previously made.

5.3.2 After fifty percent (50%) of the Work has been completed as determined by the ENGINEER, and if the character and progress has been satisfactory to the OWNER and ENGINEER, OWNER, on the recommendation of ENGINEER, may determine that as long as the character and progress of the Work remain satisfactory to them, there will be no retainage on account of subsequent Work and materials and equipment not incorporated into the Work, but delivered and suitably stored, which results in the Owner withholding a retainage equal to five percent (5%) of the Contract Price until Substantial Completion. However, OWNER shall reserve the right to reinstate withholding a retainage of ten percent (10%) if OWNER, on the recommendation of ENGINEER, determines that the progress or character of the Work is not satisfactory.

5.3.3 Upon Substantial Completion of the Work, OWNER shall pay an amount sufficient to increase total payments to the CONTRACTOR to ninety-five percent (95%) of the Contract Price, less such amounts as ENGINEER shall determine in accordance with Article 14 of the General Conditions.”

5.4 Final Payment. Upon final completion of the Work in accordance with the Contract Documents, OWNER shall pay CONTRACTOR an amount sufficient to increase total payments to ninety-eight percent (98%) of the Contract Price. However, not less than two percent (2%) of the Contract Price shall be retained until Record Drawings, specifications, addenda, modifications and shop drawings, including all manufacturers instructional and parts manuals are delivered to and accepted by the ENGINEER.

ARTICLE VI - CONTRACTOR'S REPRESENTATIONS

In order to induce OWNER to enter into this Agreement, CONTRACTOR makes the following representations:

6.1 CONTRACTOR has visited the work site and familiarized himself with the nature and extent of the Contract Documents, Work, locality, and all local conditions and federal, state and local laws, ordinances, rules and regulations that in any manner may affect cost, progress or performance of the Work.

6.2 CONTRACTOR has studied carefully all reports of investigations and tests of subsurface and latent physical conditions at the site or otherwise affecting cost, progress or performance of the Work which were relied upon by the ENGINEER in the preparation of the Drawings and Specifications, and which have been identified in the General and Supplementary Conditions of the Contract Documents.

6.3 CONTRACTOR has made or caused to be made examinations, investigations, tests and studies of such reports and related data in addition to those referred to in Paragraph 6.2 above as he deems necessary for the performance of the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents; and no additional examinations, investigations, tests, reports or similar data are, or will be, required by CONTRACTOR for such purposes.

6.4 CONTRACTOR has correlated the results of all such observations, examinations, investigations, tests, reports and data with the terms and conditions of the Contract Documents.

6.5 CONTRACTOR has given ENGINEER written notice of all conflicts, errors or discrepancies that he has discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to the CONTRACTOR.

ARTICLE VII - CONTRACT DOCUMENTS

The Contract Documents which comprise the entire Agreement between the OWNER and CONTRACTOR are attached to this Agreement, are made a part hereof and consist of the following:

- 7.1 This Agreement (Section 00500) (pages __ to __, inclusive).
- 7.2 Exhibits to this Agreement (sheets __ to __, inclusive). N/A
- 7.3 Performance Bond, Payment Bond and Certificates of Insurance.
- 7.4 Notice of Award and Notice to Proceed.
- 7.5 General Conditions (Section 00700) as amended by the Supplementary Conditions.
- 7.6 Supplementary Conditions (Section 00800).
- 7.7 Florida Department of Environmental Protection Bureau of Water Facilities Funding Supplementary Conditions for Formally Advertised Construction Procurement.
- 7.8 Project Manual bearing the general title: "CITY OF CRESTVIEW, ANTIOCH ELEVATED STORAGE TANK" and consisting of Divisions 0 through 16 as listed in the table of contents.
- 7.9 Drawings bearing the following general title: "CITY OF CRESTVIEW, ANTIOCH ELEVATED STORAGE TANK" and consisting of the sheets as listed in the Drawings Index.
- 7.10 Addenda Numbers __ through __, inclusive.
- 7.11 Bid Form (Section 00300) (Pages 1 to 11, inclusive).
- 7.12 All applicable provisions of State and Federal Law and any modification, including Change Orders or written amendments duly delivered after execution of Agreement.

7.13 Advertisement for Bids, Instructions to Bidders, Bid Bond, Noncollusion Affidavit, General Requirements, Field Orders and State of Florida Contract Provisions.

There are no Contract Documents other than those listed above in this Article VII. The Contract Documents may only be altered, amended, or repealed in accordance with Article 3 of the General Conditions as modified in the Supplementary Conditions.

ARTICLE VIII - MISCELLANEOUS

8.1 No assignment by the parties hereto of any rights under, or interest in, the Contract Documents will be binding on another party hereto without the written consent of the party sought to be bound; and specifically, but without limitation, monies that may become due and monies that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent of an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

8.2 OWNER and CONTRACTOR each binds himself, his partners, successors, assigns and legal representatives to the other party hereto, his partners, successors, assigns or legal representatives in respect to all covenants, agreements and obligations contained in the Contract Documents.

8.3 Terms used in this Agreement, which are defined in Article 1 of the General Conditions, shall have the meanings indicated in the General Conditions, as modified in the Supplementary Conditions.

ARTICLE IX - GOVERNING LAW

This Agreement shall be governed by the laws of the State of Florida. Both parties agree that the courts of the State of Florida shall have jurisdiction of any claim arising in connection with this Agreement. In the event of litigation arising out of this Agreement, the prevailing party shall be entitled to the award of attorney's fees and costs at both the trial and appellate level. Venue for any litigation arising out of this agreement shall be in Orange County, Florida.

IN WITNESS WHEREOF, the parties hereto have signed this Agreement in triplicate. One (1) counterpart each has been delivered to OWNER, CONTRACTOR and ENGINEER. All portions of the Contract Documents have been signed or identified by OWNER and CONTRACTOR or by ENGINEER on their behalf.

This Agreement will be effective on _____, 2021.

OWNER: CITY OF CRESTVIEW, FLORIDA

By: _____

ATTEST: _____

CITY CLERK

APPROVED AS TO FORM AND CORRECTNESS: _____

CITY ATTORNEY

CONTRACTOR:

By: _____

Title: _____

(CORPORATE SEAL)

ATTEST: _____

SECRETARY

END OF SECTION

Performance Bond

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

CONTRACTOR (Name and Address):

SURETY (Name and Address of Principal Place
of Business):

OWNER (Name and Address):

CONTRACT

Date:

Amount:

Description (Name and Location):

BOND

Date (Not earlier than Contract Date):

Amount:

Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Performance Bond to be duly executed on its behalf by its authorized officer, agent or representative.

CONTRACTOR AS PRINCIPAL

Company: _____ (Corp. Seal)

Signature: _____

Name and Title:

SURETY

Company: _____ (Corp. Seal)

Signature: _____

Name and Title:

(Attach Power of Attorney)

(Space is provided below for signatures of additional parties, if required.)

CONTRACTOR AS PRINCIPAL

Company: _____ (Corp. Seal)

Signature: _____

Name and Title:

SURETY

Company: _____ (Corp. Seal)

Signature: _____

Name and Title:

EJCDC No. 1910-28-A (1996 Edition)

Originally prepared through the joint efforts of the Surety Association of America, Engineers Joint Contract Documents Committee, the Associated General Contractors of America, and the American Institute of Architects.

1. The CONTRACTOR and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Contract, which is incorporated herein by reference.

2. If the CONTRACTOR performs the Contract, the Surety and the CONTRACTOR have no obligation under this Bond, except to participate in conferences as provided in paragraph 3.1.

3. If there is no OWNER Default, the Surety's obligation under this Bond shall arise after:

3.1. The OWNER has notified the CONTRACTOR and the Surety at the addresses described in paragraph 10 below, that the OWNER is considering declaring a CONTRACTOR Default and has requested and attempted to arrange a conference with the CONTRACTOR and the Surety to be held not later than fifteen days after receipt of such notice to discuss methods of performing the Contract. If the OWNER, the CONTRACTOR and the Surety agree, the CONTRACTOR shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive the OWNER's right, if any, subsequently to declare a CONTRACTOR Default; and

3.2. The OWNER has declared a CONTRACTOR Default and formally terminated the CONTRACTOR's right to complete the Contract. Such CONTRACTOR Default shall not be declared earlier than twenty days after the CONTRACTOR and the Surety have received notice as provided in paragraph 3.1; and

3.3. The OWNER has agreed to pay the Balance of the Contract Price to:

3.3.1. The Surety in accordance with the terms of the Contract;

3.3.2 Another contractor selected pursuant to paragraph 4.3 to perform the Contract.

4. When the OWNER has satisfied the conditions of paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

4.1. Arrange for the CONTRACTOR, with consent of the OWNER, to perform and complete the Contract; or

4.2. Undertake to perform and complete the Contract itself, through its agents or through independent contractors; or

4.3. Obtain bids or negotiated proposals from qualified contractors acceptable to the OWNER for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by the OWNER and the contractor selected with the OWNER's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the Bonds issued on the Contract, and pay to the OWNER the amount of damages as described in paragraph 6 in excess of the Balance of the Contract Price incurred by the OWNER resulting from the CONTRACTOR Default; or

4.4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances;

4.4.1 After investigation, determine the amount for which it may be liable to the OWNER and, as soon as practicable after the amount is determined, tender payment therefor to the OWNER; or

4.4.2 Deny liability in whole or in part and notify the OWNER citing reasons therefor.

5. If the Surety does not proceed as provided in paragraph 4 with reasonable promptness, the Surety shall be deemed to be in default on this Bond fifteen days after receipt of an additional written notice from the OWNER to the Surety demanding that the Surety perform its obligations under this Bond, and the OWNER shall be entitled to enforce any remedy available to the OWNER. If the Surety proceeds as provided in paragraph 4.4, and the OWNER refuses the payment tendered or the Surety has denied

liability, in whole or in part, without further notice the OWNER shall be entitled to enforce any remedy available to the OWNER.

6. After the OWNER has terminated the CONTRACTOR's right to complete the Contract, and if the Surety elects to act under paragraph 4.1, 4.2, or 4.3 above, then the responsibilities of the Surety to the OWNER shall not be greater than those of the CONTRACTOR under the Contract, and the responsibilities of the OWNER to the Surety shall not be greater than those of the OWNER under the Contract. To a limit of the amount of this Bond, but subject to commitment by the OWNER of the Balance of the Contract Price to mitigation of costs and damages on the Contract, the Surety is obligated without duplication for:

6.1. The responsibilities of the CONTRACTOR for correction of defective Work and completion of the Contract;

6.2. Additional legal, design professional and delay costs resulting from the CONTRACTOR's Default, and resulting from the actions or failure to act of the Surety under paragraph 4; and

6.3. Liquidated damages, or if no liquidated damages are specified in the Contract, actual damages caused by delayed performance or non-performance of the CONTRACTOR.

7. The Surety shall not be liable to the OWNER or others for obligations of the CONTRACTOR that are unrelated to the Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the OWNER or its heirs, executors, administrators, or successors.

8. The Surety hereby waives notice of any change, including changes of time, to the Contract or to related subcontracts, purchase orders and other obligations.

9. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the Work or part of the Work is located and shall be instituted within two years after CONTRACTOR Default or within two years after the CONTRACTOR ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

10. Notice to the Surety, the OWNER or the CONTRACTOR shall be mailed or delivered to the address shown on the signature page.

11. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the Contract was performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted here from and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

12. Definitions.

12.1 Balance of the Contract Price: The total amount payable by the OWNER to the CONTRACTOR under the Contract after all proper adjustments have been made, including allowance to the CONTRACTOR of any amounts received or to be received by the OWNER in settlement of insurance or other Claims for damages to which the CONTRACTOR is entitled, reduced by all valid and proper payments made to or on behalf of the CONTRACTOR under the Contract.

12.2. Contract: The agreement between the OWNER and the CONTRACTOR identified on the signature page, including all Contract Documents and changes thereto.

12.3. CONTRACTOR Default: Failure of the CONTRACTOR, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Contract.

12.4. OWNER Default: Failure of the OWNER, which has neither been remedied nor waived, to pay the CONTRACTOR as required by the Contract or to perform and complete or comply with the other terms thereof.

(FOR INFORMATION ONLY--Name, Address and Telephone)
AGENT or BROKER: OWNER'S REPRESENTATIVE (Engineer or other party):

Payment Bond

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

CONTRACTOR (Name and Address):

SURETY (Name and Address of Principal Place
of Business):

OWNER (Name and Address):

CONTRACT

Date:

Amount:

Description (Name and Location):

BOND

Date (Not earlier than Contract Date):

Amount:

Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Payment Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

Company: _____ (Corp. Seal)

Signature: _____

Name and Title:

SURETY

Company: _____ (Corp. Seal)

Signature: _____

Name and Title:

(Attach Power of Attorney)

(Space is provided below for signatures of additional parties, if required.)

CONTRACTOR AS PRINCIPAL

Company: _____ (Corp. Seal)

Signature: _____

Name and Title:

SURETY

Company: _____ (Corp. Seal)

Signature: _____

Name and Title:

EJCDC No. 1910-28-B (1996 Edition)

Originally prepared through the joint efforts of the Surety Association of America, Engineers Joint Contract Documents Committee, the Associated General Contractors of America, the American Institute of Architects, the American Subcontractors Association, and the Associated Specialty Contractors.

1. The CONTRACTOR and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the OWNER to pay for labor, materials and equipment furnished for use in the performance of the Contract, which is incorporated herein by reference.

2. With respect to the OWNER, this obligation shall be null and void if the CONTRACTOR:

2.1. Promptly makes payment, directly or indirectly, for all sums due Claimants, and

2.2. Defends, indemnifies and holds harmless the OWNER from all claims, demands, liens or suits by any person or entity who furnished labor, materials or equipment for use in the performance of the Contract, provided the OWNER has promptly notified the CONTRACTOR and the Surety (at the addresses described in paragraph 12) of any claims, demands, liens or suits and tendered defense of such claims, demands, liens or suits to the CONTRACTOR and the Surety, and provided there is no OWNER Default.

3. With respect to Claimants, this obligation shall be null and void if the CONTRACTOR promptly makes payment, directly or indirectly, for all sums due.

4. The Surety shall have no obligation to Claimants under this Bond until:

4.1. Claimants who are employed by or have a direct contract with the CONTRACTOR have given notice to the Surety (at the addresses described in paragraph 12) and sent a copy, or notice thereof, to the OWNER, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.

4.2. Claimants who do not have a direct contract with the CONTRACTOR:

1. Have furnished written notice to the CONTRACTOR and sent a copy, or notice thereof, to the OWNER, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials were furnished or supplied or for whom the labor was done or performed; and

2. Have either received a rejection in whole or in part from the CONTRACTOR, or not received within 30 days of furnishing the above notice any communication from the CONTRACTOR by which the CONTRACTOR had indicated the claim will be paid directly or indirectly; and

3. Not having been paid within the above 30 days, have sent a written notice to the Surety and sent a copy, or notice thereof, to the OWNER, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to the CONTRACTOR.

5. If a notice required by paragraph 4 is given by the OWNER to the CONTRACTOR or to the Surety, that is sufficient compliance.

6. When the Claimant has satisfied the conditions of paragraph 4, the Surety shall promptly and at the Surety's expense take the following actions:

6.1. Send an answer to the Claimant, with a copy to the OWNER, within 45 days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed.

6.2. Pay or arrange for payment of any undisputed amounts.

7. The Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

8. Amounts owed by the OWNER to the CONTRACTOR under the Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any Performance Bond. By the CONTRACTOR furnishing and the OWNER accepting this Bond, they agree that all funds earned by the CONTRACTOR in the

performance of the Contract are dedicated to satisfy obligations of the CONTRACTOR and the Surety under this Bond, subject to the OWNER's priority to use the funds for the completion of the Work.

9. The Surety shall not be liable to the OWNER, Claimants or others for obligations of the CONTRACTOR that are unrelated to the Contract. The OWNER shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

10. The Surety hereby waives notice of any change, including changes of time, to the Contract or to related Subcontracts, purchase orders and other obligations.

11. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the Work or part of the Work is located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by paragraph 4.1 or paragraph 4.2.3, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the OWNER or the CONTRACTOR shall be mailed or delivered to the addresses shown on the signature page. Actual receipt of notice by Surety, the OWNER or the CONTRACTOR, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is, that this Bond shall be construed as a statutory Bond and not as a common law bond.

14. Upon request of any person or entity appearing to be a potential beneficiary of this Bond, the CONTRACTOR shall promptly furnish a copy of this Bond or shall permit a copy to be made.

15. DEFINITIONS

15.1. Claimant: An individual or entity having a direct contract with the CONTRACTOR or with a Subcontractor of the CONTRACTOR to furnish labor, materials or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Contract, architectural and engineering services required for performance of the Work of the CONTRACTOR and the CONTRACTOR's Subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.

15.2. Contract: The agreement between the OWNER and the CONTRACTOR identified on the signature page, including all Contract Documents and changes thereto.

15.3. OWNER Default: Failure of the OWNER, which has neither been remedied nor waived, to pay the CONTRACTOR as required by the Contract or to perform and complete or comply with the other terms thereof.

(FOR INFORMATION ONLY--Name, Address and Telephone)

AGENCY or BROKER: OWNER'S REPRESENTATIVE (Engineer or other party):

SECTION 00650

CERTIFICATE OF INSURANCE

A. INSURANCE REQUIREMENTS

1. Contractor shall purchase and maintain such comprehensive general liability and other insurance as required by this document. Should any of the required insurance policies be canceled before the expiration date thereof, the insuring company shall provide written notice to each insured 30 days prior to cancellation.

B. CERTIFICATE OF INSURANCE FORM

1. The Certificate of Insurance submitted to the Owner and Engineer shall be on the Insurance Company's form with a format similar to the popular ACORD Corporation form.
2. The Owner's project name and project number shall be shown on the Certificate.
3. Three (3) Certificates shall be submitted along with the executed Contract Agreement.

A. Minimum Scope of Insurance:

Coverage shall be at least as broad as:

1. Insurance Services Office Form No. CG 0001 (11/85) or CG 0002 (2/86) Commercial General Liability; and Insurance Services Office Form No. GL 0404 (5181) Broad Form Comprehensive General Liability; endorsement, and
2. Insurance Services Office form No. CA 0001 (Ed. 1/87) covering Automobile Liability, code 1 "any auto", and CA 0002 (1/87), and
3. Workers' Compensation as required by the State of Florida and Employers' Liability insurance:

B. Minimum Limits of Insurance:

Contractor shall maintain coverage's and limits as follows:

1. General Liability:

Aggregate Limit: \$1,000,000.

Products and completed operation aggregate limit: \$500,000.

Personal and advertising injury limit: N/A.

Each occurrence limit: \$500,000.

Fire damage limit: \$50,000 any one fire.

Medical expense limit: \$5,000 per person.
Blanket: no.

(1) Designated contractors (specify): City of Crestview

2. Automobile Liability:

- (a) Business auto with symbol(s): one (1)
- (b) Limit per accident: \$1,000,000.

3. Workers' Compensation as required by Florida laws, and Employer's Liability with the following minimum limits:

- (a) Each accident: \$100,000.
- (b) Per employee disease: \$100,000.
- (c) All claims disease: \$500,000.

C. Deductibles and Self-Insured Retentions:

Any deductible or self-insured retention must be declared to and approved by the City. At the option of the City, either the insurer shall reduce or eliminate such deductibles or self insured retentions as respects the City, its officials and employees, or the contractor shall procure a bond guaranteeing payment of losses and related investigation, claim administration and defense expenses.

D. Acceptability of Insurers: Insurance should be placed with insurers having a Bests' rating of A-Excellent and Xiii Financial Size.

E. Verification of Coverage: Successful Contractor shall furnish the City with certificates of insurance and with original endorsements affecting coverage's required by this appendix. The certificates and endorsement for each insurance policy are to be signed by a person authorized by that insurer to bind coverage on its behalf. The certificate and endorsement are to be on forms provided or approved by the City and are to be received and approved in final form by the before work commences.

City

F. Subcontractors: Contractor shall include all subcontractors as insured's under its policies or shall furnish separate certivicates and endorsements for each subcontractor. All coverage's for subcontractors shall be subject to all of the requirements stated herein.

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the controlling Laws and Regulations.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly by

ACEC

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ASCE American Society
of Civil Engineers

P/E National Society of
Professional Engineers
Professional Engineers in Private Practice

AMERICAN COUNCIL OF ENGINEERING COMPANIES

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Endorsed by



CONSTRUCTION SPECIFICATIONS INSTITUTE

These General Conditions have been prepared for use with the Suggested Forms of Agreement Between Owner and Contractor (EJCDC C-520 or C-525, 2007 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other. Comments concerning their usage are contained in the Narrative Guide to the EJCDC Construction Documents (EJCDC C-001, 2007 Edition). For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (EJCDC C-800, 2007 Edition).

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.
 3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. *Asbestos*—Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.
 5. *Bid*—The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 6. *Bidder*—The individual or entity who submits a Bid directly to Owner.
 7. *Bidding Documents*—The Bidding Requirements and the proposed Contract Documents (including all Addenda).
 8. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and the Bid Form with any supplements.
 9. *Change Order*—A document recommended by Engineer which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.
 10. *Claim*—A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.
 11. *Contract*—The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. *Contract Documents*—Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.
13. *Contract Price*—The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).
14. *Contract Times*—The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any; (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.
15. *Contractor*—The individual or entity with whom Owner has entered into the Agreement.
16. *Cost of the Work*—See Paragraph 11.01 for definition.
17. *Drawings*—That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.
18. *Effective Date of the Agreement*—The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.
19. *Engineer*—The individual or entity named as such in the Agreement.
20. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.
21. *General Requirements*—Sections of Division 1 of the Specifications.
22. *Hazardous Environmental Condition*—The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto.
23. *Hazardous Waste*—The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.
24. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
25. *Liens*—Charges, security interests, or encumbrances upon Project funds, real property, or personal property.
26. *Milestone*—A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

27. *Notice of Award*—The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.
28. *Notice to Proceed*—A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.
29. *Owner*—The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.
30. *PCBs*—Polychlorinated biphenyls.
31. *Petroleum*—Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.
32. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.
33. *Project*—The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.
34. *Project Manual*—The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.
35. *Radioactive Material*—Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.
36. *Resident Project Representative*—The authorized representative of Engineer who may be assigned to the Site or any part thereof.
37. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.
38. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.
39. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

40. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.
41. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.
42. *Specifications*—That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.
43. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.
44. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.
45. *Successful Bidder*—The Bidder submitting a responsive Bid to whom Owner makes an award.
46. *Supplementary Conditions*—That part of the Contract Documents which amends or supplements these General Conditions.
47. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or Subcontractor.
48. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
49. *Unit Price Work*—Work to be paid for on the basis of unit prices.
50. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.
51. *Work Change Directive*—A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an

addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 *Terminology*

A. The words and terms discussed in Paragraph 1.02.B through F are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives:*

1. The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09 or any other provision of the Contract Documents.

C. *Day:*

1. The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective:*

1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - a. does not conform to the Contract Documents; or
 - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - c. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

E. *Furnish, Install, Perform, Provide:*

1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
 3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
 4. When “furnish,” “install,” “perform,” or “provide” is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, “provide” is implied.
- F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 Delivery of Bonds and Evidence of Insurance

- A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.
- B. *Evidence of Insurance:* Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.02 Copies of Documents

- A. Owner shall furnish to Contractor up to ten printed or hard copies of the Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction.

2.03 Commencement of Contract Times; Notice to Proceed

- A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

2.04 *Starting the Work*

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

2.05 *Before Starting Construction*

- A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:
 - 1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;
 - 2. a preliminary Schedule of Submittals; and
 - 3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.06 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit instructions, receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.07 *Initial Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.
 - 1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of

the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that reasonably may be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the indicated result will be provided whether or not specifically called for, at no additional cost to Owner.
- C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

3.02 *Reference Standards*

- A. Standards, Specifications, Codes, Laws, and Regulations
 1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
 2. No provision of any such standard, specification, manual, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

- A. *Reporting Discrepancies:*

1. *Contractor's Review of Contract Documents Before Starting Work:* Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor discovers, or has actual knowledge of, and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.
2. *Contractor's Review of Contract Documents During Performance of Work:* If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) any standard, specification, manual, or code, or (c) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:
 - a. the provisions of any standard, specification, manual, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference in the Contract Documents); or
 - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Amending and Supplementing Contract Documents*

- A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.
- B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:
 1. A Field Order;
 2. Engineer's approval of a Shop Drawing or Sample (subject to the provisions of Paragraph 6.17.D.3); or

3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

- A. Contractor and any Subcontractor or Supplier shall not:
 1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions; or
 2. reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

3.06 *Electronic Data*

- A. Unless otherwise stated in the Supplementary Conditions, the data furnished by Owner or Engineer to Contractor, or by Contractor to Owner or Engineer, that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.
- B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.
- C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

ARTICLE 4 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

4.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the

Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 *Subsurface and Physical Conditions*

A. *Reports and Drawings:* The Supplementary Conditions identify:

- 1. those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site; and
- 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

- 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
- 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
- 3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

4.03 *Differing Subsurface or Physical Conditions*

A. *Notice:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed either:

- 1. is of such a nature as to establish that any "technical data" on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or
- 2. is of such a nature as to require a change in the Contract Documents; or
- 3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

- B. *Engineer's Review:* After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of Owner's obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Engineer's findings and conclusions.

C. *Possible Price and Times Adjustments:*

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and
 - b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:
 - a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or
 - b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or
 - c. Contractor failed to give the written notice as required by Paragraph 4.03.A.
3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, neither Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data provided by others; and
2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
 - a. reviewing and checking all such information and data;
 - b. locating all Underground Facilities shown or indicated in the Contract Documents;
 - c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction; and
 - d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated:*

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

4.05 *Reference Points*

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.06 *Hazardous Environmental Condition at Site*

- A. *Reports and Drawings:* The Supplementary Conditions identify those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at the Site.
- B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
 - 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or
 - 2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
 - 3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.
- D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to

permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 4.06.E.

- E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered written notice to Contractor: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.
- F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.
- G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 5 – BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

- A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.
- B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed each bond.
- C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

5.02 *Licensed Sureties and Insurers*

- A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.03 *Certificates of Insurance*

- A. Contractor shall deliver to Owner, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.
- B. Owner shall deliver to Contractor, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.

- C. Failure of Owner to demand such certificates or other evidence of Contractor's full compliance with these insurance requirements or failure of Owner to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.
- D. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor.
- E. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

5.04 *Contractor's Insurance*

- A. Contractor shall purchase and maintain such insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:
 - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;
 - 2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;
 - 3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;
 - 4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:
 - a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or
 - b. by any other person for any other reason;
 - 5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and
 - 6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.
- B. The policies of insurance required by this Paragraph 5.04 shall:
 - 1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, be written on an occurrence basis, include as additional insureds (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, members, partners,

employees, agents, consultants, and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;
3. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;
4. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);
5. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and
6. include completed operations coverage:
 - a. Such insurance shall remain in effect for two years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

5.05 *Owner's Liability Insurance*

- A. In addition to the insurance required to be provided by Contractor under Paragraph 5.04, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

5.06 *Property Insurance*

- A. Unless otherwise provided in the Supplementary Conditions, Owner shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:
 1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of

them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee;

2. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by the Supplementary Conditions.
 3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);
 4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;
 5. allow for partial utilization of the Work by Owner;
 6. include testing and startup; and
 7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued.
- B. Owner shall purchase and maintain such equipment breakdown insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee.
- C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other loss payee to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.
- D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

- E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under this Paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Contractor whether or not such other insurance has been procured by Owner.

5.07 *Waiver of Rights*

- A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or loss payees thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.
- B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for:
1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
 2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them.

5.08 *Receipt and Application of Insurance Proceeds*

- A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the loss payees, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order.
- B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

5.09 *Acceptance of Bonds and Insurance; Option to Replace*

- A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

- A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to Paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6 – CONTRACTOR’S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

6.02 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.
- B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner’s written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

6.03 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.
- B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

6.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below.
1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.
 2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.05 *Substitutes and "Or-Equals"*

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.
1. "*Or-Equal*" Items: If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that:
 - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
 - 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and
 - 3) it has a proven record of performance and availability of responsive service.
 - b. Contractor certifies that, if approved and incorporated into the Work:
 - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

2. *Substitute Items:*

- a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.
- b. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.
- c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented by the General Requirements, and as Engineer may decide is appropriate under the circumstances.
- d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
 - 1) shall certify that the proposed substitute item will:
 - a) perform adequately the functions and achieve the results called for by the general design,
 - b) be similar in substance to that specified, and
 - c) be suited to the same use as that specified;
 - 2) will state:
 - a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time,
 - b) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and
 - c) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;
 - 3) will identify:
 - a) all variations of the proposed substitute item from that specified, and
 - b) available engineering, sales, maintenance, repair, and replacement services; and
 - 4) shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.

- B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.
- C. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by a Change Order in the case of a substitute and an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.
- D. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- E. *Engineer's Cost Reimbursement:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
- F. *Contractor's Expense:* Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

6.06 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.
- B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or

entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.

- C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:
1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity; nor
 2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.
- D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.
- E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.
- F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as a loss payee on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

6.07 *Patent Fees and Royalties*

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its

use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

6.08 *Permits*

- A. Unless otherwise provided in the Supplementary Conditions, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

6.09 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.
- C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner

and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

6.10 *Taxes*

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

6.11 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas:*

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.
 2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.
 3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.
- B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.
- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
- D. *Loading Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

6.12 *Record Documents*

- A. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to Engineer for reference. Upon completion of the Work, these record documents, Samples, and Shop Drawings will be delivered to Engineer for Owner.

6.13 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:
 - 1. all persons on the Site or who may be affected by the Work;
 - 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 - 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.
- C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.
- D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
- E. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts

any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

- F. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

- A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.15 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

6.16 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

6.17 *Shop Drawings and Samples*

- A. Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals (as required by Paragraph 2.07). Each submittal will be identified as Engineer may require.

1. *Shop Drawings:*

- a. Submit number of copies specified in the General Requirements.
- b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.

2. *Samples:*

- a. Submit number of Samples specified in the Specifications.

- b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 6.17.D.
- B. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. *Submittal Procedures:*

1. Before submitting each Shop Drawing or Sample, Contractor shall have:
 - a. reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - c. determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal.
3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawings or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

D. *Engineer's Review:*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the 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.
2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the

Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

E. *Resubmittal Procedures:*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

6.18 *Continuing the Work*

- A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on representation of Contractor's warranty and guarantee.
- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
 1. observations by Engineer;
 2. recommendation by Engineer or payment by Owner of any progress or final payment;

3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
4. use or occupancy of the Work or any part thereof by Owner;
5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;
6. any inspection, test, or approval by others; or
7. any correction of defective Work by Owner.

6.20 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .
- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
 1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

6.21 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.
- B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.
- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.
- D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

ARTICLE 7 – OTHER WORK AT THE SITE

7.01 *Related Work at Site*

- A. Owner may perform other work related to the Project at the Site with Owner's employees, or through other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:
 - 1. written notice thereof will be given to Contractor prior to starting any such other work; and
 - 2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.
- B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner, and Owner, if Owner is performing other work with Owner's employees, proper and safe

access to the Site, provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.

- C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

7.02 *Coordination*

- A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:
 - 1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;
 - 2. the specific matters to be covered by such authority and responsibility will be itemized; and
 - 3. the extent of such authority and responsibilities will be provided.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

7.03 *Legal Relationships*

- A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.
- B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's wrongful actions or inactions.
- C. Contractor shall be liable to Owner and any other contractor under direct contract to Owner for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's wrongful action or inactions.

ARTICLE 8 – OWNER’S RESPONSIBILITIES

8.01 *Communications to Contractor*

- A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

8.02 *Replacement of Engineer*

- A. In case of termination of the employment of Engineer, Owner shall appoint an engineer to whom Contractor makes no reasonable objection, whose status under the Contract Documents shall be that of the former Engineer.

8.03 *Furnish Data*

- A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

8.04 *Pay When Due*

- A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.05 *Lands and Easements; Reports and Tests*

- A. Owner’s duties with respect to providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner’s identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

8.06 *Insurance*

- A. Owner’s responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

8.07 *Change Orders*

- A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

8.08 *Inspections, Tests, and Approvals*

- A. Owner’s responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

8.09 *Limitations on Owner’s Responsibilities*

- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor’s means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws

and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

8.10 *Undisclosed Hazardous Environmental Condition*

- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

8.11 *Evidence of Financial Arrangements*

- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents.

8.12 *Compliance with Safety Program*

- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed pursuant to Paragraph 6.13.D.

ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *Owner's Representative*

- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract Documents.

9.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

9.03 *Project Representative*

- A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

9.04 *Authorized Variations in Work*

- A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

9.05 *Rejecting Defective Work*

- A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.06 *Shop Drawings, Change Orders and Payments*

- A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.
- B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.
- C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.
- D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations

on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

9.08 *Decisions on Requirements of Contract Documents and Acceptability of Work*

- A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question.
- B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believes that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.
- C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.
- D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 *Limitations on Engineer's Authority and Responsibilities*

- A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.
- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of,

and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.

- E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to the Resident Project Representative, if any, and assistants, if any.

9.10 *Compliance with Safety Program*

- A. While at the Site, Engineer's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Engineer has been informed pursuant to Paragraph 6.13.D.

ARTICLE 10 – CHANGES IN THE WORK; CLAIMS

10.01 *Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).
- B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

10.02 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.D.

10.03 *Execution of Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:
 - 1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;
 - 2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and
 - 3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of

executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

10.04 *Notification to Surety*

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

10.05 *Claims*

- A. *Engineer's Decision Required:* All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.
- B. *Notice:* Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Times shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).
- C. *Engineer's Action:* Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:
 - 1. deny the Claim in whole or in part;
 - 2. approve the Claim; or
 - 3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.
- D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.

- E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.
- F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

ARTICLE 11 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

11.01 *Cost of the Work*

- A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 11.01.B, and shall include only the following items:
 - 1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.
 - 2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
 - 3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
 - d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
 - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
 - f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.
 - g. The cost of utilities, fuel, and sanitary facilities at the Site.
 - h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, express and courier services, and similar petty cash items in connection with the Work.
 - i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

B. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.
 2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
 4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
 5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A.
- C. *Contractor's Fee:* When all the Work is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.
- D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.
- B. *Cash Allowances:*
1. Contractor agrees that:
 - a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 - b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in

the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

C. *Contingency Allowance:*

1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and
2. there is no corresponding adjustment with respect to any other item of Work; and
3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 12 – CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

- B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:
1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or
 2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or
 3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).
- C. *Contractor's Fee*: The Contractor's fee for overhead and profit shall be determined as follows:
1. a mutually acceptable fixed fee; or
 2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;
 - b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 12.01.C.2.a and 12.01.C.2.b is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;
 - d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;
 - e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
 - f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.
- B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

12.03 *Delays*

- A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.
- B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.
- D. Owner, Engineer, and their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.
- E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

ARTICLE 13 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 Notice of Defects

- A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. Defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 Access to Work

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

13.03 Tests and Inspections

- A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.
- B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:
 - 1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;
 - 2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in Paragraph 13.04.C; and
 - 3. as otherwise specifically provided in the Contract Documents.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.

- E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation.
- F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.04 *Uncovering Work*

- A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.
- B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.
- C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.
- D. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.05 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 *Correction or Removal of Defective Work*

- A. Promptly after receipt of written notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers,

architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

- B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.07 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
1. repair such defective land or areas; or
 2. correct such defective Work; or
 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.
- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.
- E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

13.08 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and for the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.09 *Owner May Correct Defective Work*

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, correct, or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.
- C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 Schedule of Values

- A. The Schedule of Values established as provided in Paragraph 2.07.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.02 Progress Payments

A. Applications for Payments:

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.
2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

B. Review of Applications:

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's

review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

- a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
- a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
- a. to supervise, direct, or control the Work, or
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
 - d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:

- a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;
- b. the Contract Price has been reduced by Change Orders;
- c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or
- d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. *Payment Becomes Due:*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

D. *Reduction in Payment:*

1. Owner may refuse to make payment of the full amount recommended by Engineer because:
 - a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;
 - b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
 - c. there are other items entitling Owner to a set-off against the amount recommended; or
 - d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.
2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor remedies the reasons for such action.
3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1 and subject to interest as provided in the Agreement.

14.03 *Contractor's Warranty of Title*

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

14.04 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the tentative certificate to Owner, notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will, within said 14 days, execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.
- E. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the tentative list.

14.05 *Partial Utilization*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 14.04.A through D for that part of the Work.
2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

14.06 *Final Inspection*

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.07 *Final Payment*

A. *Application for Payment:*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.
2. The final Application for Payment shall be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.6;
 - b. consent of the surety, if any, to final payment;
 - c. a list of all Claims against Owner that Contractor believes are unsettled; and

- d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

B. Engineer's Review of Application and Acceptance:

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. Payment Becomes Due:

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and will be paid by Owner to Contractor.

14.08 *Final Completion Delayed*

- A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 *Waiver of Claims*

- A. The making and acceptance of final payment will constitute:
1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and
 2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

15.01 *Owner May Suspend Work*

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will justify termination for cause:
1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);
 2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;
 3. Contractor's repeated disregard of the authority of Engineer; or
 4. Contractor's violation in any substantial way of any provisions of the Contract Documents.
- B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:
1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion);

2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere; and
 3. complete the Work as Owner may deem expedient.
- C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph, Owner shall not be required to obtain the lowest price for the Work performed.
- D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.
- E. 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 moneys due Contractor by Owner will not release Contractor from liability.
- F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B and 15.02.C.

15.03 *Owner May Terminate For Convenience*

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
1. 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;
 2. 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 and profit on such expenses;
 3. all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other

dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. reasonable expenses directly attributable to termination.

B. 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.

15.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

ARTICLE 16 – DISPUTE RESOLUTION

16.01 *Methods and Procedures*

A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.

B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:

1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions; or

2. agrees with the other party to submit the Claim to another dispute resolution process; or
3. gives written notice to the other party of the intent to submit the Claim to a court of competent jurisdiction.

ARTICLE 17 – MISCELLANEOUS

17.01 *Giving Notice*

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:
 1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended; or
 2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 *Computation of Times*

- A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.03 *Cumulative Remedies*

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this Paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

17.04 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

17.05 *Controlling Law*

- A. This Contract is to be governed by the law of the state in which the Project is located.

17.06 *Headings*

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

SECTION 00800

SUPPLEMENTARY CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract (ACEC/NSPE/ASCE) Document No. C-700, 2007 edition) and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect. Where conflicts exist between these Supplementary Conditions and the FDEP Supplementary Conditions, the FDEP Supplementary Conditions shall govern.

SC-1.01 The terms used in these Supplementary Conditions which are defined in the Standard General Conditions of the Construction Contract (No. C-700, 2007 Edition) have the meanings assigned to them in the Standard General Conditions.

SC-1.01.12 Delete the definition of "Contract Documents" in Article 1 of the General Conditions. "Contract Documents" are the documents enumerated in Article 8 of the Agreement.

SC-1.01.44 Delete the definition of Substantial Completion and insert the following in its place:

Substantial Completion - The Work (or a specified part thereof) has progressed to the point where, in the opinion of the ENGINEER as evidenced by ENGINEER's definitive certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents and that all conditions precedent to Substantial Completion have been met in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to any Work refer to Substantial Completion thereof.

Add the following definitions:

SC-1.01.52 Compensable Delay - Any delay beyond the control and without the fault or negligence of the CONTRACTOR resulting from OWNER-caused changes in the Work, differing site conditions, suspensions of the Work, or termination for convenience by the OWNER.

SC-1.01.53 Correction Period - The time during which the CONTRACTOR must correct defective Work or remove defective Work from the site and replace it with non-defective Work, all at no cost to the OWNER, pursuant to paragraph 13.07 of the General Conditions, as supplemented.

- SC-1.01.54 Final Completion - The date upon which the final payment is due to be paid by OWNER to CONTRACTOR.
- SC-1.01.55 Excusable Delay - Any delay beyond the control and without the fault or negligence of the CONTRACTOR, the OWNER, or any other contractor caused by events or circumstances such as, but not limited to, acts of God or of the public enemy, acts of interveners, acts of the government, fires, floods, epidemics, quarantine restrictions, freight embargoes, and hurricanes, tornadoes, or new sink holes. Labor disputes and above average rainfall shall give rise only to Inexcusable Delays.
- SC-1.01.56 Float or Slack Time - The time available in the progress schedule during which an unexpected activity can be completed without delaying the Substantial Completion of the Work.
- SC-1.01.57 Inexcusable Delay - Any delay caused either (i) by events or circumstances within the control of the CONTRACTOR, such as inadequate crewing, slow submittals, etc., which might have been avoided by the exercise of care, prudence, foresight, or diligence on the part of the CONTRACTOR, (ii) by weather conditions (other than hurricanes and tornadoes) or (iii) labor disputes.
- SC-1.01.58 Nonprejudicial Delay - Any delay impacting a portion of the Work within the available total Float or Slack Time, as that term is used in Section 01310: Progress Schedules and not necessarily preventing completion of the Work within the Contract Time.
- SC-1.01.59 Prejudicial Delay - Any Excusable or Compensable Delay impacting the Work and exceeding the total Float Time available in the progress schedule, thus preventing completion of the Work within the Contract Time unless the Work is accelerated.
- SC-1.01.60 Preoperational Testing (Check-Out-Testing) - All field inspections, installation checks, water tests, performance tests, and necessary corrections required of the CONTRACTOR as a condition or conditions to achieving Substantial Completion to demonstrate to the OWNER and ENGINEER that individual components of the Work have been properly constructed and operate in accordance with the Contract Documents for their intended purposes.
- SC-1.01.61 Start-Up Testing (Demonstration Testing) - A predefined trial period required as a condition to Substantial Completion during which CONTRACTOR is to operate the entire Work (or any part thereof agreed to by the OWNER) under actual and simulated operating conditions for the purpose (i) of making such minor adjustments and changes to the Work as may be necessary for the Work

to comply with the Contract Documents and (ii) of complying with the final test requirements in the Contract Documents.

SC-2.02 Delete paragraph 2.02 of the General Conditions in its entirety and insert the following in its place:

2.2.1 After the Agreement has been executed, the CONTRACTOR will be furnished one (1) complete set of reproducible Drawings (24 x 36) and one (1) reproducible copy of the Project Manual (Contract Requirements and Specifications) and all addenda.

2.2.2 The CONTRACTOR shall furnish each of the Subcontractors, Suppliers, Permitting Agencies, and others such copies of the Contract Documents as may be required for their Work. All copies of the Contract Documents shall be printed from the reproducible.

SC-2.03 Delete paragraph 2.03 of the General Conditions in its entirety and insert the following in its place.

2.03 The Contract Time will commence to run on the day indicated in the Notice to Proceed. The Notice to Proceed may be given at any time after the Effective Date of the Agreement. In no event will the Contract Time commence to run later than the sixtieth (60th) day after the Effective Date of the Agreement.

SC-2.05 Add the following immediately after subparagraph 2.05.3 of the General Conditions:

2.05.4 The submittals required in subparagraphs 2.05.1, 2.05.2 and 2.05.3 shall be as specified in Section 01310, 01340, and 01370, respectively.

SC-2.07 Delete paragraph 2.07A.2 of the General Conditions in its entirety and insert the following in its place:

2.07.A.2 CONTRACTOR'S schedule of shop drawings and sample submittals will be acceptable to ENGINEER only if it provides a minimum of thirty (30) days for reviewing and processing the submittals. Shop Drawings requiring resubmission and review shall not rise to an excusable or compensable delay.

SC-3.03 Add the following immediately after paragraph 3.03 A of the General Conditions:

3.03 B Measurements

1. When measurements are affected by conditions already established or where items have to be fitted into construction conditions, it shall be the CONTRACTOR's responsibility to verify all such dimensions at the site and the actual job dimensions shall take precedence over scale and figure dimensions on the Drawings.

2. The CONTRACTOR shall carefully study and compare all Drawings, Specifications and other instructions; shall test all figures on the Drawings before laying out the Work; shall notify the ENGINEER of all errors, inconsistencies, or omissions which he may discover; and obtain specific instructions before proceeding with the Work. The CONTRACTOR shall not take advantage of any apparent error or omissions which may be found in the Contract Documents, and the ENGINEER shall be entitled to make such corrections therein and interpretations thereof as may be deemed necessary for the fulfillment of their intent. The CONTRACTOR shall be responsible for all errors in construction which could have been avoided by such examination and notification and shall correct, at CONTRACTORS own expense, all Work improperly constructed through failure to notify the ENGINEER and request specific instructions.

3.03 B Amend paragraph 3.03 B to read 3.03 C.

SC-3.06 Add the following immediately after paragraph 3.06.C:

3.06.D The CONTRACTOR shall submit hard copies of all information required by Sections 01027, 01340 and 01730 and all forms that require the CONTRACTOR signature. Other CONTRACTOR submittals may be electronic data if approved by the ENGINEER.

SC-4.03.A.4 In the last paragraph of 4.03.A after "then CONTRACTOR shall" amend "promptly" to read "within three (3) days".

SC-4.04.B.1 In the first sentence of 4.04.B.1 amend "promptly" to read "within three (3) days".

SC-4.06.E Add the following immediately after paragraph 4.06.E of the General Conditions:

The provisions of paragraphs 4.06.A, 4.06.B, 4.06.C, 4.06.D and 4.06.E shall not apply where the Work is performed upon public lands, rights-of-way, easements or other properties of which the OWNER does not own. In such case, Contractor's sole remedy shall be an extension of contract time.

SC-4.07 Add a new paragraph immediately after paragraph 4.06 of the General Conditions which is to read as follows:

4.07 No claim of the CONTRACTOR under paragraphs 4.03, 4.04 and 4.06 shall be allowed unless, (1) the CONTRACTOR has given the notice required in the respective sub-paragraph above, and (2) within thirty (30) days (but before final payment) after the CONTRACTOR has given written notice, the CONTRACTOR submits to the OWNER a detailed claim setting forth the CONTRACTOR's right to an increase in the Contract Price or extension of the Contract Time as provided in Articles 11 and 12 of the General Conditions.

SC-5.01 Add the following immediately after paragraph 5.01 C of the General Conditions:

D. The Surety shall be rated as "A" or better as to General Policyholders Rating and Class X or better as to Financial Category by Best's Key Rating Guide, published by Alfred M. Best Company, Inc., of 75 Fulton Street, New York, New York, 10038.

E. All Surety Companies are subject to approval and may be rejected by the OWNER without cause.

F. The bonding limit of the Surety shall not exceed ten percent (10%) of the policyholder surplus (capital and surplus) as listed by the aforementioned Best's Key Rating Guide, on any one risk (penalty or amount of any one bond).

G. The Agent countersigning the bond shall be resident in the County where the Project is located and/or other counties that are acceptable to the OWNER.

SC-5.04.A The limits of liability for the insurance required by paragraph 5.04 of the General Conditions shall provide coverage for not less than the following amounts or where required by Law and Regulations.

Worker's Compensation, Employer's Liability etc., (under paragraphs 5.04.A.1 and 5.04.A.2 of the General Conditions):

- (1) State: Coverage A: Statutory
- (2) Applicable Federal: Statutory
- (3) Employer's Liability:
 - Each Accident \$ 500,000
 - Each Employee \$ 500,000
 - Disease \$ 100,000

5.04.A.3 thru 5.04.A.6 of the General Conditions which shall also include completed operations and product liability coverages and eliminate the exclusion with respect to property under the care, custody and control of Contractor:

- (1) Commercial General Liability (Bodily Injury and Property Damage single limit each occurrence): \$ 1,000,000
- (2) Umbrella Liability \$ 2,000,000
- (3) Business Automobile Liability:
 - Combined Single Limit - (Bodily Injury and Property Damage)
 - \$ 1,000,000 Each Occurrence

SC-5.04.B.1 Additional Insureds:

Owner:
City of Crestview

Engineer:
(To Be Named At A Later Date)

Crestview, FL _____

The Contractual Liability coverage required by paragraph 5.04 of the General Conditions shall provide coverage for not less than the following amounts:

- (1) Each Aggregate \$ 1,000,000
- (2) Each Occurrence (Bodily Injury and Property Damage) \$ 1,000,000

SC-5.06.A Revise paragraph 5.06.A. of the General Conditions as follows: Replace the word "Owner" with the word "CONTRACTOR" such that CONTRACTOR is required to purchase property insurance.

5.06.A.1 Name Additional Property Insureds (as previously listed).

5.06.A.2 Include coverage for hurricanes, floods, wind, and sinkholes.

5.06.A.7 Delete paragraph 5.06.A.7 in its entirety and replace with the following:

Be maintained in effect until Final Completion, unless otherwise agreed to in writing by OWNER, CONTRACTOR and ENGINEER with thirty (30) days written notice to each other additional insured to whom a certificate of insurance has been issued.

The policies of insurance required to be purchased and maintained by CONTRACTOR in accordance with this paragraph 5.06 shall comply with the requirements of GC-5.08.

SC-5.06.B Delete paragraph 5.06.B in its entirety.

SC-5.10 Delete paragraph 5.10 of the General Conditions in its entirety and insert the following in its place:

5.10 The CONTRACTOR shall maintain all insurance as required in Paragraph 5.06 for the Work and allow OWNER to occupy or use a portion or portions of the Work prior to Substantial Completion. CONTRACTOR shall make appropriate provisions with insurers providing the proper endorsements, if required. The property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

SC-6.01.B Add to the end of 6.01.B "Resident superintendent shall be fluent in English."

SC-6.02 Add the following sub-paragraphs immediately after paragraph 6.02.B of the General Conditions which are to read as follow:

6.02.B.1 Maintenance work may be performed during hours other than regular working hours. Regular working hours are defined as daylight hours between one-half hour after sunrise to one-half hour before sunset but not more than eight (8) hours per day forty (40) hours per week during weekdays. Requests to Work during other than regular working hours must be submitted to

the OWNER at least seventy-two (72) hours in advance of the period proposed for such irregular working hours and shall set forth the proposed schedule for such hours to give the OWNER ample time to arrange for its personnel to be at the site of the Work.

6.02.B.2 The OWNER will pay for charges of ENGINEER and construction observation performed during regular working hours. The CONTRACTOR shall pay for additional engineering and construction observation charges required during irregular hours which may be authorized under the provisions of paragraph SC-6.02.B.1.

6.02.B.3 The CONTRACTOR shall also pay for the costs of additional engineering charges and construction observation required during the correction of defective Work. Such additional costs incurred during irregular working hours and during the correction of defective Work, shall be subsidiary obligation of the CONTRACTOR and no extra payment shall be made by the OWNER on account of such Work.

SC-6.05 Delete the first paragraph in 6.05.A of the General Conditions in its entirety and insert the following in its place:

6.05.A ENGINEER and OWNER have no obligation to consider "or equal" items or substitutions unless such items are specifically identified in Section 00300 by CONTRACTOR at the time of bid. All "or equal" items and substitute items must be identified at the time of bid. It is the OWNER's sole prerogative to have ENGINEER review proposals, other than those identified in Section 00300, proposed by CONTRACTOR during the course of the Work. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function and quality required. Unless the specification or description contains or is followed by words "or equal" or "or approved equal" no substitution is permitted. Other items of material or equipment of other Suppliers will be reviewed by ENGINEER, with OWNER's approval, if the material or equipment is not named in Section 00300.

- SC-6.08 Add the following to the end of paragraph 6.08.A in the General Conditions:
- "The OWNER, prior to the advertisement of the Project, has applied for or has secured permits and/or licenses for the Project as referenced in Section 01065: Permits and Fees. The CONTRACTOR shall obtain and pay for all other construction permits required."
- SC-6.11.B Add the following the end of 6.11.B:
- "Contractor shall remove and dispose of waste materials, rubbish, and other debris on a weekly basis or when directed by the OWNER or ENGINEER."
- SC-6.11.C Add to the end of 6.11.C:
- "Contractor shall clean the site and the Work to the satisfaction of the OWNER."
- SC-6.11 Add a new sub-paragraph immediately after paragraph 6.11.D of the General Conditions which are to read as follows:
- 6.11.E Use of the OWNER's existing washrooms, lavatories, sanitary facilities or plumbing fixtures by the CONTRACTOR or any of its employees or Subcontractors will not be permitted.
- SC-6.13.C The Owner does not have safety programs that are specifically applicable to the Work. All safety programs associated with the Work shall be the responsibility of the Contractor.
- SC-6.13.D Replace paragraph 6.13.D with the following:
- "Contractor's duties and responsibilities for safety and protection of the Work shall continue until Final Completion and at all times during the correction period that Contractor, subcontractor, supplier, or any other individual directly or indirectly employed by any of them are on site to perform work."
- SC-6.13 Add the following paragraph 6.13.G:
- "The CONTRACTOR shall be completely responsible for any tanks, wet wells or similar structures that may become buoyant during the construction and modification operations due to the ground water or floods and before the structure is put into operation. Should there be any possibility of buoyancy of a structure, the CONTRACTOR shall take the necessary steps to prevent its buoyancy either by increasing the structures weight, by filling it with approved material or other acceptable methods. The proposed final structures have been designed against buoyancy; however, during various construction stages, methods employed by the CONTRACTOR and other conditions which

may affect the buoyancy, the CONTRACTOR shall take the necessary precautions against buoyancy. Damage to any structures due to floating or flooding shall be repaired or the structures replaced at the CONTRACTOR's expense."

SC-6.17 E.1 Add the following at the end of paragraph 6.17.E.1 in the General Conditions:

"Shop Drawings and other submittal data shall be reviewed by the ENGINEER for each original submittal and first re-submittal; thereafter, the CONTRACTOR shall reimburse OWNER for services rendered by ENGINEER for review time and other associated costs of subsequent re-submittals."

SC-6.22 Add the following new paragraphs after paragraph 6.21 of the General Conditions to read as follows:

6.22 Additional Costs: The CONTRACTOR shall reimburse the OWNER for services rendered by the ENGINEER when made necessary by the following:

6.22.1. Work damaged by fire, flood, lightning, or any other cause during construction.

6.22.2. Default by CONTRACTOR or any Subcontractor.

SC-7.01.C In the first sentence of paragraph 7.01.C, amend "promptly" to read "within three (3) days."

Amend the last sentence to read, "Contractor's failure to so report within three (3) days will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work."

SC-7.02 Delete paragraph 7.02 of the General conditions in its entirety and insert the following in its place:

7.02 The parties expressly acknowledge that the Work to be done by the CONTRACTOR under this contract may interface with the Work of other contractors. Thus, in addition to the foregoing paragraphs in this Article 7, the following provisions apply.

7.02.A The CONTRACTOR shall cooperate with all other contractors who may be performing Work on behalf of the OWNER in the vicinity of the Work to be done under this contract, and CONTRACTOR shall conduct his operation as to interfere to the least possible extent with the Work of such contractor.

7.02.B The CONTRACTOR shall promptly make good, at its own expense, any injury or damage that may be caused by it to other contractors, employees or subcontractors or suppliers thereof.

7.02.C Any difference or conflict which may arise between the CONTRACTOR and other contractors in regard to their respective Work shall be adjusted and determined by the OWNER.

7.02.D If the Work is delayed because of any acts or omissions of any other contractor, the CONTRACTOR shall have no claim against the OWNER on that account.

SC-8.06 Delete paragraph 8.06 of the General Conditions in its entirety.

SC-9.08.D Add the following sentences to the end of paragraph 9.08.D of the General Conditions:

"No action, either at law or at equity, shall be brought in connection with any such claim, dispute or other matter later than thirty (30) days after the date on which the ENGINEER has rendered such written decision in respect thereof. Failure to bring an action within said thirty (30) day period shall result in ENGINEER's decision being final and binding upon the OWNER and the CONTRACTOR. In no event may any such action be brought after the time at which instituting such proceedings would be otherwise barred by the applicable statute of limitations."

SC-10.01.C &
SC-10.01.D Add the following new paragraphs after paragraph 10.01.B of the General Conditions:

10.01.C At anytime, ENGINEER may request a quotation from CONTRACTOR for a proposed change in the Work. Within seven (7) calendar days after receipt of a request for a quotation for a proposed change, the CONTRACTOR shall submit a written and detailed proposal for an increase or decrease in the Contract Price or Contract Time for the proposed change. ENGINEER shall have twenty-one (21) calendar days after receipt of the detailed proposal to respond in writing. The proposal shall include an itemized estimate of all costs and time for performance that will result directly or indirectly from the proposed change. Unless otherwise directed, itemized estimates shall be in accordance with Articles 11 and 12 of the General Conditions and in sufficient detail to permit an analysis by ENGINEER of all material,

labor, equipment, subcontract, and overhead costs and fees and shall cover all Work involved in the change, whether such Work was deleted, added, changed, or impacted. Any amount claimed for subcontracts shall be similarly supported. Itemized schedule adjustments shall be in sufficient detail to permit an analysis of impact as required in Section 01310: Progress Schedules. Notwithstanding the request for quotation, the CONTRACTOR shall carry on the Work and maintain the progress schedule. Delays in the submittal of the written and detailed quotation will be considered a non-prejudicial delay as defined in the Supplementary Conditions.

10.01.D The adjustment in Contract Price and/or Contract Time stated in a Change Order shall comprise the total price and/or time adjustment due or owed the CONTRACTOR for the Work or changes defined in the Change Order. By executing the Change Order, the CONTRACTOR acknowledges and agrees that the stipulated price and/or time adjustments include the costs and delays for all Work contained in the Change Order, including costs and delays associated with the interruption of schedules, extended overheads, delay, acceleration and cumulative impacts or ripple effect on all other non-affected Work under this contract. Signing of the Change Order constitutes full and mutual accord and satisfaction for the adjustment in the Contract Price or Contract Time as a result of increases or decreases in costs and time of performance caused directly and indirectly from the change, subject to the current scope of the entire Work as set forth in the Contract Documents. Acceptance of the Change Order constitutes an agreement between OWNER and CONTRACTOR that the Change Order represents an equitable adjustment to the Contract Documents, and that the CONTRACTOR will waive all rights to file a claim on this Change Order after it is properly executed.

SC-10.05 Add the following new paragraphs after paragraph 10.05.F of the General Conditions:

10.05.G. This Project is a "Public Work" under Chapter 255, Florida Statutes. No liens may be filed against OWNER. Any Claimant may apply to the OWNER for a copy of this Contract and the Public Construction Bond. The Claimant shall have a right of action against the CONTRACTOR and surety for the amount due him. Such action shall not involve the OWNER in any expense claims against the CONTRACTOR or the surety are subject to timely prior notice to both the CONTRACTOR

and the Surety as specified in Section 255.05 Florida Statutes. The CONTRACTOR shall insert the following in all subcontracts hereunder.

"NOTICE: Claims for labor, materials, and supplies are not assertable against the OWNER and are subject to proper prior notice to the CONTRACTOR and the Surety pursuant to Chapter 255 of the Florida Statutes. This paragraph shall be insert in every subcontract hereunder."

SC-12.02 Delete paragraph 12.02 of the General Conditions in its entirety and insert the following in its place:

12.02.A The Contract Time may be changed only by a Change Order. Any claim for an extension or shortening in the Contract Time shall be based on written notice delivered to the OWNER and ENGINEER within fifteen (15) days from detection or the beginning of any event or circumstance giving rise to an Excusable or Compensable Delay and setting forth the general nature of the cause of delay. Within thirty (30) days of any such detection or beginning of event, the CONTRACTOR shall provide the analysis and documentation required to ascertain the facts, as specified in Section 01310: Progress Schedules and shall provide a written statement that the adjustment claimed is the entire adjustment to which the CONTRACTOR has reason to believe it is entitled as a result of the occurrence of said event. No claim by the CONTRACTOR under this provision shall be allowed unless the CONTRACTOR has given the notice and the analysis and documentation required in this paragraph, or if asserted after final payment.

12.02.B No forfeiture due to delay shall be made because of any Excusable and Prejudicial Delays in the completion of the entire Work or a specified part thereof. Any such delays shall not entitle the CONTRACTOR to any change in Contract Price. The sole remedy of the CONTRACTOR shall be an extension of the Contract Time pursuant to this Article and the provisions of Section 01310: Progress Schedules.

12.02.C No forfeiture due to delay shall be made because of any Compensable and Prejudicial Delays in the completion of the Work or a specified part thereof. Any such delays will entitle the CONTRACTOR solely to an extension of the Contract Time pursuant to this Article and the provisions of Section 01310: Progress Schedules, of the General Requirements.

- 12.02.D No extensions of Contract Time or increases in Contract Price shall be granted for Nonprejudicial Delays of any type or for Inexcusable Delays, unless otherwise agreed to by the OWNER at his sole discretion.
- SC-13.03 B Delete Paragraph 13.03.B and sub-paragraphs 13.03.B.1, 13.03.B.2 and 13.03.B.3 in their entirety and insert the following:
- 13.03.B Payment of testing and laboratory services is specified in Section 01410; Testing and Laboratory Services for inspections and tests required by the Contract Documents. In addition to the requirements specified in Section 01410, CONTRACTOR shall pay for all inspections, tests or approvals covered by paragraph 13.03.C.
- SC-13.06 Add a new paragraph 13.06.C as follows:
- "The CONTRACTOR shall not be entitled to an extension of Contract Time or increase in Contract Cost for removing or correcting defective work."
- SC-13.07.A Add a new paragraph 13.07.A.5:
- "When deemed necessary by OWNER, CONTRACTOR shall furnish and install at no cost to OWNER, such temporary equipment and material necessary to maintain functionality of the Work while defective Work is being corrected or replaced."
- SC-13.07.B Revise the first (1st) sentence of paragraph 13.07.B as follows:
- "..., or in an emergency where delay would cause risk of loss, damage, present a threat to OWNER or the public, the environmental or cause or present a threat of violation of any Laws and Regulations, OWNER may..."
- SC-14.02 Add a new paragraph 14.02.A.4 as follows:
- "Applications for payment shall be in accordance with Section 01027."
- SC-14.02 Delete subparagraph 14.02.C of the General Conditions and replace it with the following sentence:
- "Thirty (30) days after presentation of the Application for Payment to OWNER with ENGINEER's recommendation, the amount recommended will (subject to the provisions of the last sentence of paragraph 14.02.B) become due and payable by OWNER to CONTRACTOR."

SC-14.04.A Delete the first sentence of paragraph 14.04.A of the General Conditions and replace it with the following sentences:

"After all requirements of Section 01700: Contract Closeout have been met with respect to Substantial Completion, then when CONTRACTOR considers the entire Work ready for its intended use CONTRACTOR shall notify OWNER and ENGINEER in writing that the entire Work is substantially complete (except for items specifically listed by CONTRACTOR as incomplete) and request that ENGINEER issue a certificate of Substantial Completion."

SC-14.06.A Amend 14.06.A to read as follows:

"After all requirements of Section 01700: Contract Closeout have been met with respect to Final Inspection Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies. Contractor shall not request a Final Inspection until CONTRACTOR has achieved Substantial Completion."

SC-14.07.A Add the following subparagraphs after Paragraph 14.07.A.3 of the General Conditions:

14.07.A.4 Notwithstanding any provision of the Contract Documents to the contrary, the OWNER shall not be deemed to have accepted the Work or waived claims against the CONTRACTOR until (i) payment of all remaining amounts of the Contract Price as provided under Paragraph 5.3. of the Agreement, (ii) all Record Drawings, specifications, addenda, modifications and shop drawings are delivered to and accepted by the ENGINEER, and (iii) the CONTRACTOR has met all conditions of General Condition 13.07 - Correction Period.

SC-15.01 Add a new subparagraph immediately after paragraph 15.01.A of the General Conditions to read as follows:

15.01.B Notwithstanding this paragraph 15.01, if the OWNER stops Work under paragraph 13.05 or suspends the CONTRACTOR's services under paragraph 13.06 of the General Conditions, or suspends the Work or any portion thereof because of the CONTRACTOR's failure to prosecute the Work without endangering persons and property, the CONTRACTOR shall not be entitled to an extension of Contract Time or increase in Contract Price.

SC-16.01 Add a new paragraph 16.01.D as follows:

"The CONTRACTOR shall carry on the Work and maintain the progress schedule during any dispute, regardless of how resolved, unless otherwise mutually agreed in writing. Venue for any litigation, at law or equity or arbitration, shall lie exclusively in the place of the OWNER's choosing. This Contract, or any provision hereof, shall be construed and interpreted, and any litigation arising therefrom, shall be governed by the laws of the State of Florida."

SC-17.01 Add the following after paragraph 17.01.A.2:

"3. Delivered by an independent carrier than can substantiate delivery with a tracking number and name of an individual or member of the firm accepting receipt."

SC-17.07 &
SC-17.08 Add the two paragraphs immediately after paragraph 17.06 of the General Conditions which are to read as follows:

17.07 The form of all submittals, notices, change orders and other documents permitted or required to be used or transmitted under the Contract Documents shall be determined by the ENGINEER.

17.08 All representations, warranties and guarantees made in the Contract Documents shall survive final payment and termination or completion of the Agreement. Also, the obligation of the CONTRACTOR to maintain the Work until Substantial Completion shall survive final payment and termination or completion of the Agreement.

END OF SECTION

SECTION 00843

CHANGE ORDER FORM

Project: **City of Crestview
Antioch Elevated Storage Tank**

CHANGE ORDER NO. _____

DATE OF ISSUANCE: _____

CONTRACTOR: _____

EFFECTIVE DATE: _____

ENGINEER: _____

OWNER'S CONTRACT NO.: _____

The following changes are hereby made to the Contract Documents:

CHANGE IN CONTRACT PRICE:	CHANGE IN CONTRACT TIMES:
Original Contract Price \$ _____	Original Contract Times Substantial Completion: _____ Ready for final payment: _____ days or dates
Net changes from previous Change Orders No. ___ to No. ___ \$ _____	Net change from previous Change Orders No. ___ to No. ___ _____ days
Contract Price prior to this Change Order \$ _____	Contract Times prior to this Change Order Substantial Completion: _____ Ready for final payment: _____ days or dates
Net Increase (decrease) of this Change Order \$ _____	Net Increase (decrease) of this Change Order _____ days
Contract Price with all approved Change Orders \$ _____	Contract Times with all approved Change Orders Substantial Completion: _____ Ready for final payment: _____ days or dates

CHANGES ORDERED:

- I. GENERAL This change order is necessary to cover changes in the work to be performed under this Contract. The General Conditions, Supplementary Conditions, Specifications and all parts of the Project Manual listed in Article 1, Definitions, of the General Conditions apply to and govern all work under this change order.

Change Order No. _____

- II. REQUIRED CHANGES: _____

- III. JUSTIFICATION: _____

- IV. PAYMENT: _____

V. APPROVAL AND CHANGE AUTHORIZATION: _____

Acknowledgments:

The aforementioned change, and work affected thereby, is subject to all provisions of the original contract not specifically changed by this Change Order; and,

It is expressly understood and agreed that the approval of the Change Order shall have no effect on the original contract other than matters expressly provided herein.

Change Order Request by: _____

Change(s) Ordered by: _____

RECOMMENDED BY:

ACCEPTED BY:

(Engineer)

(Contractor)

By: _____
(Authorized Signature) (Date)

By: _____
(Authorized Signature) (Date)

(Title)

(Title)

APPROVED BY:

City of Crestview, Florida

(Owner)

By: _____
(Authorized Signature) (Date)

END OF SECTION

SECTION 00844

APPLICATION AND CERTIFICATE FOR PAYMENT FORM

Application No. _____ Progress _____ Final _____

Engineer's Project No.: _____

Project: **City of Crestview**
Antioch Elevated Storage Tank

Contractor: _____ Contract Date: _____

Contract for: _____

Application Date: _____ For Period Ending _____

Change Order Summary		ADDITIONS	DEDUCTIONS
Change Orders approved in previous months by OWNER TOTAL			
Approved this month			
Number	Date Approved		
TOTALS			
Net Change by Change Orders			

- 1. ORIGINAL CONTRACT SUM \$ _____
- 2. Net Change by Change Order \$ _____
- 3. CONTRACT SUM TO DATE (Line 1 and 2) \$ _____
- 4. TOTAL COMPLETED AND STORED TO DATE \$ _____
- 5. RETAINAGE: (Column I & N, Forms 00845 and 00846)
 - a. _____% of Completed Work \$ _____
 - b. _____% of Stored Material \$ _____
 - Total Retainage (Line 5a and 5b) \$ _____
- 6. TOTAL EARNED LESS RETAINAGE
(Line 4 less Line 5 Total) \$ _____
- 7. LESS PREVIOUS CERTIFICATES FOR PAYMENT
(Line 6 from prior Certificate) \$ _____
- 8. AMOUNT DUE THIS APPLICATION \$ _____
- 9. BALANCE TO FINISH, PLUS RETAINAGE
(Line 3 less Line 6) \$ _____

Contractor's Certification

The undersigned Contractor hereby swears under penalty of perjury that (1) all previous progress payments received from the Owner on account of Work performed under the contract referred to above have been applied by the undersigned to discharge in full all obligations of the undersigned incurred in connection with Work covered by prior Applications for Payment numbered 1 through _____ inclusive; and (2) all materials and equipment incorporated in said Project or otherwise listed in or covered by this Application for Payment are free and clear of all liens, claims, security interest and encumbrances; (3) all Work covered by this Application for Payment is in accordance with the Contract Documents and not defective as that term is defined in the Contract Documents.

Dated _____, 20__

(Contractor)

By: _____
(Name)

(Title)

COUNTY OF _____

STATE OF _____

Before me on this _____ day of _____, 20__, personally appeared _____, known to me, who being duly sworn, deposes and says that (s)he is the _____ of the Contractor above mentioned; that(s) he executed the above Application for Payment and statement on behalf of said Contractor; and that all of the statements contained therein are true, correct and complete.

Notary Public
My Commission Expires _____

Engineer's Recommendation

Payment of the above AMOUNT DUE THIS APPLICATION is recommended.

By: _____
(Authorized Signature)

Date: _____

Owner's Approval

By: _____

(Title)

Acct. No. _____

Date: _____

END OF SECTION

SECTION 00849

CONTRACTOR'S FINAL RELEASE OF LIEN

Before me the undersigned authority in said County and State, appeared _____ who, being first duly sworn, deposes and says that he is _____ of _____, a company and/or corporation authorized to do business under the laws of Florida, which is the Contractor on the Contract described as: City of Crestview – Antioch Elevated Storage Tank dated the _____ day of _____, 20____, that the said deponent is duly authorized to make this affidavit by resolution of the Board of Directors of said company and/or corporation; that deponent knows of his own knowledge that said Contract has been complied with in every particular by said Contractor and that all parts of the work have been approved by the Owner's Engineers; that there are no bills remaining unpaid for labor, material, or otherwise, in connection with said Contract and work, and that there are no suits pending against the undersigned as Contractor or anyone in connection with the work done and materials furnished or otherwise under said Contract. Deponent further says that the final estimate which has been submitted to the owner simultaneously with the making of the affidavit constitutes all claims and demands against the Owner on account of said Contract or otherwise, and the acceptance of the sum specified in said final estimate will operate as a full and final release and discharge of the Owner from any further claims, demands or compensation by Contractor under the above Contract. Deponent further agrees that all guarantees under this Contract shall be in full force from the date of this release as spelled out in the Contract Documents.

Sworn to and subscribed to before me this _____ day of _____, 20_____.

Notary Public

My Commission Expires _____

We, the _____ having heretofore executed a Performance Bond for the above-mentioned Contractor covered Project and Section as described above in the sum of _____ dollars (\$_____), hereby agree that the Owner may make full payment of the final estimate, including the retained percentage, to said Contractor.

It is fully understood that the granting of the right to the Owner to make payment of the final estimate to said Contractor and/or his assigns, shall in no way relieve the surety company of its obligations under its bond, as set forth in the Specifications, Contract and Bond pertaining to the above Project.

IN WITNESS WHEREOF, the _____ has caused this instrument to be executed on its behalf by its _____ and/or its duly authorized attorney in fact, and its corporate seal to be hereunto affixed, all of this _____ day of _____, A.D., 20_____.

Surety Company

Attorney in Fact

(Power of Attorney must be attached if executed by Attorney in Fact)

STATE OF FLORIDA

COUNTY OF _____

Before me the undersigned authority, personally appeared to me well known as the person described in and who executed the foregoing instrument in the name of _____ and/or _____ purpose therein expressed and that he had due and legal authority to execute the same on behalf of said _____, a corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal at _____ this _____ day of _____, 20_____.

Notary Public

END OF SECTION

**TECHNICAL
SPECIFICATIONS**

**SECTION 01 11 00
SUMMARY OF WORK**

PART 1 GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

- A. The completed Work will provide Owner with a new elevated composite water storage tank. Work includes, but is not limited to, site clearing, site grading, construction of deep pile foundation, installation of prefabricated composite water tank, installation of approximately 1550 linear feet of 10-inch PVC water main, and all other site improvements associated with this Project.
- B. Work includes interfacing new composite tank with existing Panhandle Alarm panel and existing water infrastructure. Work also includes programming and control logic associated with all improvements.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES**

PART 1 GENERAL

1.01 PROPOSAL REQUESTS

- A. Owner may, in anticipation of ordering an addition, deletion, or revision to the Work, request Contractor to prepare a detailed proposal of cost and times to perform contemplated change.
- B. Proposal request will include reference number for tracking purposes and detailed description of and reason for proposed change, and such additional information as appropriate and as may be required for Contractor to accurately estimate cost and time impact on Project.
- C. Proposal request is for information only; Contractor is neither authorized to execute proposed change nor to stop Work in progress as result of such request.
- D. Contractor's written proposal shall be transmitted to Engineer promptly, but not later than 14 days after Contractor's receipt of Owner's written request. Proposal shall remain firm for a maximum period of 45 days after receipt by Engineer.
- E. Owner's request for proposal or Contractor's failure to submit such proposal within the required time period will not justify a Claim for an adjustment in Contract Price or Contract Times (or Milestones).

1.02 CLAIMS

- A. Include, at a minimum:
 - 1. Specific references including (i) Drawing numbers, (ii) Specification section and article/paragraph number, and (iii) Submittal type, Submittal number, date reviewed, Engineer's comment, as applicable, with appropriate attachments.
 - 2. Stipulated facts and pertinent documents, including photographs and statements.
 - 3. Interpretations relied upon.
 - 4. Description of (i) nature and extent of Claim, (ii) who or what caused the situation, (iii) impact to the Work and work of others, and (iv) discussion of claimant's justification for requesting a change to price or times or both.

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5. Estimated adjustment in price claimant believes it is entitled to with full documentation and justification.
6. Requested Change in Contract Times: Include at least (i) Progress Schedule documentation showing logic diagram for request, (ii) documentation that float times available for Work have been used, and (iii) revised activity logic with durations including sub-network logic revisions, duration changes, and other interrelated schedule impacts, as appropriate.
7. Documentation as may be necessary as set forth below for Work Change Directive, and as Engineer may otherwise require.

1.03 WORK CHANGE DIRECTIVES

A. Procedures:

1. Engineer will:
 - a. Initiate, including a description of the Work involved and any attachments.
 - b. Affix signature, demonstrating Engineer's recommendation.
 - c. Transmit five copies to Owner for authorization.
2. Owner will:
 - a. Affix signature, demonstrating approval of the changes involved.
 - b. Return four copies to Engineer, who will retain one copy, send one copy to the Resident Project Representative or other field representative, and forward two copies to Contractor.
3. Upon completion of Work covered by the Work Change Directive or when final Contract Times and Contract Price are determined, Contractor shall submit documentation for inclusion in a Change Order.
4. Contractor's documentation shall include but not be limited to:
 - a. Appropriately detailed records of Work performed to enable determination of value of the Work.
 - b. Full information required to substantiate resulting change in Contract Times and Contract Price for Work. On request of Engineer, provide additional data necessary to support documentation.
 - c. Support data for Work performed on a unit price or Cost of the Work basis with additional information such as:
 - 1) Dates Work was performed, and by whom.
 - 2) Time records, wage rates paid, and equipment rental rates.
 - 3) Invoices and receipts for materials, equipment, and subcontracts, all similarly documented.

- B. Effective Date of Work Change Directive: Date of signature by Owner, unless otherwise indicated thereon.

1.04 CHANGE ORDERS

A. Procedure:

1. Engineer will prepare six copies of proposed Change Order and transmit such with Engineer's written recommendation and request to Contractor for signature.
2. Contractor shall, upon receipt, either: (i) promptly sign copies, retaining one for its file, and return remaining five copies to Engineer for Owner's signature, or (ii) return unsigned five copies with written justification for not executing Change Order.
3. Engineer will, upon receipt of Contractor signed copies, promptly forward Engineer's written recommendation and partially executed five copies for Owner's signature, or if Contractor fails to execute the Change Order, Engineer will promptly so notify Owner and transmit Contractor's justification to Owner.
4. Upon receipt of Contractor-executed Change Order, Owner will promptly either:
 - a. Execute Change Order, retaining one copy for its file and returning four copies to Engineer; or
 - b. Return to Engineer unsigned copies with written justification for not executing Change Order.
5. Upon receipt of Owner-executed Change Order, Engineer will transmit two copies to Contractor, one copy to Resident Project Representative or other field representative, and retain one copy, or if Owner fails to execute the Change Order, Engineer will promptly so notify Contractor and transmit Owner's justification to Contractor.
6. Upon receipt of Owner-executed Change Order, Contractor shall:
 - a. Perform Work covered by Change Order.
 - b. Revise Schedule of Values to adjust Contract Price and submit with next Application for Payment.
 - c. Revise Progress Schedule to reflect changes in Contract Times, if any, and to adjust times for other items of Work affected by change.
 - d. Enter changes in Project record documents after completion of change related Work.

B. In signing a Change Order, Owner and Contractor acknowledge and agree that:

1. Stipulated compensation (Contract Price or Contract Times, or both) set forth includes payment for (i) the Cost of the Work covered by the Change Order, (ii) Contractor's fee for overhead and profit, (iii) interruption of Progress Schedule, (iv) delay and impact, including cumulative impact, on other Work under the Contract Documents, and (v) extended overheads.

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2. Change Order constitutes full mutual accord and satisfaction for the change to the Work.
3. Unless otherwise stated in the Change Order, all requirements of the original Contract Documents apply to the Work covered by the Change Order.

1.05 COST OF THE WORK

- A. In determining the supplemental costs allowed, the following will apply.
- B. Rental of construction equipment and machinery and the parts thereof having a replacement value in excess of \$1,000, whether owned by Contractor or rented or leased from others, shall meet the following requirements:
 1. Full rental costs for leased equipment shall not exceed rates listed in the Rental Rate Blue Book published by Equipment Watch, as adjusted to the regional area of the Project. Owned equipment costs shall not exceed the single shift rates established in the Cost Reference Guide (CRG) published by Equipment Watch. The most recent published edition in effect at commencement of actual equipment use shall be used.
 2. Rates shall apply to equipment in good working condition. Equipment not in good condition, or larger than required, may be rejected by Engineer or accepted at reduced rates.
 3. Leased Equipment: For equipment leased or rented in arm's length transactions from outside vendors, maximum rates shall be determined by the following actual usage/Payment Category:
 - a. Less than 8 hours: Hourly rate.
 - b. 8 or more hours but less than 7 days: Daily rate.
 - c. 7 or more days but less than 30 days: Weekly rate.
 - d. 30 days or more: Monthly rate.
 4. Arm's length rental and lease transactions are those in which the firm involved in the rental or lease of equipment is not associated with, owned by, have common management, directorship, facilities and/or stockholders with the firm renting the equipment.
 5. Financial arrangements associated with rental and lease transactions that provide Contractor remuneration or discounts not visible to the Owner must be disclosed and integrated with charged rates.
 6. Leased Equipment in Use: Actual equipment use time documented by Engineer shall be the basis that equipment was on and utilized at the Project Site. In addition to the leasing rate above, equipment operational costs shall be paid at the estimated hourly operating cost rate set forth in the Rental Rate Blue Book if not already included in the lease rate. Hours of operation shall be based upon actual equipment usage to the nearest quarter hour, as recorded by Engineer.

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7. Leased Equipment, When Idle (Standby): Idle or standby equipment is equipment onsite or in transit to and from the Work Site and necessary to perform the Work under the modification, but not in actual use. Idle equipment time, as documented by Engineer, shall be paid at the leasing rate determined above, excluding operational costs.
8. Owned and Other Equipment in Use: Equipment rates for owned equipment or equipment provided in other than arm's length transaction shall not exceed the single shift total hourly costs rate developed in accordance with the CRG and as modified herein for multiple shifts. This total hourly rate will be paid for each hour the equipment actually performs work. Hours of operation shall be based upon actual equipment usage as recorded by Engineer. This rate shall represent payment in full for Contractor's direct costs.
9. Owned and Other Equipment, When Idle (Standby): Equipment necessary to be onsite to perform the Work on single shift operations, but not utilized, shall be paid for at the ownership hourly expense rate developed in accordance with the CRG, provided its presence and necessity onsite has been documented by Engineer. Payment for idle time of portions of a normal workday, in conjunction with original contract Work, will not be allowed. In no event shall idle time claimed in a day for a particular piece of equipment exceed the normal Work or shift schedule established for the Project. It is agreed that this rate shall represent payment in full for Contractor's direct costs. When Engineer determines that the equipment is not needed to continuously remain at the Work Site, payment will be limited to actual hours in use.
10. Owned and Other Equipment, Multiple Shifts: For multiple shift operations, the CRG single shift total hourly costs rate shall apply to the operating equipment during the first shift. For subsequent shifts, up to two in a 24-hour day, operating rate shall be the sum of the total hourly CRG operating cost and 60 percent of the CRG ownership and overhaul expense. Payment for idle or standby time for second and third shifts shall be 20 percent of the CRG ownership and overhaul expense.
11. When necessary to obtain owned equipment from sources beyond the Project limits, the actual cost to transfer equipment to the Site and return it to its original location will be allowed as an additional item of expense. Move-in and move-out allowances will not be made for equipment brought to the Project if the equipment is also used on original Contract or related Work.
12. If the move-out destination is not to the original location, payment for move-out will not exceed payment for move-in.

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13. If move is made by common carrier, the allowance will be the amount paid for the freight. If equipment is hauled with Contractor's own forces, rental will be allowed for the hauling unit plus the hauling unit operator's wage. If equipment is transferred under its own power, the rental will be 75 percent of the appropriate total hourly costs for the equipment, without attachments, plus the equipment operator's wage.
14. Charges for time utilized in servicing equipment to ready it for use prior to moving and similar charges will not be allowed.
15. When a breakdown occurs on any piece of owned equipment, payment shall cease for that equipment and any other owned equipment idled by the breakdown.
16. If any part of the Work is shut down by Owner, standby time will be paid during nonoperating hours if diversion of equipment to other Work is not practicable. Engineer reserves the right to cease standby time payment when an extended shutdown is anticipated.
17. If a rate has not been established in the CRG for owned equipment, Contractor may:
 - a. If approved by Engineer, use the rate of the most similar model found, considering such characteristics as manufacturer, capacity, horsepower, age, and fuel type, or
 - b. Request Equipment Watch to furnish a written response for a rate on the equipment, which shall be presented to Engineer for approval; or
 - c. Request Engineer to establish a rate.

1.06 FIELD ORDER

- A. Engineer will issue Field Orders, with three copies to Contractor.
- B. Effective date of the Field Order shall be the date of signature by Engineer, unless otherwise indicated thereon.
- C. Contractor shall acknowledge receipt by signing and returning one copy to Engineer.
- D. Field Orders will be incorporated into subsequent Change Orders, as a no-cost change to the Contract.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 29 00
PAYMENT PROCEDURES**

PART 1 GENERAL

1.01 SUBMITTALS

- A. Informational Submittals:
 - 1. Schedule of Values: Submit on Contractor's standard form.
 - 2. Application for Payment.
 - 3. Final Application for Payment.

1.02 SCHEDULE OF VALUES

- A. Prepare a separate Schedule of Values for each schedule of the Work under the Agreement.
- B. Upon request of Engineer, provide documentation to support the accuracy of the Schedule of Values.
- C. Unit Price Work: Reflect unit price quantity and price breakdown from conformed Bid Form.
- D. Lump Sum Work: List bonds and insurance premiums, mobilization, demobilization, preliminary and detailed progress schedule preparation, equipment testing, facility startup, and contract closeout separately.
- E. An unbalanced or front-end loaded schedule will not be acceptable.
- F. Summation of the complete Schedule of Values representing all the Work shall equal the Contract Price.

1.03 APPLICATION FOR PAYMENT

- A. Transmittal Summary Form: Attach one Summary Form with each detailed Application for Payment for each schedule and include Request for Payment of Materials and Equipment on Hand as applicable. Execute certification by authorized officer of Contractor.
- B. Use detailed Application for Payment Form suitable to Engineer.
- C. Provide separate form for each schedule as applicable.

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- D. Include accepted Schedule of Values for each schedule or portion of lump sum Work and the unit price breakdown for the Work to be paid on a unit priced basis.
- E. Include separate line item for each Change Order and Work Change Directive executed prior to date of submission. Provide further breakdown of such as requested by Engineer.
- F. Preparation:
 - 1. Round values to nearest dollar.
 - 2. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form(s) for each schedule as applicable, a listing of materials on hand for each schedule as applicable, and such supporting data as may be requested by Engineer.

1.04 PAYMENT

- A. Payment for all Lump Sum Work shown or specified in Contract Documents is included in the Contract Price. Payment will be based on a percentage complete basis for each line item of the accepted Schedule of Values.

1.05 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

- A. Payment will not be made for following:
 - 1. Loading, hauling, and disposing of rejected material.
 - 2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.
 - 3. Rejected loads of material, including material rejected after it has been placed by reason of failure of Contractor to conform to provisions of Contract Documents.
 - 4. Material not unloaded from transporting vehicle.
 - 5. Defective Work not accepted by Owner.
 - 6. Material remaining on hand after completion of Work.

1.06 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

- A. Partial Payment: No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings and preliminary operation and maintenance data is acceptable to Engineer.
- B. Final Payment: Will be made only for products incorporated in Work; remaining products, for which partial payments have been made, shall revert to Contractor unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 31 13
PROJECT COORDINATION**

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational:

1. Photographs:

- a. Digital Images: Submit one copy of DVD disc containing images of the existing site conditions within 5 days of being taken. Each image is to have a minimum file size of 1.4 Mb (1,400 Kb) so viewed resolution is high quality. The production of larger file sizes with higher resolution is encouraged.

1.02 UTILITY NOTIFICATION AND COORDINATION

- A. Coordinate the Work with various utilities within Project limits. Notify applicable utilities prior to commencing Work, if damage occurs, or if conflicts or emergencies arise during the Work.

1.03 WORK SEQUENCING/CONSTRAINTS

- A. Include work sequences in the Progress Schedule.
- B. Unless otherwise approved by the Owner, Contractor shall limit working hours to a period of 7 a.m. to 5 p.m., Monday through Friday, and shall not work on nationally-recognized holidays.
- C. Perform work in a manner to minimize impact to the public by following local noise ordinance requirements.

1.04 FACILITY OPERATIONS

- A. Continuous operation of Owner's facilities is of critical importance. Schedule and conduct activities to enable existing facilities to operate continuously, unless otherwise specified.
- B. Contractor shall not disturb the daily functions or activities of Antioch Elementary School without prior coordination with the City and School officials.
- C. Perform Work continuously during critical connections and changeovers, and as required to prevent interruption of Owner's operations.

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- D. When necessary, plan, design, and provide various temporary services, utilities, connections, temporary piping and heating, access, and similar items to maintain continuous operations of Owner's facility.
- E. Do not close lines, open or close valves, or take other action which would affect the operation of existing systems, except as specifically required by the Contract Documents and after authorization by Owner and Engineer. Such authorization will be considered within 48 hours after receipt of Contractor's written request.
- F. Process or Facility Shutdown:
 - 1. Provide 7 days advance written request for approval of need to shut down a process or facility to Owner and Engineer.
 - 2. Power outages will be considered upon 48 hours written request to Owner and Engineer. Describe the reason, anticipated length of time, and areas affected by the outage. Provide temporary provisions for continuous power supply to critical facility components.
- G. Do not proceed with Work affecting a facility's operation without obtaining Owner's and Engineer's advance approval of the need for and duration of such Work.

1.05 ADJACENT FACILITIES AND PROPERTIES

- A. Examination:
 - 1. After Effective Date of the Agreement and before Work at Site is started, Contractor, Engineer, and affected property owners and utility owners shall make a thorough examination of pre-existing conditions including existing buildings, structures, and other improvements in vicinity of Work, as applicable, which could be damaged by construction operations.
 - 2. Periodic reexamination shall be jointly performed to include, but not limited to, cracks in structures, settlement, leakage, and similar conditions.
- B. Documentation:
 - 1. Record and submit documentation of observations made on examination inspections in accordance with Article Construction Photographs and Article Audio-Video Recordings.
 - 2. Such documentation shall be used as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of Contractor's operations, and is for the protection of adjacent property owners, Contractor, and Owner.

1.06 CONSTRUCTION PHOTOGRAPHS

A. General:

1. Photographically document all phases of the Project including preconstruction, construction progress, and post-construction.
2. Engineer shall have right to select subject matter and vantage point from which photographs are to be taken.
3. Digital Images: No post-session electronic editing of images is allowed. Stored image shall be actual image as captured without cropping or other edits.

B. Preconstruction and Post-Construction:

1. After Effective Date of the Agreement and before Work at Site is started, and again upon issuance of Substantial Completion, take a minimum of 48 photographs of Site and property adjacent to perimeter of Site.
2. Particular emphasis shall be directed to structures both inside and outside the Site.
3. Format: Digital.

C. Construction Progress Photos:

1. Photographically demonstrate progress of construction, showing every aspect of Site and adjacent properties as well as interior and exterior of new or impacted structures.
2. Weekly: Take 24 photographs using.

D. Documentation:

1. Digital Images:
 - a. Electronic image shall have date taken embedded into image.
 - b. Archive using a commercially available photo management system that provides listing of photographs including date, keyword description, and direction of photograph.
 - c. Label each disk with Project and Owner's name, and month and year images were produced.

1.07 AUDIO-VIDEO RECORDINGS

- A. Prior to beginning the Work on Site or of a particular area of the Work, and again within 10 days following date of Substantial Completion, videograph Site and property adjacent to Site.

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- B. In the case of preconstruction recording, no work shall begin in the area prior to Engineer's review and approval of content and quality of video for that area.
- C. Particular emphasis shall be directed to physical condition of existing vegetation, structures, and pavements within pipeline alignment, and areas adjacent to and within the easement, and on Contractor storage and staging areas.
- D. Engineer shall have right to select subject matter and vantage point from which videos are to be taken.
- E. Video Format and Quality:
 - 1. DVD format, with sound.
 - 2. Video:
 - a. Produce bright, sharp, and clear images with accurate colors, free of distortion and other forms of picture imperfections.
 - b. Electronically, and accurately display the month, day, year, and time of day of the recording.
 - 3. Audio:
 - a. Audio documentation shall be done clearly, precisely, and at a moderate pace.
 - b. Indicate date, project name, and a brief description of the location of recording, including:
 - 1) Facility name.
 - 2) Street names or easements.
 - 3) Addresses of private property.
 - 4) Direction of coverage, including engineering stationing, if applicable.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CUTTING, FITTING, AND PATCHING

- A. Cut, fit, adjust, or patch Work and work of others, including excavation and backfill as required, to make Work complete.
- B. Obtain prior written authorization of Engineer before commencing Work to cut or otherwise alter:
 - 1. Structural or reinforcing steel, structural column or beam, elevated slab, trusses, or other structural member.
 - 2. Weather-resistant or moisture-resistant elements.

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3. Efficiency, maintenance, or safety of element.
 4. Work of others.
- C. Refinish surfaces to provide an even finish.
1. Refinish continuous surfaces to nearest intersection.
 2. Refinish entire assemblies.
 3. Finish restored surfaces to such planes, shapes, and textures that no transition between existing work and the Work is evident in finished surfaces.
- D. Restore existing work, Underground Facilities, and surfaces that are to remain in completed Work including concrete-embedded piping, conduit, and other utilities as specified and as shown on Drawings.
- E. Make restorations with new materials and appropriate methods as specified for new Work of similar nature; if not specified, use recommended practice of manufacturer or appropriate trade association.
- F. Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces and fill voids.
- G. Remove specimens of installed Work for testing when requested by Engineer.

END OF SECTION

**SECTION 01 31 19
PROJECT MEETINGS**

PART 1 GENERAL

1.01 GENERAL

- A. Engineer will schedule physical arrangements for meetings throughout progress of the Work, prepare meeting agenda with regular participant input and distribute with written notice of each meeting, preside at meetings, record minutes to include significant proceedings and decisions, and reproduce and distribute copies of minutes within 5 days after each meeting to participants and parties affected by meeting decisions.

1.02 PRECONSTRUCTION CONFERENCE

- A. Contractor shall be prepared to discuss the following subjects, as a minimum:
 - 1. Required schedules.
 - 2. Status of Bonds and insurance.
 - 3. Sequencing of critical path work items.
 - 4. Progress payment procedures.
 - 5. Project changes and clarification procedures.
 - 6. Use of Site, access, storage areas, security, and temporary facilities.
 - 7. Major product delivery and priorities.
 - 8. Contractor's safety plan and representative.
- B. Attendees will include:
 - 1. Owner's representatives.
 - 2. Contractor's office representative.
 - 3. Contractor's resident superintendent.
 - 4. Contractor's quality control representative.
 - 5. Subcontractors' representatives whom Contractor may desire, or Engineer may request to attend.
 - 6. Engineer's representatives.
 - 7. Others as appropriate.

1.03 PRELIMINARY SCHEDULES REVIEW MEETING

- A. As set forth in General Conditions and Section 01 32 00, Construction Progress Documentation.

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1.04 PROGRESS MEETINGS

- A. Engineer will schedule regular progress meetings at Site, conducted monthly to review the Work progress, Progress Schedule, Schedule of Submittals, Application for Payment, contract modifications, and other matters needing discussion and resolution.
- B. Attendees will include:
 - 1. Owner's representative(s), as appropriate.
 - 2. Contractor, Subcontractors, and Suppliers, as appropriate.
 - 3. Engineer's representative(s).
 - 4. Others as appropriate.

1.05 QUALITY CONTROL MEETINGS

- A. In accordance with Section 01 45 16.13, Contractor Quality Control.
- B. Scheduled by Engineer on regular basis and as necessary to review test and inspection reports, and other matters relating to quality control of the Work and work of other Contractors.
- C. Attendees will include:
 - 1. Contractor.
 - 2. Contractor's designated quality control representative.
 - 3. Subcontractors and Suppliers, as necessary.
 - 4. Engineer's representatives.

1.06 PROCESS INSTRUMENTATION AND CONTROL SYSTEMS (PICS) COORDINATION MEETINGS

- A. Engineer will schedule up to three meetings at Site, conducted to review specific requirements of PICS work.
- B. Attendees will include:
 - 1. Contractor.
 - 2. Owner.
 - 3. PICS Subcontractor/Installer.
 - 4. Engineer's representatives.

1.07 PREINSTALLATION MEETINGS

- A. When required in individual Specification sections, convene at Site prior to commencing the Work of that section.
- B. Require attendance of entities directly affecting, or affected by, the Work of that section.
- C. Notify Engineer 4 days in advance of meeting date.
- D. Provide suggested agenda to Engineer to include reviewing conditions of installation, preparation and installation or application procedures, and coordination with related Work and work of others.

1.08 FACILITY STARTUP MEETINGS

- A. Schedule and attend a minimum of three facility startup meetings. The first of such meetings shall be held prior to submitting Facility Startup Plan, as specified in Section 01 91 14, Equipment Testing and Facility Startup, and shall include preliminary discussions regarding such plan.
- B. Agenda items shall include, but not be limited to, content of Facility Startup Plan, coordination needed between various parties in attendance, and potential problems associated with startup.
- C. Attendees will include:
 - 1. Contractor.
 - 2. Contractor's designated quality control representative.
 - 3. Subcontractors and equipment manufacturer's representatives whom Contractor deems to be directly involved in facility startup.
 - 4. Engineer's representatives.
 - 5. Owner's operations personnel.
 - 6. Others as required by Contract Documents or as deemed necessary by Contractor.

1.09 OTHER MEETINGS

- A. In accordance with Contract Documents and as may be required by Owner and Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION**

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Preliminary Progress Schedule: Submit at least 7 days prior to preconstruction conference.
2. Detailed Progress Schedule:
 - a. Submit initial Detailed Progress Schedule in accordance with General Conditions.
 - b. Submit an Updated Progress Schedule at each update, in accordance with Article Detailed Progress Schedule.
3. Submit with Each Progress Schedule Submission:
 - a. Contractor's certification that Progress Schedule submission is actual schedule being used for execution of the Work.
 - b. Electronic file compatible with latest version of Microsoft Project, unless otherwise approved by Engineer.
 - c. Progress Schedule: 4 legible copies.
 - d. Narrative Progress Report: Same number of copies as specified for Progress Schedule.

1.02 PRELIMINARY PROGRESS SCHEDULE

- A. In addition to basic requirements outlined in General Conditions, show a detailed schedule, beginning with Notice to Proceed, for minimum duration of 90 days, and a summary of balance of Project through Final Completion.
- B. Show activities including, but not limited to the following:
 1. Notice to Proceed.
 2. Permits.
 3. Submittals, with review time. Contractor may use Schedule of Submittals specified in Section 01 33 00, Submittal Procedures.
 4. Early procurement activities for long lead equipment and materials.
 5. Initial Site work.
 6. Earthwork.
 7. Specified Work sequences and construction constraints.
 8. Contract Milestone and Completion Dates.
 9. Owner-furnished products delivery dates or ranges of dates.
 10. Major structural, mechanical, equipment, electrical, and instrumentation and control Work.

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11. System startup summary.
 12. Project close-out summary.
 13. Demobilization summary.
- C. Update Preliminary Progress Schedule monthly as part of progress payment process. Failure to do so may result in the Owner withholding all or part of the monthly progress payment until the Preliminary Progress Schedule is updated in a manner acceptable to Engineer.
- D. Format: In accordance with Article Progress Schedule—Bar Chart.

1.03 DETAILED PROGRESS SCHEDULE

- A. In addition to requirements of General Conditions, submit Detailed Progress Schedule beginning with Notice to Proceed and continuing through Final Completion.
- B. Show the duration and sequences of activities required for complete performance of the Work reflecting means and methods chosen by Contractor.
- C. When accepted by Engineer, Detailed Progress Schedule will replace Preliminary Progress Schedule and become Baseline Schedule. Subsequent revisions will be considered as Updated Progress Schedules.
- D. Format: In accordance with Article Progress Schedule—Bar Chart.
- E. Update monthly to reflect actual progress and occurrences to date, including weather delays.

1.04 PROGRESS SCHEDULE—BAR CHART

- A. General: Comprehensive bar chart schedule, generally as outlined in Associated General Contractors of America (AGC) 580, “Construction Project Planning and Scheduling Guidelines.” If a conflict occurs between the AGC publication and this specification, this specification shall govern.
- B. Format:
1. Unless otherwise approved, white paper, 11-inch by 17-inch sheet size.
 2. Title Block: Show name of Project and Owner, date submitted, revision or update number, and name of scheduler.
 3. Identify horizontally, across the top of the schedule, the time frame by year, month, and day.

4. Identify each activity with a unique number and a brief description of the Work associated with that activity.
 5. Legend: Describe standard and special symbols used.
- C. Contents: Identify, in chronological order, those activities reasonably required to complete the Work, including as applicable, but not limited to:
1. Obtaining permits, submittals for early product procurement, and long lead time items.
 2. Mobilization and other preliminary activities.
 3. Initial Site work.
 4. Specified Work sequences, constraints, and Milestones, including Substantial Completion date(s).
 5. Subcontract Work.
 6. Major equipment design, fabrication, factory testing, and delivery dates.
 7. Sitework.
 8. Concrete Work.
 9. Prefabricated tank installation Work.
 10. Water main Work.
 11. Instrumentation and control Work.
 12. Interfaces with Owner existing infrastructure.
 13. Other important Work for the facilities.
 14. Equipment and system startup and test activities.
 15. Project closeout and cleanup.
 16. Demobilization.

1.05 PROGRESS OF THE WORK

- A. Updated Progress Schedule shall reflect:
1. Progress of Work to within 5 working days prior to submission.
 2. Approved changes in Work scope and activities modified since submission.
 3. Delays in Submittals or resubmittals, deliveries, or Work.
 4. Adjusted or modified sequences of Work.
 5. Other identifiable changes.
 6. Revised projections of progress and completion.
 7. Report of changed logic.
- B. Produce detailed sub-schedules during Project, upon request of Owner or Engineer, to further define critical portions of the Work such as facility shutdowns.

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- C. If an activity is not completed by its latest scheduled completion date and this failure is anticipated to extend Contract Times (or Milestones), submit, within 7 days of such failure, a written statement as to how nonperformance will be corrected to return Project to acceptable current Progress Schedule. Actions by Contractor to complete the Work within Contract Times (or Milestones) will not be justification for adjustment to Contract Price or Contract Times.
- D. Owner may order Contractor to increase equipment, labor force, or working hours if Contractor fails to:
 - 1. Complete a Milestone activity by its completion date.
 - 2. Satisfactorily execute Work as necessary to prevent delay to overall completion of Project, at no additional cost to Owner.

1.06 SCHEDULE ACCEPTANCE

- A. Engineer's acceptance will demonstrate agreement that:
 - 1. Proposed schedule is accepted with respect to:
 - a. Contract Times, including Final Completion and all intermediate Milestones, are within the specified times.
 - b. Specified Work sequences and constraints are shown as specified.
 - c. Access restrictions are accurately reflected.
 - d. Startup and testing times are as specified.
 - e. Submittal review times are as specified.
 - f. Startup testing duration is as specified, and timing is acceptable.
 - 2. In all other respects, Engineer's acceptance of Contractor's schedule indicates that, in Engineer's judgment, schedule represents reasonable plan for constructing Project in accordance with the Contract Documents. Engineer's review will not make any change in Contract requirements. Lack of comment on any aspect of schedule that is not in accordance with the Contract Documents will not thereby indicate acceptance of that change, unless Contractor has explicitly called the nonconformance to Engineer's attention in submittal. Schedule remains Contractor's responsibility and Contractor retains responsibility for performing all activities, for activity durations, and for activity sequences required to construct Project in accordance with the Contract Documents.
- B. Unacceptable Preliminary Progress Schedule:
 - 1. Make requested corrections; resubmit within 10 days.
 - 2. Until acceptable to Engineer as Baseline Progress Schedule, continue review and revision process, including updating schedule on a monthly basis to reflect actual progress and occurrences to date.

- C. Unacceptable Detailed Progress Schedule:
 - 1. Make requested corrections; resubmit within 10 days.
 - 2. Until acceptable to Engineer as Baseline Progress Schedule, continue review and revision process.

1.07 ADJUSTMENT OF CONTRACT TIMES

- A. Reference General Conditions and Section 01 26 00, Contract Modification Procedures.
- B. Evaluation and reconciliation of Adjustments of Contract Times shall be based on the Updated Progress Schedule at the time of proposed adjustment or claimed delay.
- C. Schedule Contingency:
 - 1. Contingency, when used in the context of the Progress Schedule, is time between Contractor's proposed Completion Time and Contract Completion Time.
 - 2. Contingency included in Progress Schedule is a Project resource available to both Contractor and Owner to meet Contract Milestones and Contract Times. Use of Schedule contingency shall be shared to the proportionate benefit of both parties.
 - 3. Use of schedule contingency suppression techniques such as preferential sequencing and extended activity times is prohibited.
 - 4. Pursuant to Contingency sharing provisions of this specification, no time extensions will be granted, nor will delay damages be paid until a delay occurs which (i) consumes all available contingency time, and (ii) extends Work beyond the Contract Completion date.
- D. Claims Based on Contract Times:
 - 1. Where Engineer has not yet rendered formal decision on Contractor's Claim for adjustment of Contract Times, and parties are unable to agree as to amount of adjustment to be reflected in Progress Schedule, reflect an interim adjustment in the Progress Schedule as acceptable to Engineer.
 - 2. It is understood and agreed that such interim acceptance will not be binding on either Contractor or Owner, and will be made only for the purpose of continuing to schedule Work until such time as formal decision has been rendered as to an adjustment, if any, of the Contract Times.
 - 3. Revise Progress Schedule prepared thereafter in accordance with Engineer's formal decision.

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PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 33 00
SUBMITTAL PROCEDURES**

PART 1 GENERAL

1.01 DEFINITIONS

- A. Action Submittal: Written and graphic information submitted by Contractor that requires Engineer's approval.
- B. Informational Submittal: Information submitted by Contractor that requires Engineer's review and determination that submitted information is in accordance with the Conditions of the Contract.

1.02 PROCEDURES

- A. Direct submittals to Engineer at the following, unless specified otherwise.
- B. Transmittal of Submittal:
 - 1. Contractor shall:
 - a. Review each submittal and check for compliance with Contract Documents.
 - b. Stamp each submittal with uniform approval stamp before submitting to Engineer.
 - 1) Stamp to include Project name, submittal number, Specification number, Contractor's reviewer name, date of Contractor's approval, and statement certifying submittal has been reviewed, checked, and approved for compliance with Contract Documents.
 - 2) Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
 - 2. Complete, sign, and transmit with each submittal package, one Transmittal of Contractor's Submittal form attached at end of this section.
 - 3. Identify each submittal with the following:
 - a. Numbering and Tracking System:
 - 1) Sequentially number each submittal.
 - 2) Resubmission of submittal shall have original number with sequential alphabetic suffix.

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- b. Specification section and paragraph to which submittal applies.
 - c. Project title and Engineer's project number.
 - d. Date of transmittal.
 - e. Names of Contractor, Subcontractor or Supplier, and manufacturer as appropriate.
4. Identify and describe each deviation or variation from Contract Documents.
- C. Format:
1. Do not base Shop Drawings on reproductions of Contract Documents.
 2. Package submittal information by individual Specification section. Do not combine different Specification sections together in submittal package, unless otherwise directed in Specification.
 3. Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract Documents.
 4. Index with labeled tab dividers in orderly manner.
- D. Timeliness: Schedule and submit in accordance Schedule of Submittals, and requirements of individual Specification sections.
- E. Processing Time:
1. Time for review shall commence on Engineer's receipt of submittal.
 2. Engineer will act upon Contractor's submittal and transmit response to Contractor not later than 30 days after receipt, unless otherwise specified.
 3. Resubmittals will be subject to same review time.
 4. No adjustment of Contract Times or Price will be allowed as a result of delays in progress of Work caused by rejection and subsequent resubmittals.
- F. Resubmittals: Clearly identify each correction or change made.
- G. Incomplete Submittals:
1. Engineer will return entire submittal for Contractor's revision if preliminary review deems it incomplete.
 2. When any of the following are missing, submittal will be deemed incomplete:
 - a. Contractor's review stamp; completed and signed.
 - b. Transmittal of Contractor's Submittal; completed and signed.
 - c. Insufficient number of copies.

H. Submittals not required by Contract Documents:

1. Will not be reviewed and will be returned stamped “Not Subject to Review.”
2. Engineer will keep one copy and return submittal to Contractor.

1.03 ACTION SUBMITTALS

A. Prepare and submit Action Submittals required by individual Specification sections.

B. Shop Drawings:

1. Copies: Five and one reproducible, except copyrighted documents.
2. Identify and Indicate:
 - a. Applicable Contract Drawing and Detail number, products, units and assemblies, and system or equipment identification or tag numbers.
 - b. Equipment and Component Title: Identical to title shown on Drawings.
 - c. Critical field dimensions and relationships to other critical features of Work. Note dimensions established by field measurement.
 - d. Project-specific information drawn accurately to scale.
3. Manufacturer’s standard schematic drawings and diagrams as follows:
 - a. Modify to delete information that is not applicable to the Work.
 - b. Supplement standard information to provide information specifically applicable to the Work.
4. Product Data: Provide as specified in individual specifications.
5. Foreign Manufacturers: When proposed, include names and addresses of at least two companies that maintain technical service representatives close to Project.

C. Action Submittal Dispositions: Engineer will review, comment, stamp, and distribute as noted:

1. Approved:
 - a. Contractor may incorporate product(s) or implement Work covered by submittal.
 - b. Distribution:
 - 1) One copy furnished Resident Project Representative.
 - 2) One copy retained in Engineer’s file.
 - 3) Remaining copies returned to Contractor appropriately annotated.

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2. Approved as Noted:
 - a. Contractor may incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
 - b. Distribution:
 - 1) One copy furnished Resident Project Representative.
 - 2) One copy retained in Engineer's file.
 - 3) Remaining copies returned to Contractor appropriately annotated.
3. Partial Approval, Resubmit as Noted:
 - a. Make corrections or obtain missing portions, and resubmit.
 - b. Except for portions indicated, Contractor may begin to incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
 - c. Distribution:
 - 1) One copy furnished Resident Project Representative.
 - 2) One copy retained in Engineer's file.
 - 3) Remaining copies returned to Contractor appropriately annotated.
4. Revise and Resubmit:
 - a. Contractor may not incorporate product(s) or implement Work covered by submittal.
 - b. Distribution:
 - 1) One copy furnished Resident Project Representative.
 - 2) One copy retained in Engineer's file.
 - 3) Remaining copies returned to Contractor appropriately annotated.

1.04 INFORMATIONAL SUBMITTALS

A. General:

1. Copies: Submit three copies, unless otherwise indicated in individual Specification section.
2. Refer to individual Specification sections for specific submittal requirements.
3. Engineer will review each submittal. If submittal meets conditions of the Contract, Engineer will forward copy to appropriate parties. If Engineer determines submittal does not meet conditions of the Contract and is therefore considered unacceptable, Engineer will retain one copy and return remaining copy with review comments to Contractor, and require that submittal be corrected and resubmitted.

- B. Certificates:
1. General:
 - a. Provide notarized statement that includes signature of entity responsible for preparing certification.
 - b. Signed by officer or other individual authorized to sign documents on behalf of that entity.
 2. Welding: In accordance with individual specification sections.
 3. Installer: Prepare written statements on manufacturer's letterhead certifying installer complies with requirements as specified in individual Specification section.
 4. Material Test: Prepared by qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
 5. Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency or specified in individual specification sections.
 6. Manufacturer's Certificate of Proper Installation: In accordance with Section 01 43 33, Manufacturers' Field Services.
- C. Construction Photographs and Video In accordance with Section 01 31 13, Project Coordination, and as may otherwise be required in Contract Documents.
- D. Closeout Submittals: In accordance with Section 01 77 00, Closeout Procedures.
- E. Contractor-design Data (related to temporary construction):
1. Written and graphic information.
 2. List of assumptions.
 3. List of performance and design criteria.
 4. Summary of loads or load diagram, if applicable.
 5. Calculations.
 6. List of applicable codes and regulations.
 7. Name and version of software.
 8. Information requested in individual Specification section.
- F. Manufacturer's Instructions: Written or published information that documents manufacturer's recommendations, guidelines, and procedures in accordance with individual Specification section.

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- G. Operation and Maintenance Data: As required in Section 01 78 23, Operation and Maintenance Data.
- H. Payment:
 - 1. Application for Payment: In accordance with Section 01 29 00, Payment Procedures.
 - 2. Schedule of Values: In accordance with Section 01 29 00, Payment Procedures.
- I. Quality Control Documentation: As required in Section 01 29 00, Payment Procedures.
- J. Schedules:
 - 1. Schedule of Submittals: Prepare separately or in combination with Progress Schedule as specified in Section 01 33 00, Project Coordination.
 - a. Show for each, at a minimum, the following:
 - 1) Specification section number.
 - 2) Identification by numbering and tracking system as specified under Paragraph Transmittal of Submittal.
 - 3) Estimated date of submission to Engineer, including reviewing and processing time.
 - b. On a monthly basis, submit updated Schedule of Submittals to Engineer if changes have occurred or resubmittals are required.
 - 2. Progress Schedules: In accordance with Section 01 33 00, Project Coordination.
- K. Special Guarantee: Supplier's written guarantee as required in individual Specification sections.
- L. Statement of Qualification: Evidence of qualification, certification, or registration as required in Contract Documents to verify qualifications of professional land surveyor, engineer, materials testing laboratory, specialty Subcontractor, trade, Specialist, consultant, installer, and other professionals.
- M. Submittals Required by Laws, Regulations, and Governing Agencies:
 - 1. Promptly submit promptly notifications, reports, certifications, payrolls, and otherwise as may be required, directly to the applicable federal, state, or local governing agency or their representative.
 - 2. Transmit to Engineer for Owner's records one copy of correspondence and transmittals (to include enclosures and attachments) between Contractor and governing agency.

N. Test, Evaluation, and Inspection Reports:

1. General: Shall contain signature of person responsible for test or report.
2. Factory:
 - a. Identification of product and specification section, type of inspection or test with referenced standard or code.
 - b. Date of test, Project title and number, and name and signature of authorized person.
 - c. Test results.
 - d. If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
 - e. Provide interpretation of test results, when requested by Engineer.
 - f. Other items as identified in individual Specification sections.
3. Field:
 - a. As a minimum, include the following:
 - 1) Project title and number.
 - 2) Date and time.
 - 3) Record of temperature and weather conditions.
 - 4) Identification of product and specification section.
 - 5) Type and location of test, Sample, or inspection, including referenced standard or code.
 - 6) Date issued, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector.
 - 7) If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
 - 8) Provide interpretation of test results, when requested by Engineer.
 - 9) Other items as identified in individual Specification sections.

O. Testing and Startup Data: In accordance with Section 01 91 14, Equipment Testing and Facility Startup.

P. Training Data: In accordance with Section 01 43 33, Manufacturers' Field Services.

1.05 SUPPLEMENTS

A. The supplement listed below, following "End of Section", is part of this Specification.

1. Forms: Transmittal of Contractor's Submittal.

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PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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<p>TRANSMITTAL OF CONTRACTOR'S SUBMITTAL (ATTACH TO EACH SUBMITTAL)</p>			
DATE: _____			
<p>TO: _____ _____ _____ _____</p> <p>FROM: _____ Contractor _____ _____</p>	<p>Submittal No.: _____</p> <p><input type="checkbox"/> New Submittal <input type="checkbox"/> Resubmittal</p> <p>Project: _____</p> <p>Project No.: _____</p> <p>Specification Section No.: _____ (Cover only one section with each transmittal)</p> <p>Schedule Date of Submittal: _____</p>		
SUBMITTAL TYPE:	<input type="checkbox"/> Shop Drawing	<input type="checkbox"/> Sample	<input type="checkbox"/> Informational
	<input type="checkbox"/> Deferred		

The following items are hereby submitted:

Number of Copies	Description of Item Submitted (Type, Size, Model Number, Etc.)	Spec. and Para. No.	Drawing or Brochure Number	Contains Variation to Contract	
				No	Yes

Contractor hereby certifies that (i) Contractor has complied with the requirements of Contract Documents in preparation, review, and submission of designated Submittal and (ii) the Submittal is complete and in accordance with the Contract Documents and requirements of laws and regulations and governing agencies.

By: _____
Contractor (Authorized Signature)

SECTION 01 42 13
ABBREVIATIONS AND ACRONYMS

PART 1 GENERAL

1.01 REFERENCE TO STANDARDS AND SPECIFICATIONS OF TECHNICAL SOCIETIES

- A. Reference to standards and specifications of technical societies and reporting and resolving discrepancies associated therewith shall be as provided in Article 3 of the General Conditions, and as may otherwise be required herein and in the individual Specification sections.
- B. Work specified by reference to published standard or specification of government agency, technical association, trade association, professional society or institute, testing agency, or other organization shall meet requirements or surpass minimum standards of quality for materials and workmanship established by designated standard or specification.
- C. Where so specified, products or workmanship shall also meet or exceed additional prescriptive or performance requirements included within Contract Documents to establish a higher or more stringent standard of quality than required by referenced standard.
- D. Where two or more standards are specified to establish quality, product and workmanship shall meet or exceed requirements of most stringent.
- E. Where both a standard and a brand name are specified for a product in Contract Documents, proprietary product named shall meet or exceed requirements of specified reference standard.
- F. Copies of standards and specifications of technical societies:
 - 1. Copies of applicable referenced standards have not been bound in these Contract Documents.
 - 2. Where copies of standards are needed by Contractor, obtain a copy or copies directly from publication source and maintain in an orderly manner at the Site as Work Site records, available to Contractor's personnel, Subcontractors, Owner, and Engineer.

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1.02 ABBREVIATIONS

A. Abbreviations for trade organizations and government agencies: Following is a list of construction industry organizations and government agencies to which references may be made in the Contract Documents, with abbreviations used.

1.	AA	Aluminum Association
2.	AABC	Associated Air Balance Council
3.	AAMA	American Architectural Manufacturers Association
4.	AASHTO	American Association of State Highway and Transportation Officials
5.	ABMA	American Bearing Manufacturers' Association
6.	ACI	American Concrete Institute
7.	AEIC	Association of Edison Illuminating Companies
8.	AGA	American Gas Association
9.	AGMA	American Gear Manufacturers' Association
10.	AI	Asphalt Institute
11.	AISC	American Institute of Steel Construction
12.	AISI	American Iron and Steel Institute
13.	AITC	American Institute of Timber Construction
14.	ALS	American Lumber Standards
15.	AMCA	Air Movement and Control Association
16.	ANSI	American National Standards Institute
17.	APA	APA – The Engineered Wood Association
18.	API	American Petroleum Institute
19.	APWA	American Public Works Association
20.	AHRI	Air-Conditioning, Heating, and Refrigeration Institute
21.	ASA	Acoustical Society of America
22.	ASABE	American Society of Agricultural and Biological Engineers
23.	ASCE	American Society of Civil Engineers
24.	ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
25.	ASME	American Society of Mechanical Engineers
26.	ASNT	American Society for Nondestructive Testing
27.	ASSE	American Society of Sanitary Engineering
28.	ASTM	ASTM International
29.	AWI	Architectural Woodwork Institute
30.	AWPA	American Wood Preservers' Association
31.	AWPI	American Wood Preservers' Institute
32.	AWS	American Welding Society
33.	AWWA	American Water Works Association
34.	BHMA	Builders Hardware Manufacturers' Association

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35.	CBM	Certified Ballast Manufacturer
36.	CDA	Copper Development Association
37.	CGA	Compressed Gas Association
38.	CISPI	Cast Iron Soil Pipe Institute
39.	CMAA	Crane Manufacturers' Association of America
40.	CRSI	Concrete Reinforcing Steel Institute
41.	CS	Commercial Standard
42.	CSA	Canadian Standards Association
43.	CSI	Construction Specifications Institute
44.	DIN	Deutsches Institut für Normung e.V.
45.	DIPRA	Ductile Iron Pipe Research Association
46.	EIA	Electronic Industries Alliance
47.	EJCDC	Engineers Joint Contract Documents' Committee
48.	ETL	Electrical Test Laboratories
49.	FAA	Federal Aviation Administration
50.	FCC	Federal Communications Commission
51.	FDA	Food and Drug Administration
52.	FDOT	Florida Department of Transportation
53.	FEMA	Federal Emergency Management Agency
54.	FIPS	Federal Information Processing Standards
55.	FM	FM Global
56.	Fed. Spec.	Federal Specifications (FAA Specifications)
57.	FS	Federal Specifications and Standards (Technical Specifications)
58.	GA	Gypsum Association
59.	GANA	Glass Association of North America
60.	HI	Hydraulic Institute
61.	HMI	Hoist Manufacturers' Institute
62.	IBC	International Building Code
63.	ICBO	International Conference of Building Officials
64.	ICC	International Code Council
65.	ICEA	Insulated Cable Engineers' Association
66.	IFC	International Fire Code
67.	IEEE	Institute of Electrical and Electronics Engineers, Inc.
68.	IESNA	Illuminating Engineering Society of North America
69.	IFI	Industrial Fasteners Institute
70.	IGMA	Insulating Glass Manufacturer's Alliance
71.	IMC	International Mechanical Code
72.	INDA	Association of the Nonwoven Fabrics Industry
73.	IPC	International Plumbing Code
74.	ISA	International Society of Automation
75.	ISO	International Organization for Standardization

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76.	ITL	Independent Testing Laboratory
77.	JIC	Joint Industry Conferences of Hydraulic Manufacturers
78.	MIA	Marble Institute of America
79.	MIL	Military Specifications
80.	MMA	Monorail Manufacturers' Association
81.	MSS	Manufacturer's Standardization Society
82.	NAAMM	National Association of Architectural Metal Manufacturers
83.	NACE	NACE International
84.	NBGQA	National Building Granite Quarries Association
85.	NEBB	National Environmental Balancing Bureau
86.	NEC	National Electrical Code
87.	NECA	National Electrical Contractor's Association
88.	NEMA	National Electrical Manufacturers' Association
89.	NESC	National Electrical Safety Code
90.	NETA	InterNational Electrical Testing Association
91.	NFPA	National Fire Protection Association
92.	NHLA	National Hardwood Lumber Association
93.	NICET	National Institute for Certification in Engineering Technologies
94.	NIST	National Institute of Standards and Technology
95.	NRCA	National Roofing Contractors Association
96.	NRTL	Nationally Recognized Testing Laboratories
97.	NSF	NSF International
98.	NSPE	National Society of Professional Engineers
99.	NTMA	National Terrazzo and Mosaic Association
100.	NWWDA	National Wood Window and Door Association
101.	OSHA	Occupational Safety and Health Act (both Federal and State)
102.	PCI	Precast/Prestressed Concrete Institute
103.	PEI	Porcelain Enamel Institute
104.	PPI	Plastic Pipe Institute
105.	PS	Product Standards Section-U.S. Department of Commerce
106.	RMA	Rubber Manufacturers' Association
107.	RUS	Rural Utilities Service
108.	SAE	SAE International
109.	SDI	Steel Deck Institute
110.	SDI	Steel Door Institute
111.	SJI	Steel Joist Institute
112.	SMACNA	Sheet Metal and Air Conditioning Contractors National Association
113.	SPI	Society of the Plastics Industry
114.	SSPC	The Society for Protective Coatings

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115. STI/SPFA	Steel Tank Institute/Steel Plate Fabricators Association
116. SWI	Steel Window Institute
117. TEMA	Tubular Exchanger Manufacturers' Association
118. TCA	Tile Council of North America
119. TIA	Telecommunications Industry Association
120. UBC	Uniform Building Code
121. UFC	Uniform Fire Code
122. UL	Underwriters Laboratories Inc.
123. UMC	Uniform Mechanical Code
124. USBR	U.S. Bureau of Reclamation
125. WCLIB	West Coast Lumber Inspection Bureau
126. WI	Wood Institute
127. WWPA	Western Wood Products Association

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 43 33
MANUFACTURERS' FIELD SERVICES**

PART 1 GENERAL

1.01 DEFINITIONS

- A. Person-Day: One person for 8 hours within regular Contractor working hours.

1.02 SUBMITTALS

- A. Informational Submittals:
 - 1. Training Schedule: Submit, in accordance with requirements of this Specification, not less than 21 days prior to start of equipment installation and revise as necessary for acceptance.

1.03 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

- A. Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system, with full authority by the equipment manufacturer to issue the certifications required of the manufacturer. Additional qualifications may be specified in the individual Specification section.
- B. Representative subject to acceptance by Owner and Engineer. No substitute representatives will be allowed unless prior written approval by such has been given.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

- A. Furnish manufacturers' services, when required by an individual Specification section, to meet the requirements of this section.
- B. Where time is necessary in excess of that stated in the Specifications for manufacturers' services, or when a minimum time is not specified, time required to perform specified services shall be considered incidental.
- C. Schedule manufacturer' services to avoid conflict with other onsite testing or other manufacturers' onsite services.

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- D. Determine, before scheduling services, that conditions necessary to allow successful testing have been met.
- E. Only those days of service approved by Engineer will be credited to fulfill specified minimum services.
- F. When specified in individual specification sections, manufacturer's onsite services shall include:
 - 1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Contractor's assembly, erection, installation or application procedures.
 - 2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.
 - 3. Providing, on a daily basis, copies of manufacturers' representatives field notes and data to Engineer.
 - 4. Revisiting the Site as required to correct problems and until installation and operation are acceptable to Engineer.
 - 5. Resolution of assembly or installation problems attributable to or associated with respective manufacturer's products and systems.
 - 6. Assistance during functional and performance testing, and facility startup and evaluation.
 - 7. Training of Owner's personnel in the operation and maintenance of respective product as required.

3.02 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

- A. When so specified, a Manufacturer's Certificate of Proper Installation form, a copy of which is attached to this section, shall be completed and signed by equipment manufacturer's representative.
- B. Such form shall certify signing party is a duly authorized representative of manufacturer, is empowered by manufacturer to inspect, approve, and operate their equipment and is authorized to make recommendations required to ensure equipment is complete and operational.

3.03 TRAINING

- A. General:
 - 1. Furnish manufacturers' representatives for detailed classroom and hands-on training to Owner's personnel on operation and maintenance of specified product (system, subsystem, component) and as may be required in applicable Specifications.

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2. Furnish trained, articulate personnel to coordinate and expedite training, to be present during training coordination meetings with Owner, and familiar with operation and maintenance manual information specified in Section 01 78 23, Operation and Maintenance Data.
 3. Manufacturer's representative shall be familiar with facility operation and maintenance requirements as well as with specified equipment.
 4. Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.
- B. Post-startup Training: If required in Specifications, furnish and coordinate training of Owner's operating personnel by respective manufacturer's representatives.

3.04 SUPPLEMENTS

- A. The supplement listed below, following "End of Section," is part of this Specification.
1. Manufacturer's Certificate of Proper Installation.

END OF SECTION

MANUFACTURER’S CERTIFICATE OF PROPER INSTALLATION

OWNER _____ EQPT SERIAL NO: _____

EQPT TAG NO: _____ EQPT/SYSTEM: _____

PROJECT NO: _____ SPEC. SECTION: _____

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

- Installed in accordance with Manufacturer’s recommendations.
- Inspected, checked, and adjusted.
- Serviced with proper initial lubricants.
- Electrical and mechanical connections meet quality and safety standards.
- All applicable safety equipment has been properly installed.
- Functional tests.
- System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)

Note: Attach any performance test documentation from manufacturer.

Comments: _____

I, the undersigned Manufacturer’s Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate their equipment and (iii) authorized to make recommendations required to ensure equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20__

Manufacturer: _____

By Manufacturer’s Authorized Representative: _____
(Authorized Signature)

**SECTION 01 45 16.13
CONTRACTOR QUALITY CONTROL**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. D3740, Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
 - b. E329, Use in the Evaluation of Testing and Inspection Agencies as Used in Construction.

1.02 DEFINITIONS

- A. Contractor Quality Control (CQC): The means by which Contractor ensures that the construction, to include that performed by subcontractors and suppliers, complies with the requirements of the Contract.

1.03 SUBMITTALS

- A. Informational Submittals:
 - 1. CQC Plan: Submit, not later than 30 days after receipt of Notice to Proceed.
 - 2. CQC Report: Submit, weekly, an original and one copy in report form.

1.04 OWNER'S QUALITY ASSURANCE

- A. All Work is subject to Owner's quality assurance inspection and testing at all locations and at all reasonable times before acceptance to ensure strict compliance with the terms of the Contract Documents.
- B. Owner's quality assurance inspections and tests are for the sole benefit of Owner and do not:
 - 1. Relieve Contractor of responsibility for providing adequate quality control measures;
 - 2. Relieve Contractor of responsibility for damage to or loss of the material before acceptance;
 - 3. Constitute or imply acceptance; or
 - 4. Affect the continuing rights of Owner after acceptance of the completed Work.

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- C. The presence or absence of a quality assurance inspector does not relieve Contractor from any Contract requirement.
- D. Promptly furnish all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by Engineer.
- E. Owner may charge Contractor for any additional cost of inspection or test when:
 - 1. Work is not ready at the time specified by Contractor for inspection or test.
 - 2. when work as tested fails the required test requiring retesting.
 - 3. when prior rejection makes re-inspection or retest necessary.
 - 4. when Contractor's subsequent work after testing alters previously tested work requiring its retesting.
- F. Quality assurance inspections and tests will be performed in a manner that will not unnecessarily delay the Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Maintain an adequate inspection system and perform such inspections as will ensure that the Work conforms to the Contract Documents.
- B. Maintain complete inspection records and make them available at all times to Owner and Engineer.
- C. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product that complies with the Contract Documents. The system shall cover all construction and demolition operations, both onsite and offsite, including Work by subcontractors, fabricators, suppliers and purchasing agents, and shall be keyed to the proposed construction sequence.

3.02 COORDINATION MEETING

- A. After the Preconstruction Conference, but before start of construction, and prior to acceptance of the CQC Plan, schedule a meeting with Engineer and Owner to discuss the quality control system.
- B. Develop a mutual understanding of the system details, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite Work, and the interrelationship of Contractor's management and control with the Owner's Quality Assurance.
- C. There may be occasions when subsequent conferences may be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures that may require corrective action by Contractor.

3.03 QUALITY CONTROL ORGANIZATION

- A. CQC System Manager:
 - 1. Designate an individual within Contractor's organization who will be responsible for overall management of CQC and have the authority to act in CQC matters for the Contractor.
 - 2. CQC System Manager may perform other duties on the Project.
 - 3. CQC System Manager shall be an experienced construction person, with a minimum of 3 years construction experience on similar type Work.
 - 4. CQC System Manager shall report to the Contractor's project manager or someone higher in the organization. Project manager in this context shall mean the individual with responsibility for the overall quality and production management of the Project.
 - 5. CQC System Manager shall be onsite during construction; periods of absence may not exceed three contiguous working days at any one time.
 - 6. Identify an alternate for CQC System Manager to serve with full authority during the System Manager's absence. The requirements for the alternate will be the same as for designated CQC System Manager.
- B. Organizational Changes: Obtain Engineer's acceptance before replacing the CQC manager. Requests for changes shall include name, and qualifications of the proposed replacement.

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3.04 QUALITY CONTROL PHASING

- A. CQC shall include at least three phases of control to be conducted by CQC System Manager for all definable features of Work, as follows:
1. Preparatory Phase:
 - a. Notify Owner at least 48 hours in advance of beginning any of the required action of the preparatory phase.
 - b. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The CQC System Manager shall instruct applicable CQC staff as to the acceptable level of workmanship required in order to meet Contract requirements.
 - c. Document the results of the preparatory phase meeting by separate minutes prepared by the CQC System Manager and attached to the QC report.
 - d. Perform prior to beginning Work on each definable feature of Work:
 - 1) Review applicable Contract Specifications.
 - 2) Review applicable Contract Drawings.
 - 3) Verify that all materials and/or equipment have been tested, submitted, and approved.
 - 4) Verify that provisions have been made to provide required control inspection and testing.
 - 5) Examine the Work area to verify that all required preliminary Work has been completed and is in compliance with the Contract.
 - 6) Perform a physical examination of required materials, equipment, and sample Work to verify that they are on hand, conform to approved Shop Drawing or submitted data, and are properly stored.
 - 7) Review the appropriate activity hazard analysis to verify safety requirements are met.
 - 8) Review procedures for constructing the Work, including repetitive deficiencies.
 - 9) Document construction tolerances and workmanship standards for that phase of the Work.
 - 10) Check to verify that the plan for the Work to be performed, if so required, has been accepted by Engineer.

2. Initial Phase:
 - a. Accomplish at the beginning of a definable feature of Work:
 - 1) Notify Owner at least 48 hours in advance of beginning the initial phase.
 - 2) Perform prior to beginning Work on each definable feature of Work:
 - a) Review minutes of the preparatory meeting.
 - b) Check preliminary Work to verify compliance with Contract requirements.
 - c) Verify required control inspection and testing.
 - d) Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Comparison with sample panels is appropriate.
 - e) Resolve all differences.
 - f) Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.
 - 3) Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the QC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.
 - 4) The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.
3. Follow-up Phase:
 - a. Perform daily checks to verify continuing compliance with Contract requirements, including control testing, until completion of the particular feature of Work.
 - b. Daily checks shall be made a matter of record in the CQC documentation and shall document specific results of inspections for all features of Work for the day or shift.
 - c. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of Work that will be affected by the deficient Work. Constructing upon or concealing nonconforming Work will not be allowed.
4. Additional Preparatory and Initial Phases: Additional preparatory and initial phases may be conducted on the same definable features of Work as determined by Owner if the quality of ongoing Work is unacceptable; or if there are changes in the applicable QC staff or in the onsite production supervision or work crew; or if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

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3.05 CONTRACTOR QUALITY CONTROL PLAN

A. General:

1. Plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used.
2. An interim plan for the first 30 days of operation will be considered.
3. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of Work to be started.
4. Work outside of the features of Work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of Work to be started.

B. Content:

1. Plan shall cover the intended CQC organization for the entire Contract and shall include the following, as a minimum:
 - a. Letters of Authority: A copy of a letter to the CQC System Manager signed by an authorized official of the firm, describing the responsibilities and delegating sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop Work which is not in compliance with the Contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities and responsibilities. Copies of these letters will also be furnished to Owner.
 - b. Submittals: Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers and purchasing agents.
 - c. Testing: Control, verification and acceptance testing procedures for each specific test to include the test name, frequency, specification paragraph containing the test requirements, the personnel and laboratory responsible for each type of test, and an estimate of the number of tests required.
 - d. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests, including documentation.
 - e. Procedures for tracking deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.
 - f. Reporting procedures, including proposed reporting formats; include a copy of the CQC report form.

- C. Acceptance of Plans: Acceptance of the Contractor's basic and addendum CQC plans is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. Owner reserves the right to require Contractor to make changes in the CQC plan and operations including removal of personnel, as necessary, to obtain the quality specified.
- D. Notification of Changes: After acceptance of the CQC plan, Contractor shall notify Engineer, in writing, a minimum of 7 calendar days prior to any proposed change. Proposed changes are subject to acceptance by Engineer.

3.06 CONTRACTOR QUALITY CONTROL REPORT

- A. As a minimum, prepare a CQC report for every 7 calendar days. Account for all days throughout the life of the Contract. Reports shall be signed and dated by CQC System Manager. Include copies of test reports and copies of reports prepared by QC staff.
- B. Maintain current records of quality control operations, activities, and tests performed, including the Work of subcontractors and suppliers.
- C. Records shall be on an acceptable form and shall be a complete description of inspections, the results of inspections, daily activities, tests, and other items, including but not limited to the following:
 - 1. Contractor/subcontractor and their areas of responsibility.
 - 2. Operating plant/equipment with hours worked, idle, or down for repair.
 - 3. Work performed today, giving location, description, and by whom. When a network schedule is used, identify each phase of Work performed each day by activity number.
 - 4. Test and/or control activities performed with results and references to specifications/plan requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.
 - 5. Material received with statement as to its acceptability and storage.
 - 6. Identify submittals reviewed, with Contract reference, by whom, and action taken.
 - 7. Offsite surveillance activities, including actions taken.
 - 8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
 - 9. List instructions given/received and conflicts in Drawings and/or Specifications.
 - 10. Contractor's verification statement.

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11. Indicate a description of trades working on the Project; the number of personnel working; weather conditions encountered; and any delays encountered.
12. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in file work and workmanship comply with the Contract.

3.07 SUBMITTAL QUALITY CONTROL

- A. Submittals shall be as specified in Section 01 33 00, Submittal Procedures. The CQC organization shall be responsible for certifying that all submittals are in compliance with the Contract requirements. Owner will furnish copies of test report forms upon request by Contractor. Contractor may use other forms as approved.

3.08 TESTING QUALITY CONTROL

- A. Testing Procedure:
 1. Perform tests specified or required to verify that control measures are adequate to provide a product which conforms to Contract requirements. Perform the following activities and record the following data:
 - a. Verify testing procedures comply with contract requirements.
 - b. Verify facilities and testing equipment are available and comply with testing standards.
 - c. Check test instrument calibration data against certified standards.
 - d. Verify recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
 - e. Documentation:
 - 1) Record results of all tests taken, both passing and failing, on the CQC report for the date taken.
 - 2) Include specification paragraph reference, location where tests were taken, and the sequential control number identifying the test.
 - 3) Actual test reports may be submitted later, if approved by Engineer, with a reference to the test number and date taken.
 - 4) Provide directly to Engineer an information copy of tests performed by an offsite or commercial test facility. Test results shall be signed by an engineer registered in the state where the tests are performed.
 - 5) Failure to submit timely test reports, as stated, may result in nonpayment for related Work performed and disapproval of the test facility for this Contract.

- B. Testing Laboratories: Laboratory facilities, including personnel and equipment, utilized for testing soils, concrete, asphalt and steel shall meet criteria detailed in ASTM D3740 and ASTM E329, and be accredited by the American Association of Laboratory Accreditation (AALA), National Institute of Standards and Technology (NIST), National Voluntary Laboratory Accreditation Program (NVLAP), the American Association of State Highway and Transportation Officials (AASHTO), or other approved national accreditation authority. Personnel performing concrete testing shall be certified by the American Concrete Institute (ACI).

3.09 COMPLETION INSPECTION

- A. CQC System Manager shall conduct an inspection of the Work at the completion of all Work or any milestone established by a completion time stated in the Contract.
- B. Punchlist:
 - 1. CQC System Manager shall develop a punchlist of items which do not conform to the Contract requirements.
 - 2. Include punchlist in the CQC report, indicating the estimated date by which the deficiencies will be corrected.
 - 3. CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected and so notify the Owner.
 - 4. These inspections and any deficiency corrections required will be accomplished within the time stated for completion of the entire Work or any particular increment thereof if the Project is divided into increments by separate completion dates.

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Association of Nurserymen (AAN): American Standards for Nursery Stock.
 2. Federal Emergency Management Agency (FEMA).
 3. National Fire Prevention Association (NFPA): 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations.
 4. Telecommunications Industry Association (TIA); Electronic Industries Alliance (EIA): 568B, Commercial Building Telecommunications Cabling Standard.
 5. U.S. Department of Agriculture (USDA): Urban Hydrology for Small Watersheds.
 6. U.S. Weather Bureau: Rainfall-Frequency Atlas of the U.S. for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years.

1.02 SUBMITTALS

- A. Informational Submittals: Copies of permits and approvals for construction as required by Laws and Regulations and governing agencies.

1.03 MOBILIZATION

- A. Mobilization includes, but is not limited to, these principal items:
1. Obtaining required permits.
 2. Moving Contractor's field office and equipment required for first month operations onto Site.
 3. Installing temporary construction power, wiring, and lighting facilities.
 4. Providing onsite Internet service.
 5. Providing onsite sanitary facilities and potable water facilities as specified and as required by Laws and Regulations, and governing agencies.
 6. Arranging for and erection of Contractor's work and storage yard.
 7. Posting OSHA required notices and establishing safety programs and procedures.
 8. Having Contractor's superintendent at Site full time.

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1.04 PROTECTION OF WORK AND PROPERTY

- A. Comply with Owner's safety rules while on Owner's property.
- B. Keep Owner informed of serious onsite accidents and related claims.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 TEMPORARY UTILITIES

- A. Power: Contractor to provide means of power during construction as needed.
- B. Lighting: Provide temporary lighting to meet applicable safety requirements to allow erection, application, or installation of materials and equipment, and observation or inspection of the Work.
- C. Water:
 - 1. Hydrant Water: Is available from nearby hydrants. Secure written permission for connection and use from water department and meet requirements for use. Contractor will be responsible for installing a water meter and paying for usage.
 - 2. Provide means to prevent water used for testing from flowing back into source pipeline.
- D. Sanitary and Personnel Facilities: Provide and maintain facilities for Contractor's employees, Subcontractors, and other onsite employers' employees. Service, clean, and maintain facilities and enclosures.
- E. Fire Protection: Furnish and maintain on Site adequate firefighting equipment capable of extinguishing incipient fires. Comply with applicable parts of NFPA 241.

3.02 PROTECTION OF WORK AND PROPERTY

- A. General:
 - 1. Perform Work within right-of-way, property boundary, and easements in a systematic manner that minimizes inconvenience to property owners and the public.
 - 2. No residence or business shall be cut off from vehicular traffic without prior approval from Engineer and residence or business owner. Provide a minimum of 48 hours notice of work and will be limited to a period not to exceed 4 hours, unless special arrangements have been made.

3. Maintain in continuous service existing oil and gas pipelines, underground power, telephone or communication cable, water mains, irrigation lines, sewers, poles and overhead power, and other utilities encountered along line of the Work, unless other arrangements satisfactory to owners of said utilities have been made.
 4. Where completion of the Work requires temporary or permanent removal or relocation of existing utility, coordinate activities with owner of said utility and perform work to their satisfaction.
 5. Protect, shore, brace, support, and maintain underground pipes, conduits, drains, and other underground utility construction uncovered or otherwise affected by construction operations.
 6. Keep fire hydrants and water control valves free from obstruction and available for use at all times.
 7. In areas where Contractor's operations are adjacent to or near a utility, such as gas, telephone, television, electric power, water, sewer, or irrigation system, and such operations may cause damage or inconvenience, suspend operations until arrangements necessary for protection have been made by Contractor.
 8. Notify property owners and utility offices that may be affected by construction operation at least 2 days in advance: Before exposing a utility, obtain utility owner's permission. Should service of utility be interrupted due to Contractor's operation, notify proper authority immediately. Cooperate with said authority in restoring service as promptly as possible and bear costs incurred.
 9. Do not impair operation of existing sewer system. Prevent construction material, pavement, concrete, earth, volatile and corrosive wastes, and other debris from entering sewers, pump stations, or other sewer structures.
 10. Maintain original Site drainage wherever possible.
- B. Site Security: Provide and maintain additional temporary security fences as necessary to protect the Work and Contractor-furnished products not yet installed.
- C. Barricades and Lights:
1. Provide as required by the FDOT Vehicle Code and in sufficient quantity to safeguard public and the Work.
 2. Provide as necessary to prevent unauthorized entry to construction areas and affected roads, streets, and alleyways, inside and outside of fenced area, and as required to ensure public safety and the safety of Contractor's employees, other employer's employees, and others who may be affected by the Work.

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3. Provide to protect existing facilities and adjacent properties from potential damage.
4. Locate to enable access by facility operators and property owners.
5. Protect streets, roads, highways, and other public thoroughfares that are closed to traffic by effective barricades with acceptable warning signs.
6. Locate barricades at the nearest intersecting public thoroughfare on each side of blocked section.
7. Illuminate barricades and obstructions with warning lights from sunset to sunrise.

D. Signs and Equipment:

1. Conform to requirements of manual published by the Florida Department of Transportation.
2. Traffic Cones: Provide to delineate traffic lanes to guide and separate traffic movements.
3. ROAD CONSTRUCTION AHEAD Signs: Provide four, size 48 inches by 48 inches. Place in conspicuous locations, approximately 200 feet in advance of the Work, and facing approaching traffic.
4. Provide at obstructions, such as material piles and equipment.
5. Use to alert general public of construction hazards, which would include surface irregularities, unramped walkways, grade changes, and trenches or excavations in roadways and in other public access areas.

E. Existing Structures:

1. Where Contractor contemplates removal of small structures such as mailboxes, signposts, and culverts that interfere with Contractor's operations, obtain approval of property owner and Engineer.
2. Move mailboxes to temporary locations accessible to postal service.
3. Replace items removed in their original location and a condition equal to or better than original.

F. Waterways: Keep ditches, culverts, and natural drainages continuously free of construction materials and debris.

G. Dewatering: Construct, maintain, and operate cofferdams, channels, flume drains, sumps, pumps, or other temporary diversion and protection works. Furnish materials required, install, maintain, and operate necessary pumping and other equipment for the environmentally safe removal and disposal of water from the various parts of the Work. Maintain foundations and parts of the Work free from water.

3.03 TEMPORARY CONTROLS

- A. Noise Control: Provide acoustical barriers so noise emanating from tools or equipment will not exceed legal noise levels.
- B. Water Pollution Control:
 - 1. Divert sanitary sewage and nonstorm waste flow interfering with construction and requiring diversion to sanitary sewers. Do not cause or permit action to occur which would cause an overflow to existing waterway.
 - 2. Prior to commencing excavation and construction, obtain Engineer's agreement with detailed plans showing procedures intended to handle and dispose of sewage, groundwater, and dewatering pump discharges.
 - 3. Comply with Section 01 57 13, Temporary Erosion and Sedimentation Control, for stormwater flow and surface runoff.
 - 4. Do not dispose of volatile wastes such as mineral spirits, oil, chemicals, or paint thinner in storm or sanitary drains. Disposal of wastes into streams or waterways is prohibited. Provide acceptable containers for collection and disposal of waste materials, debris, and rubbish.
- C. Erosion, Sediment, and Flood Control: Provide, maintain, and operate temporary facilities as specified in Section 01 57 13, Temporary Erosion and Sedimentation Control, to control erosion and sediment releases, and to protect the Work and existing facilities from flooding during construction period.

3.04 STORAGE YARDS AND BUILDINGS

- A. Coordinate requirements with Section 01 31 13, Project Coordination.
- B. Temporary Storage Yards: Construct temporary storage yards for storage of products that are not subject to damage by weather conditions.
- C. Temporary Storage Buildings:
 - 1. Provide environmental control systems that meet recommendations of manufacturers of equipment and materials stored.
 - 2. Arrange or partition to provide security of contents and ready access for inspection and inventory.
 - 3. Store combustible materials (paints, solvents, fuels) in a well-ventilated and remote building meeting safety standards.

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3.05 PARKING AREAS

- A. Control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, Owner's operations, or construction operations.

3.06 VEHICULAR TRAFFIC

- A. Comply with Laws and Regulations regarding closing or restricting use of public streets or highways. No public or private road shall be closed, except by written permission of proper authority. Ensure the least possible obstruction to traffic and normal commercial pursuits.
- B. Conduct the Work to interfere as little as possible with public travel, whether vehicular or pedestrian.
- C. Whenever it is necessary to cross, close, or obstruct roads, driveways, and walks, whether public or private, provide and maintain suitable and safe bridges, detours, or other temporary expedients for accommodation of public and private travel.
- D. Road Closures: Maintain satisfactory means of exit for persons residing or having occasion to transact business along route of the Work. If it is necessary to close off roadway or alley providing sole vehicular access to property for periods greater than 2 hours, provide written notice to each owner so affected 3 days prior to such closure. In such cases, closings of up to 4 hours may be allowed. Closures of up to 10 hours may be allowed if a week's written notice is given and undue hardship does not result.
- E. Maintenance of traffic is not required if Contractor obtains written permission from Owner and tenant of private property, or from authority having jurisdiction over public property involved, to obstruct traffic at designated point.
- F. In making street crossings, do not block more than one-half the street at a time. Whenever possible, widen shoulder on opposite side to facilitate traffic flow. Provide temporary surfacing on shoulders as necessary.
- G. Maintain top of backfilled trenches before they are paved, to allow normal vehicular traffic to pass over. Provide temporary access driveways where required. Cleanup operations shall follow immediately behind backfilling.
- H. When flaggers and guards are required by regulation or when deemed necessary for safety, furnish them with approved orange wearing apparel and other regulation traffic control devices.

- I. Notify fire department and police department before closing street or portion thereof. Notify said departments when streets are again passable for emergency vehicles. Do not block off emergency vehicle access to consecutive arterial crossings or dead-end streets, in excess of 300 linear feet, without written permission from fire department. Conduct operations with the least interference to fire equipment access, and at no time prevent such access. Furnish Contractor's night emergency telephone numbers to police department.
- J. Coordinate traffic routing with that of others working in same or adjacent areas.

3.07 CLEANING DURING CONSTRUCTION

- A. In accordance with General Conditions, as may be specified in other Specification sections, and as required herein.
- B. Wet down exterior surfaces prior to sweeping to prevent blowing of dust and debris. At least weekly, sweep floors (basins, tunnels, platforms, walkways, roof surfaces), and pick up and dispose of debris.
- C. Provide approved containers for collection and disposal of waste materials, debris, and rubbish. At least weekly, dispose of such waste materials, debris, and rubbish offsite.
- D. At least weekly, brush sweep entry drive, roadways, and other streets and walkways affected by the Work and where adjacent to the Work.

END OF SECTION

SECTION 01 57 13
TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SUMMARY

- A. This section covers Work to implement structural and nonstructural Best Management Practices (BMP) to control soil erosion by wind or water and keep eroded sediments and other construction-generated pollutants from moving off project sites. Requirements described in this specification and shown on the Drawings are part of the project Temporary Erosion and Sediment Control Plan (TESC Plan) and are the minimum for all project construction sites and conditions. This Specification covers all project activities, including material sources, disposal sites, and offsite mitigation areas unless specific project activities are excluded elsewhere in this specification or in other Contract Documents controlling the Work.
- B. National Pollutant Discharge Elimination System: Comply with Federal, state, and local laws, rules and regulations, and the National Pollutant Discharge Elimination System (NPDES) Construction Stormwater Discharge Permit or Permits applicable to the project. A copy of the Project's General Construction Permit, if applicable to the Project, is available from Owner. NPDES General Construction permits are required on projects that involve disturbance of 1 acre or more with potential to discharge stormwater to surface waters.
- C. Other Regulations: A local government erosion and sediment control permit may apply and some local agency requirements may be more stringent than this specification. Adequate erosion and sediment control is essential for complying with the federal Endangered Species Act where construction runoff enters waters inhabited by protected species.

1.02 REFERENCES

- A. Activities shall conform to the Standard Specifications, and Drawings. In the event of a conflict, the more stringent requirement shall apply.
- B. The following is a list of standards that may be referenced in this section:
 - 1. American Association of State Highway and Transportation Officials (AASHTO): M252, Standard Specification for Corrugated Polyethylene Drainage Pipe.

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2. ASTM International (ASTM):
 - a. D638, Standard Test Method for Tensile Properties of Plastics.
 - b. D2974, Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.
 - c. D3776/D3776M, Standard Test Methods for Mass Per Unit Area (Weight) of Fabric.
 - d. D4355, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
 - e. D4397, Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
 - f. D4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - g. D4533, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
 - h. D4632/D4632M, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 - i. D4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile
 - j. D6241, Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.
 - k. D6459, Standard Test Method for Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Hillslopes from Rainfall-Induced Erosion.
 - l. D6460, Standard Test Method for Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Earthen Channels from Stormwater-Induced Erosion.
 - m. D6475, Standard Test Method for Measuring Mass Per Unit Area of Erosion Control Blankets.
 - n. D7322, Standard Test Method for Determination of Rolled Erosion Control Product (RECP) Ability to Encourage Seed Germination and Plant Growth Under Bench-Scale Conditions.
 - o. D7367, Standard Test Method for Determining Water Holding Capacity of Fiber Mulches for Hydraulic Planting.
3. National Weather Service:
 - a. Precipitation-Frequency of the United States by State/Territory, 2012.
 - b. Precipitation Frequency Data Server, 2012.
4. North American Weed Management Association (NAWMA).

5. U.S. Department of Agriculture, Natural Resources Conservation Service: *Urban Hydrology for Small Watersheds*; 1986. Technical Release 55.
6. U.S. Environmental Protection Agency:
 - a. Developing Your Stormwater Pollution Prevention Plan: A Guide for Construction Sites, 2007. EPA-833-R-06-004.
 - b. National Menu of BMPs, 2012.

1.03 SYSTEM DESCRIPTION

- A. Erosion and Sediment Control: Provide, maintain, and operate temporary facilities to control erosion and sediment releases during construction period.
- B. Temporary Erosion and Sediment Control Plan (Stormwater Pollution Prevention Plan):
 1. For each phase of the scheduled work, indicate on the TESC Plan all the BMPs proposed and installed for erosion and sediment control to minimize clearing, stabilize exposed soil, divert or temporarily store flows, limit runoff from exposed areas, and filter transported sediment. Include all temporary slopes, constructed for staging or other reasons, which may not have been identified in the original Contract plans. Refer to the current local jurisdiction's erosion and sediment control manual.
 2. Contractor's construction TESC Plan and implementation schedules must be prepared by a competent individual. Furnish a signed copy of the TESC Plan with individual's name, title, state certifications, and employing firm if different than Contractor's firm.
 3. Do not begin any Site activities that have potential to cause erosion or sediment movement until the TESC Plan and implementation schedules are approved by Engineer.
 4. Keep a copy of the approved TESC Plan with updated changes onsite during all construction activities. During inactive periods longer than 7 calendar days, keep the TESC Plan onsite or provide a copy to Engineer to retain.
 5. Continually update the TESC Plan and schedules as needed for unexpected storm or other events to ensure that sediment-laden water does not leave the construction site. Add approved changes to the TESC Plan no later than 24 hours after implementation.
- C. Install high visibility fence shown on the Drawings or as instructed by Engineer. Space posts and attach fence fabric to posts as shown on the Drawings. Do not fasten fence to trees. Throughout the life of the Project, preserve and protect delineated area, acting immediately to repair or restore any fencing damaged or removed.

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- D. Preventing erosion, and controlling runoff, sedimentation, and non-stormwater pollution, is the responsibility of the Contractor to perform.
- E. Engineer may require additional temporary control measures if it appears pollution or erosion may result from weather, nature of materials, or progress on the Work.
- F. Nothing in this section shall relieve Contractor from complying with other Contract requirements.

1.04 SUBMITTALS

- A. Informational Submittals:
 - 1. The TESC Plan shall cover all areas that may be affected inside and outside the limits of the Project (including all Owner-provided sources, disposal sites, and haul roads, and all nearby land, streams, and other bodies of water).
 - 2. Allow at least 5 working days for Engineer to review any original or revised TESC Plan. Failure to approve all or part of any such Plan shall not make Owner liable to Contractor for any Work delays.

PART 2 PRODUCTS

2.01 HIGH VISIBILITY FENCING PERIMETER FENCING

- A. High Visibility Fence: UV stabilized, orange, high-density polyethylene or polypropylene mesh.
- B. Height: 4 feet minimum.
- C. Support Posts: Wood or steel with sufficient strength and durability to support the fence through the life of the Project.

2.02 SILT (SEDIMENT) FENCE

- A. Reinforcing: Welded wire fabric, 14-gauge minimum with 2-inch by 4-inch mesh.
- B. Support Posts: As recommended by manufacturer of geotextile.
- C. Fasteners: Heavy-duty wire staples at least 1-inch long, tie wires, or hog rings, as recommended by manufacturer of geotextile.

PART 3 EXECUTION

3.01 PREPARATION

- A. Engineer's acceptance of the TESC Plan is required prior to starting earth disturbing activities.
- B. Include proposed stockpile areas and installation of temporary erosion control devices, ditches, or other facilities in Work phasing plans.
- C. Areas designated for Contractor's use during Project may be temporarily developed as specified to provide working, staging, and administrative areas. Include control of sediment from these areas in the TESC Plan.
- D. High Visibility Fencing: Install high visibility fencing in accordance with the Drawings and additionally as needed.

3.02 MAINTENANCE

- A. The ESCP measures described in this specification are minimum requirements for anticipated Site conditions. During the construction period, upgrade these measures as needed to comply with all applicable local, state, and federal erosion and sediment control regulations.
- B. Maintain erosion and sediment control BMPs so they properly perform their function until Engineer determines they are no longer needed.
- C. Construction activities must avoid or minimize excavation and creation of bare ground during wet weather.
- D. The intentional washing of sediment into storm sewers or drainage ways must not occur. Vacuuming or dry sweeping and material pickup must be used to cleanup released sediments.
- E. Inspect BMPs in accordance with the schedule in the Construction Stormwater Discharge Permit(s) or as directed by Engineer.
- F. Complete an inspection report within 24 hours of an inspection. Each inspection report shall be signed and identify corrective actions. Document that corrective actions are performed within 7 days of identification. Keep a copy of all inspection reports at the Site or at an easily accessible location.

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- G. Unless otherwise specified, remove deposits before the depth of accumulated sediment and debris reaches approximately height of BMP. Dispose of debris or contaminated sediment at approved locations. Clean sediments may be stabilized onsite using BMPs as approved by Engineer.
- H. Sediment Fence: Remove trapped sediment before it reaches one-third of the above ground fence height and before fence removal.
- I. Other Sediment Barriers (such as biobags): Remove sediment before it reaches 2 inches depth above ground height and before BMP removal.
- J. Catch Basins: Clean before retention capacity has been reduced by 50 percent.
- K. Sediment Basins and Sediment Traps: Remove trapped sediments before design capacity has been reduced by 50 percent and at completion of Project.
- L. Initiate repair or replacement of damaged erosion and sediment control BMPs immediately, and work completed by end of next work day. Significant replacement or repair must be completed within 7 days, unless infeasible.
- M. Within 24 hours, remediate any significant sediment that has left construction site. Investigate cause of the sediment release and implement steps to prevent a recurrence of discharge within same 24 hours. Perform in-stream cleanup of sediment according to applicable regulations.
- N. At end of each work day, stabilize or cover soil stockpiles or implement other BMPs to prevent discharges to surface waters or conveyance systems leading to surface waters.
- O. Temporarily stabilize soils at end of shift before holidays and weekends, if needed. Ensure soils are stable during rain events at all times of year.
- P. Initiate stabilization by no later than end of next work day after construction work in an area has stopped permanently or temporarily.
- Q. Within 14 days of initiating stabilization or as specified in permit, either seed or plant stabilized area (see Section 32 92 00, Turf and Grasses); or apply non-vegetative measures and cover all areas of exposed soil. Seed dry areas as soon as Site conditions allow. Ensure that vegetation covers at least 70 percent of stabilized area. In areas where Contractor's activities have compromised erosion control functions of existing grasses, overseed existing grass. Non-vegetative measures may include blown straw and a tackifier, loose straw, or an adequate covering of compost mulch. Complete initial stabilization within 7 days if storm water discharges to surface waters impaired for sediment or nutrients, or high quality waters.

- R. Provide permanent erosion control measures on all exposed areas. Do not remove temporary sediment control practices until permanent vegetation or other cover of exposed areas is established. However, do remove all temporary erosion control measures as exposed areas become stabilized, unless doing so conflicts with local requirements. Properly dispose of construction materials and waste, including sediment retained by temporary BMPs.

3.03 REMOVAL

- A. Permanently stabilize all bare and disturbed soil after removal of erosion and sediment control BMPs. Dress sediment deposits remaining after BMPs have been removed to conform to existing grade. Prepare and seed graded area. If installation and use of erosion control BMPs have compacted or otherwise rendered soil inhospitable to plant growth, such as construction entrances, take measures to rehabilitate soil to facilitate plant growth. This may include, but is not limited to, ripping the soil, incorporating soil amendments, or seeding with specified seed.

END OF SECTION

**SECTION 01 61 00
COMMON PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 DEFINITIONS

A. Products:

1. New items for incorporation in the Work, whether purchased by Contractor or Owner for the Project, or taken from previously purchased stock, and may also include existing materials or components required for reuse.
2. Includes the terms material, equipment, machinery, components, subsystem, system, hardware, software, and terms of similar intent and is not intended to change meaning of such other terms used in Contract Documents, as those terms are self-explanatory and have well recognized meanings in construction industry.
3. Items identified by manufacturer's product name, including make or model designation, indicated in manufacturer's published product literature, that is current as of the date of the Contract Documents.

1.02 DESIGN REQUIREMENTS

- A. Where Contractor design is specified, design of installation, systems, equipment, and components, including supports and anchorage, shall be in accordance with provisions as indicated in the Drawings, with the Building Code of the City of Mobile, with the Occupational Safety and Health Administration and with all other applicable state and local agency requirements.
- B. Where Contractor design is specified; installation, systems, equipment, and components shall be designed by a qualified professional Engineer registered in the State of Alabama.

1.03 ENVIRONMENTAL REQUIREMENTS

- A. Altitude: Provide materials and equipment suitable for installation and operation under rated conditions at 50 feet above sea level.
- B. Provide equipment and devices installed outdoors or in unheated enclosures capable of continuous operation within an ambient temperature range of 10 degrees F to 105 degrees F.

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1.04 PREPARATION FOR SHIPMENT

- A. When practical, factory assemble products. Mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable protective coating.
- B. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate its purchase order number, bill of lading number, contents by name, name of Project and Contractor, equipment number, and approximate weight. Include complete packing list and bill of materials with each shipment.
- C. Extra Materials, Special Tools, Test Equipment, and Expendables:
 - 1. Furnish as required by individual Specifications.
 - 2. Schedule:
 - a. Ensure that shipment and delivery occurs concurrent with shipment of associated equipment.
 - b. Transfer to Owner shall occur immediately subsequent to Contractor's acceptance of equipment from Supplier.
 - 3. Packaging and Shipment:
 - a. Package and ship extra materials and special tools to avoid damage during long term storage in original cartons insofar as possible, or in appropriately sized, hinged-cover, wood, plastic, or metal box.
 - b. Prominently displayed on each package, the following:
 - 1) Manufacturer's part nomenclature and number, consistent with Operation and Maintenance Manual identification system.
 - 2) Applicable equipment description.
 - 3) Quantity of parts in package.
 - 4) Equipment manufacturer.
 - 4. Deliver materials to site or other area as designated by the Contractor.
 - 5. Notify Engineer, Owner, and Construction Manager upon arrival for transfer of materials.
 - 6. Replace extra materials and special tools found to be damaged or otherwise inoperable at time of transfer to Owner.
- D. Request a minimum 7-day advance notice of shipment from manufacturer. Upon receipt of manufacturer's advance notice of shipment, promptly notify Engineer of anticipated date and place of delivery.
- E. Factory Test Results: Reviewed and accepted by Engineer before product shipment as required in individual Specification sections.

1.05 DELIVERY AND INSPECTION

- A. Deliver products in accordance with accepted current Progress Schedule and coordinate to avoid conflict with the Work and conditions at Site. Deliver anchor bolts and templates sufficiently early to permit setting prior to placement of structural concrete.
- B. Deliver products in undamaged condition, in manufacturer's original container or packaging, with identifying labels intact and legible. Include on label, date of manufacture and shelf life, where applicable.
- C. Unload products in accordance with manufacturer's instructions for unloading or as specified. Record receipt of products at Site. Promptly inspect for completeness and evidence of damage during shipment.
- D. Remove damaged products from Site and expedite delivery of identical new undamaged products, and remedy incomplete or lost products to provide that specified, so as not to delay progress of the Work.

1.06 HANDLING, STORAGE, AND PROTECTION

- A. Handle and store products in accordance with manufacturer's written instructions and in a manner to prevent damage. Store in approved storage yards or sheds provided in accordance with Section 01 50 00, Temporary Facilities and Controls. Provide manufacturer's recommended maintenance during storage, installation, and until products are accepted for use by Owner.
- B. Manufacturer's instructions for material requiring special handling, storage, or protection shall be provided prior to delivery of material.
- C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to ensure that products are maintained under specified conditions, and free from damage or deterioration. Keep running account of products in storage to facilitate inspection and to estimate progress payments for products delivered, but not installed in the Work.
- D. Store electrical, instrumentation, and control products, and equipment with bearings in weather-tight structures maintained above 60 degrees F. Protect electrical, instrumentation, and control products, and insulate against moisture, water, and dust damage. Connect and operate continuously space heaters furnished in electrical equipment.

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- E. Store fabricated products above ground on blocking or skids, and prevent soiling or staining. Store loose granular materials in well-drained area on solid surface to prevent mixing with foreign matter. Cover products that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.
- F. Store finished products that are ready for installation in dry and well-ventilated areas. Do not subject to extreme changes in temperature or humidity.
- G. After installation, provide coverings to protect products from damage due to traffic and construction operations. Remove coverings when no longer needed.
- H. Hazardous Materials: Prevent contamination of personnel, storage area, and Site. Meet requirements of product specification, codes, and manufacturer's instructions.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide manufacturer's standard materials suitable for service conditions, unless otherwise specified in the individual Specifications.
- B. Where product specifications include a named manufacturer, with or without model number, and also include performance requirements, named manufacturer's products must meet the performance specifications.
- C. Like items of products furnished and installed in the Work shall be end products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, manufacturer's services, and implement same or similar process instrumentation and control functions in same or similar manner.
- D. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.
- E. Provide interchangeable components of the same manufacturer, for similar components, unless otherwise specified.
- F. Equipment, Components, Systems, and Subsystems: Design and manufacture with due regard for health and safety of operation, maintenance, and accessibility, durability of parts, and shall comply with applicable OSHA, state, and local health and safety regulations.

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- G. Regulatory Requirement: Coating materials shall meet federal, state, and local requirements limiting the emission of volatile organic compounds and for worker exposure.
- H. Safety Guards: Provide for all belt or chain drives, fan blades, couplings, or other moving or rotary parts. Cover rotating part on all sides. Design for easy installation and removal. Use 16-gauge or heavier; galvanized steel, aluminum coated steel, or galvanized or aluminum coated 1/2-inch mesh expanded steel. Provide galvanized steel accessories and supports, including bolts. For outdoors application, prevent entrance of rain and dripping water.
- I. Authority Having Jurisdiction (AHJ):
 - 1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
 - 2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.
- J. Equipment Finish:
 - 1. Provide manufacturer's standard finish and color, except where specific color is indicated.
 - 2. If manufacturer has no standard color, provide equipment with finish as approved by Owner.
- K. Special Tools and Accessories: Furnish to Owner, upon acceptance of equipment, all accessories required to place each item of equipment in full operation. These accessory items include, but are not limited to, adequate oil and grease (as required for first lubrication of equipment after field testing), light bulbs, fuses, hydrant wrenches, valve keys, handwheels, chain operators, special tools, and other spare parts as required for maintenance.
- L. Lubricant: Provide initial lubricant recommended by equipment manufacturer in sufficient quantity to fill lubricant reservoirs and to replace consumption during testing, startup, and operation until final acceptance by Owner.

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- M. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 FABRICATION AND MANUFACTURE

A. General:

1. Manufacture parts to U.S.A. standard sizes and gauges.
2. Two or more items of the same type shall be identical, by the same manufacturer, and interchangeable.
3. Design structural members for anticipated shock and vibratory loads.
4. Use 1/4-inch minimum thickness for steel that will be submerged, wholly or partially, during normal operation.
5. Modify standard products as necessary to meet performance Specifications.

B. Lubrication System:

1. Require no more than weekly attention during continuous operation.
2. Convenient and accessible; oil drains with bronze or stainless steel valves and fill-plugs easily accessible from the normal operating area or platform. Locate drains to allow convenient collection of oil during oil changes without removing equipment from its installed position.
3. Provide constant-level oilers or oil level indicators for oil lubrication systems.
4. For grease type bearings, which are not easily accessible, provide and install stainless steel tubing; protect and extend tubing to convenient location with suitable grease fitting.

2.03 SOURCE QUALITY CONTROL

- A. Where Specifications call for factory testing to be witnessed by Engineer, notify Engineer not less than 14 days prior to scheduled test date, unless otherwise specified.

- B. Calibration Instruments: Bear the seal of a reputable laboratory certifying instrument has been calibrated within the previous 12 months to a standard endorsed by the National Institute of Standards and Technology (NIST).
- C. Factory Tests: Perform in accordance with accepted test procedures and document successful completion.

PART 3 EXECUTION

3.01 INSPECTION

- A. Inspect materials and equipment for signs of pitting, rust decay, or other deleterious effects of storage. Do not install material or equipment showing such effects. Remove damaged material or equipment from the Site and expedite delivery of identical new material or equipment. Delays to the Work resulting from material or equipment damage that necessitates procurement of new products will be considered delays within Contractor's control.

3.02 MANUFACTURER'S CERTIFICATE OF COMPLIANCE

- A. With all manufactured components, a Manufacturer's Certificate of Compliance, a copy of which is attached to this section, shall be completed in full, signed by entity supplying the product, material, or service, and submitted prior to shipment of product or material or execution of the services.
- B. Engineer may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.
- C. Such form shall certify proposed product, material, or service complies with that specified. Attach supporting reference data, affidavits, and certifications as appropriate.
- D. May reflect recent or previous test results on material or product, if acceptable to Engineer.

3.03 INSTALLATION

- A. Equipment Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.
- B. No shimming between machined surfaces is allowed.
- C. Install the Work in accordance with NECA Standard of Installation, unless otherwise specified.

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- D. Repaint painted surfaces that are damaged prior to equipment acceptance.
- E. Do not cut or notch any structural member or building surface without specific approval of Engineer.
- F. Handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's instructions, and as may be specified. Retain a copy of manufacturers' instruction at Site, available for review at all times.
- G. For material and equipment specifically indicated or specified to be reused in the Work:
 - 1. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
 - 2. Arrange for transportation, storage, and handling of products that require offsite storage, restoration, or renovation. Include costs for such Work in the Contract Price.

3.04 FIELD FINISHING

- A. In accordance with Section 09 90 00, Painting and Coating, and individual Specification sections.

3.05 ADJUSTMENT AND CLEANING

- A. Perform required adjustments, tests, operation checks, and other startup activities.

3.06 LUBRICANTS

- A. Fill lubricant reservoirs and replace consumption during testing, startup, and operation prior to acceptance of equipment by Owner.

3.07 SUPPLEMENTS

- A. The supplement listed below, following "End of Section", is part of this specification.
 - 1. Form: Manufacturer's Certificate of Compliance.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF COMPLIANCE

OWNER: _____ PRODUCT, MATERIAL, OR SERVICE
PROJECT NAME: _____ SUBMITTED: _____
PROJECT NO: _____

Comments: _____

I hereby certify that the above-referenced product, material, or service called for by the Contract for the named Project will be furnished in accordance with all applicable requirements. I further certify that the product, material, or service are of the quality specified and conform in all respects with the Contract requirements, and are in the quantity shown. I further certify that we have examined the Plans and Specifications for this Project and have ascertained that this equipment or material is suitable for the purpose and use intended.

Date of Execution: _____, 20__

Manufacturer: _____

Manufacturer's Authorized Representative (*print*): _____

(Authorized Signature)

**SECTION 01 77 00
CLOSEOUT PROCEDURES**

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Submit prior to application for final payment.
 - a. Record Documents: As required in General Conditions.
 - b. Special bonds, Special Guarantees, and Service Agreements.
 - c. Consent of Surety to Final Payment: As required in General Conditions.
 - d. Releases or Waivers of Liens and Claims: As required in General Conditions.
 - e. Releases from Agreements.
 - f. Final Application for Payment: Submit in accordance with procedures and requirements stated in Section 01 29 00, Payment Procedures.
 - g. Extra Materials: As required by individual Specification sections.

1.02 RECORD DOCUMENTS

A. Quality Assurance:

1. Furnish qualified and experienced person, whose duty and responsibility shall be to maintain record documents.
2. Accuracy of Records:
 - a. Coordinate changes within record documents, making legible and accurate entries on each sheet of Drawings and other documents where such entry is required to show change.
 - b. Purpose of Project record documents is to document factual information regarding aspects of the Work, both concealed and visible, to enable future modification of the Work to proceed without lengthy and expensive Site measurement, investigation, and examination.
3. Make entries within 24 hours after receipt of information that a change in the Work has occurred.
4. Prior to submitting each request for progress payment, request Engineer's review and approval of current status of record documents. Failure to properly maintain, update, and submit record documents may result in a deferral by Engineer to recommend whole or any part of Contractor's Application for Payment, either partial or final.

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1.03 RELEASES FROM AGREEMENTS

- A. Furnish Owner written releases from property owners or public agencies where side agreements or special easements have been made, or where Contractor's operations have not been kept within the Owner's construction right-of-way.
- B. In the event Contractor is unable to secure written releases:
 - 1. Inform Owner of the reasons.
 - 2. Owner or its representatives will examine the Site, and Owner will direct Contractor to complete the Work that may be necessary to satisfy terms of the side agreement or special easement.
 - 3. Should Contractor refuse to perform this Work, Owner reserves right to have it done by separate contract and deduct cost of same from Contract Price, or require Contractor to furnish a satisfactory bond in a sum to cover legal Claims for damages.
 - 4. When Owner is satisfied that the Work has been completed in agreement with Contract Documents and terms of side agreement or special easement, right is reserved to waive requirement for written release if: (i) Contractor's failure to obtain such statement is due to grantor's refusal to sign, and this refusal is not based upon any legitimate Claims that Contractor has failed to fulfill terms of side agreement or special easement, or (ii) Contractor is unable to contact or has had undue hardship in contacting grantor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 MAINTENANCE OF RECORD DOCUMENTS

- A. General:
 - 1. Promptly following commencement of Contract Times, secure from Engineer a copy of the Drawings in electronic format. Drawings used for record documents will be full size.
 - 2. Label or stamp each record document with title, "RECORD DOCUMENTS," in neat large printed letters.
 - 3. Record information concurrently with construction progress and within 24 hours after receipt of information that change has occurred. Do not cover or conceal Work until required information is recorded.

B. Preservation:

1. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
2. Make documents and Samples available at all times for observation by Engineer.

C. Making Entries on Drawings:

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required.
 - a. Color Coding:
 - 1) Green when showing information deleted from Drawings.
 - 2) Red when showing information added to Drawings.
 - 3) Blue and circled in blue to show notes.
2. Date entries.
3. Call attention to entry by “cloud” drawn around area or areas affected.
4. Legibly mark to record actual changes made during construction, including, but not limited to:
 - a. Depths of various elements of foundation in relation to finished first floor data if not shown or where depth differs from that shown.
 - b. Horizontal and vertical locations of existing and new Underground Facilities and appurtenances, and other underground structures, equipment, or Work. Reference to at least two measurements to permanent surface improvements.
 - c. Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.
 - d. Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.
 - e. Changes made by Addenda and Field Orders, Work Change Directive, Change Order, and Engineer’s written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number.
5. Dimensions on Schematic Layouts: Show on record drawings, by dimension, the centerline of each run of items such as are described in previous subparagraph above.
 - a. Clearly identify the item by accurate note such as “cast iron drain,” “galv. water,” and the like.
 - b. Show, by symbol or note, vertical location of item (“under slab,” “in ceiling plenum,” “exposed,” and the like).
 - c. Make identification so descriptive that it may be related reliably to Specifications.

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3.02 FINAL CLEANING

- A. At completion of the Work or of a part thereof and immediately prior to Contractor's request for certificate of Substantial Completion; or if no certificate is issued, immediately prior to Contractor's notice of completion, clean entire Site or parts thereof, as applicable.
1. Leave the Work and adjacent areas affected in a cleaned condition satisfactory to Owner and Engineer.
 2. Repair, patch, and touch up marred surfaces to specified finish and match adjacent surfaces.
 3. Broom clean exterior paved driveways and parking areas.
 4. Hose clean sidewalks, loading areas, and others contiguous with principal structures.
 5. Rake clean all other surfaces.
 6. Leave water courses, gutters, and ditches open and clean.
- B. Use only cleaning materials recommended by manufacturer of surfaces to be cleaned.

END OF SECTION

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Detailed information for the preparation, submission, and Engineer's review of Operations and Maintenance (O&M) Data, as required by individual Specification sections.

1.02 DEFINITIONS

- A. Preliminary Data: Initial and subsequent submissions for Engineer's review.
- B. Final Data: Engineer-accepted data, submitted as specified herein.
- C. Maintenance Operation: As used on Maintenance Summary Form is defined to mean any routine operation required to ensure satisfactory performance and longevity of equipment. Examples of typical maintenance operations are lubrication, belt tensioning, adjustment of pump packing glands, and routine adjustments.

1.03 SEQUENCING AND SCHEDULING

- A. Equipment and System Data:
 - 1. Preliminary Data:
 - a. Do not submit until Shop Drawing for equipment or system has been reviewed and approved by Engineer.
 - b. Submit prior to shipment date.
 - 2. Final Data: Submit Instructional Manual Formatted data not less than 30 days prior to installation of equipment or system equipment or system field functional testing. Submit Compilation Formatted and Electronic Media Formatted data prior to Substantial Completion of Project.
- B. Materials and Finishes Data:
 - 1. Preliminary Data: Submit at least 15 days prior to request for final inspection.
 - 2. Final Data: Submit within 10 days after final inspection.

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1.04 DATA FORMAT

- A. Prepare preliminary and final data in the form of an instructional manual. Prepare final data on electronic media.
- B. Instructional Manual Format:
 - 1. Binder: Commercial quality, permanent, three-ring or three-post binders with durable plastic cover.
 - 2. Size: 8-1/2 inches by 11 inches, minimum.
 - 3. Cover: Identify manual with typed or printed title "OPERATION AND MAINTENANCE DATA" and list:
 - a. Project title.
 - b. Designate applicable system, equipment, material, or finish.
 - c. Identity of separate structure as applicable.
 - d. Identify volume number if more than one volume.
 - 4. Spine:
 - a. Project title.
 - b. Identify volume number if more than one volume.
 - 5. Title Page:
 - a. Contractor name, address, and telephone number.
 - b. Subcontractor, Supplier, installer, or maintenance contractor's name, address, and telephone number, as appropriate.
 - 1) Identify area of responsibility of each.
 - 2) Provide name and telephone number of local source of supply for parts and replacement.
 - 6. Table of Contents:
 - a. Neatly typewritten and arranged in systematic order with consecutive page numbers.
 - b. Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.
 - 7. Paper: 20-pound minimum, white for typed pages.
 - 8. Text: Manufacturer's printed data, or neatly typewritten.
 - 9. Three-hole punch data for binding and composition; arrange printing so that punched holes do not obliterate data.
 - 10. Material shall be suitable for reproduction, with quality equal to original. Photocopying of material will be acceptable, except for material containing photographs.

C. Electronic Media Format:

1. Portable Document Format (PDF):
 - a. After all preliminary data has been found to be acceptable to Engineer, submit Operation and Maintenance data in PDF format on CD.
 - b. Files to be exact duplicates of Engineer-accepted preliminary data. Arrange by specification number and name.
 - c. Files to be fully functional and viewable in most recent version of Adobe Acrobat.

1.05 SUBMITTALS

A. Informational:

1. Data Outline: Submit two copies of a detailed outline of proposed organization and contents of Final Data prior to preparation of Preliminary Data.
2. Preliminary Data:
 - a. Submit three copies for Engineer's review.
 - b. If data meets conditions of the Contract:
 - 1) One copy will be returned to Contractor.
 - 2) One copy will be forwarded to Resident Project Representative.
 - 3) One copy will be retained in Engineer's file.
 - c. If data does not meet conditions of the Contract:
 - 1) All copies will be returned to Contractor with Engineer's comments (on separate document) for revision.
 - 2) Engineer's comments will be retained in Engineer's file.
 - 3) Resubmit two copies revised in accordance with Engineer's comments.
3. Final Data: Submit two copies in format specified herein.

1.06 DATA FOR EQUIPMENT AND SYSTEMS

A. Content For Each Unit (or Common Units) and System:

1. Product Data:
 - a. Include only those sheets that are pertinent to specific product.
 - b. Clearly annotate each sheet to:
 - 1) Identify specific product or part installed.
 - 2) Identify data applicable to installation.
 - 3) Delete references to inapplicable information.

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- c. Function, normal operating characteristics, and limiting conditions.
 - d. Performance curves, engineering data, nameplate data, and tests.
 - e. Complete nomenclature and commercial number of replaceable parts.
 - f. Original manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.
 - g. Spare parts ordering instructions.
 - h. Where applicable, identify installed spares and other provisions for future work (e.g., reserved panel space, unused components, wiring, terminals).
2. As-installed, color-coded piping diagrams.
 3. Charts of valve tag numbers, with the location and function of each valve.
 4. Drawings: Supplement product data with Drawings as necessary to clearly illustrate:
 - a. Format:
 - 1) Provide reinforced, punched, binder tab; bind in with text.
 - 2) Reduced to 8-1/2 inches by 11 inches, or 11 inches by 17 inches folded to 8-1/2 inches by 11 inches.
 - 3) Where reduction is impractical, fold and place in 8-1/2-inch by 11-inch envelopes bound in text.
 - 4) Identify Specification section and product on Drawings and envelopes.
 - b. Relations of component parts of equipment and systems.
 - c. Control and flow diagrams.
 - d. Coordinate drawings with Project record documents to assure correct illustration of completed installation.
 5. Instructions and Procedures: Within text, as required to supplement product data.
 - a. Format:
 - 1) Organize in consistent format under separate heading for each different procedure.
 - 2) Provide logical sequence of instructions for each procedure.
 - 3) Provide information sheet for Owner's personnel, including:
 - a) Proper procedures in event of failure.
 - b) Instances that might affect validity of guarantee or Bond.
 - b. Installation Instructions: Including alignment, adjusting, calibrating, and checking.

- c. Operating Procedures:
 - 1) Startup, break-in, routine, and normal operating instructions.
 - 2) Test procedures and results of factory tests where required.
 - 3) Regulation, control, stopping, and emergency instructions.
 - 4) Description of operation sequence by control manufacturer.
 - 5) Shutdown instructions for both short and extended duration.
 - 6) Summer and winter operating instructions, as applicable.
 - 7) Safety precautions.
 - 8) Special operating instructions.
- d. Maintenance and Overhaul Procedures:
 - 1) Routine maintenance.
 - 2) Guide to troubleshooting.
 - 3) Disassembly, removal, repair, reinstallation, and re-assembly.
- 6. Guarantee, Bond, and Service Agreement: In accordance with Section 01 77 00, Closeout Procedures.

B. Content for Each Electric or Electronic Item or System:

- 1. Description of Unit and Component Parts:
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data, nameplate data, and tests.
 - c. Complete nomenclature and commercial number of replaceable parts.
 - d. Interconnection wiring diagrams, including control and lighting systems.
- 2. Circuit Directories of Panelboards:
- 3. Electrical service.
- 4. Control requirements and interfaces.
- 5. Communication requirements and interfaces.
- 6. List of electrical relay settings, and control and alarm contact settings.
- 7. Electrical interconnection wiring diagram, including as applicable, single-line, three-line, schematic and internal wiring, and external interconnection wiring.
- 8. As-installed control diagrams by control manufacturer.
- 9. Operating Procedures:
 - a. Routine and normal operating instructions.
 - b. Startup and shutdown sequences, normal and emergency.
 - c. Safety precautions.
 - d. Special operating instructions.

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10. Maintenance Procedures:
 - a. Routine maintenance.
 - b. Guide to troubleshooting.
 - c. Adjustment and checking.
 - d. List of relay settings, control and alarm contact settings.
11. Manufacturer's printed operating and maintenance instructions.
12. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

C. Maintenance Summary:

1. Compile individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components or sub-units.
2. Format:
 - a. Use Maintenance Summary Form bound with this section or electronic facsimile of such.
 - b. Each Maintenance Summary may take as many pages as required.
 - c. Use only 8-1/2-inch by 11-inch size paper.
 - d. Complete using typewriter or electronic printing.
3. Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.
4. Recommended Spare Parts:
 - a. Data to be consistent with manufacturer's Bill of Materials/Parts List furnished in O&M manuals.
 - b. "Unit" is the unit of measure for ordering the part.
 - c. "Quantity" is the number of units recommended.
 - d. "Unit Cost" is the current purchase price.

1.07 SUPPLEMENTS

- A. The supplement listed below, following "End of Section", is part of this Specification.
 1. Forms: Maintenance Summary Form.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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MAINTENANCE SUMMARY FORM

PROJECT: _____ CONTRACT NO.: _____

1. EQUIPMENT ITEM _____

2. MANUFACTURER _____

3. EQUIPMENT/TAG NUMBER(S) _____

4. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) _____

5. NAMEPLATE DATA (hp, voltage, speed, etc.) _____

6. MANUFACTURER'S LOCAL REPRESENTATIVE _____

a. Name _____ Telephone No. _____

b. Address _____

7. MAINTENANCE REQUIREMENTS

Maintenance Operation Comments	Frequency	Lubricant (If Applicable)
List briefly each maintenance operation required and refer to specific information in manufacturer's standard maintenance manual, if applicable. (Reference to manufacturer's catalog or sales literature is not acceptable.)	List required frequency of each maintenance operation.	Refer by symbol to lubricant required.

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8. LUBRICANT LIST

Reference Symbol	Shell	Exxon Mobile	Chevron Texaco	BP Amoco	Or Equal
List symbols used in No. 7 above.	List equivalent lubricants, as distributed by each manufacturer for the specific use recommended.				

9. RECOMMENDED SPARE PARTS FOR OWNER’S INVENTORY.

Part No.	Description	Unit	Quantity	Unit Cost
Note: Identify parts provided by this Contract with two asterisks.				

**SECTION 01 88 15
ANCHORAGE AND BRACING**

PART 1 GENERAL

1.01 SUMMARY

- A. This section covers requirements for anchorage and bracing of equipment, distribution systems, and other nonstructural components required in accordance with the Florida Building Code 6th Edition (2017), for wind, gravity, soil, and operational loads.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Institute of Steel Construction (AISC) 360, Specification for Structural Steel Buildings.
 - 2. American Society of Civil Engineers (ASCE): ASCE 7, Minimum Design Loads for Buildings and Other Structures.
 - 3. International Code Council (ICC): International Building Code (IBC).
 - 4. Florida Building Code Code 6th Edition (2017).

1.03 DEFINITIONS

- A. Authority Having Jurisdiction (AHJ): Permitting building agency; may be a federal, state, local, or other regional department, or individual including building official, fire chief, fire marshal, chief of a fire prevention bureau, labor department, or health department, electrical inspector; or others having statutory authority. AHJ may be Owner when authorized to be self-permitting by governmental permitting agency or when no governmental agency has authority.
- B. Designated Seismic System: Architectural, electrical, and mechanical system or their components for which component importance factor is greater than 1.0.

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

- A. General:
 - 1. Anchorage and bracing systems shall be designed by a qualified professional engineer registered in the State of Florida.

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2. Design anchorage into concrete including embedment in accordance with ACI 318-14; Chapter 17 (or other industry standard approved by Engineer), and Project Specifications.
 - a. Unless otherwise noted, design for cracked concrete condition.
3. Design anchorage and bracing of architectural, mechanical, and electrical components and systems in accordance with this section, unless a design is specifically provided within Contract Documents or where exempted hereinafter.
4. Design attachments, braces, and anchors for equipment, components, and distribution systems to structure for gravity, seismic, wind, and operational loading.
5. Anchor and brace piping and ductwork, whether exempt or not exempt for this section, so that lateral or vertical displacement does not result in damage or failure to essential architectural, mechanical, or electrical equipment.
6. Architectural Components: Includes, but are not limited to, nonstructural walls and elements, partitions, cladding and veneer, access flooring, signs, cabinets, suspended ceilings, and glass in glazed curtain walls and partitions.
7. Provide supplementary framing where required to transfer anchorage and bracing loads to structure.
8. Adjust equipment pad sizes or provide additional anchorage confinement reinforcing to provide required anchorage capacities.
9. For components exempted from design requirements of this section, provide bolted, welded, or otherwise positively fastened attachments to supporting structure.

B. Design Loads:

1. Gravity: Design anchorage and bracing for self-weight and superimposed loads on components and equipment.
2. Wind: Design anchorage and bracing for wind criteria provided on General Structural Notes on Drawings for exposed architectural components and exterior and wind-exposed mechanical and electrical equipment. Alternately, manufacturer certification may be provided for components such as roofing and flashing to verify attachments meet Project-specific design criteria.
3. Operational:
 - a. For loading supplied by equipment manufacturer for IBC required load cases.
 - b. Loads may include equipment vibration, torque, thermal effects, effects of internal contents (weight and sloshing), water hammer, and other load-inducing conditions.

- c. Locate braces to minimize vibration to or movement of structure.
- d. For vibrating loads, use anchors meeting requirements of Section 05 50 00, Metal Fabrications or Section 05 05 19, Post-Installed Anchors, for anchors with designated capacities for vibratory loading per manufacturer's ICC-ES report.

1.05 SUBMITTALS

A. Action Submittals:

- 1. Shop Drawings:
 - a. List of mechanical, and electrical equipment requiring Contractor-designed anchorage and bracing, unless specifically exempted.
 - b. Manufacturers' engineered hardware product data.
 - c. Attachment assemblies' drawings; include connection hardware, braces, and anchors or anchor bolts for nonexempt components, equipment, and systems.
 - d. Submittal will be rejected if proposed anchorage method would create excessive stress to supporting member. Revise anchorages and strengthen structural support to eliminate overstressed condition.

B. Informational Submittals:

- 1. Anchorage and Bracing Calculations: For attachments, braces, and anchorages, include IBC and Project-specific criteria as noted on General Structural Notes on Drawings, in addition to manufacturer's specific criteria used for design; sealed by a civil or structural engineer registered in the State of Florida.
- 2. Manufacturer's hardware installation requirements.

C. Deferred Submittals:

- 1. Submitted anchorage drawings and calculations are identified as IBC deferred submittals and will be submitted to and must be accepted by AHJ prior to installation of component, equipment, or distribution system.
- 2. Submit deferred Action Submittals such as Shop Drawings with supporting deferred informational submittals such as calculations no less than 4 weeks in advance of installation of component, equipment or distribution system to be anchored to structure.

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1.06 SOURCE QUALITY CONTROL

- A. Provide all other specified, regulatory required, or required repair verification inspection and testing that is not listed in Statement of Special Inspections in accordance with Section 01 45 16.13, Contractor Quality Control.
- B. Provide Source Quality Control for welding and hot-dip galvanizing of anchors in accordance with Section 05 50 00, Metal Fabrications.

PART 2 PRODUCTS

2.01 GENERAL

- A. Design and construct attachments and supports transferring seismic and non-seismic loads to structure of materials and products suitable for application and in accordance with design criteria shown on Drawings and nationally recognized standards.
- B. Provide anchor bolts for anchorage of equipment to concrete or masonry in accordance with Section 05 50 00, Metal Fabrications. Provide anchor bolts of the size, minimum embedment, and spacing designated in calculations submitted by Contractor and accepted by Engineer.
- C. Provide post-installed concrete and masonry anchors for anchorage of equipment to concrete or masonry in accordance with Section 05 05 19, Post-Installed Anchors. Provide post-installed anchors of the size, minimum embedment, and spacing designated in calculations submitted by Contractor and accepted by Engineer.
- D. Do not use powder-actuated fasteners or sleeve anchors for seismic attachments and anchorage where resistance to tension loads is required. Do not use expansion anchors, other than undercut anchors, for nonvibration isolated mechanical equipment rated over 10 horsepower.

PART 3 EXECUTION

3.01 GENERAL

- A. Make attachments, bracing, and anchorage in such a manner that component lateral force is transferred to lateral force resisting system of structure through a complete load path.
- B. Design, provide, and install overall seismic anchorage system to provide restraint in all directions, including vertical, for each component or system so anchored.

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- C. Provide snubbers in each horizontal direction and vertical restraints for components mounted on vibration isolation systems where required to resist overturning.
- D. Provide piping anchorage that maintains design flexibility and expansion capabilities at flexible connections and expansion joints.
- E. Anchor tall and narrow equipment such as motor control centers and telemetry equipment at base and within 12 inches from top of equipment, unless approved otherwise by Engineer.
- F. Do not attach mechanical, or electrical components to more than one element of a building structure at a single restraint location where such elements may respond differently during a seismic event. Do not make such attachments across building expansion and contraction joints.

3.02 INSTALLATION

- A. Do not install components or their anchorages or restraints prior to review and acceptance by Engineer and AHJ.

3.03 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. In accordance with Section 05 50 00, Metal Fabrications and Section 05 05 19, Post-Installed Anchors.
- B. Provide any other specified, regulatory required, or required repair verification inspection and testing that is not listed in Statement of Special Inspections in accordance with Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

**SECTION 01 91 14
EQUIPMENT TESTING AND FACILITY STARTUP**

PART 1 GENERAL

1.01 DEFINITIONS

- A. Facility: Entire Project, or an agreed-upon portion, including all of its unit processes.
- B. Functional Test: Test or tests in presence of Engineer and Owner to demonstrate that installed equipment meets manufacturer's installation, calibration, and adjustment requirements and other requirements as specified.
- C. Performance Test: Test or tests performed after any required functional test in presence of Engineer and Owner to demonstrate and confirm individual equipment meets performance requirements specified in individual sections.
- D. Facility Performance Demonstration:
 - 1. A demonstration, conducted by Contractor, with assistance of Owner, to demonstrate and document the performance of the entire operating facility, both manually and automatically (if required), based on criteria developed in conjunction with Owner and as accepted by Engineer.
 - 2. Such demonstration is for the purposes of (i) verifying to Owner entire facility performs as a whole, and (ii) documenting performance characteristics of completed facility for Owner's records. Neither the demonstration nor the evaluation is intended in any way to make performance of a unit process or entire facility the responsibility of Contractor, unless such performance is otherwise specified.

1.02 SUBMITTALS

- A. Informational Submittals:
 - 1. Facility Startup and Performance Demonstration Plan.
 - 2. Functional and performance test results.
 - 3. Completed Facility Performance Demonstration/Certification Form.

1.03 FACILITY STARTUP AND PERFORMANCE DEMONSTRATION PLAN

- A. Develop a written plan, in conjunction with Owner's operations personnel; to include the following:
 - 1. Step-by-step instructions for startup of each unit process and the complete facility.

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2. Facility Performance Demonstration/Certification Form (sample attached), to minimally include the following:
 - a. Description of unit processes included in the facility startup.
 - b. Sequence of unit process startup to achieve facility startup.
 - c. Description of computerized operations, if any, included in the facility.
 - d. Contractor certification facility is capable of performing its intended function(s), including fully automatic operation.
 - e. Signature spaces for Contractor and Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EQUIPMENT TESTING

A. Preparation:

1. Complete installation before testing.
2. Furnish qualified manufacturers' representatives, when required by individual Specification sections.
3. Obtain and submit from equipment manufacturer's representative Manufacturer's Certificate of Proper Installation Form, in accordance with Section 01 43 33, Manufacturers' Field Services, when required by individual Specification sections.
4. Equipment Test Report Form: Provide written test report for each item of equipment to be tested, to include the minimum information:
 - a. Owner/Project Name.
 - b. Equipment or item tested.
 - c. Date and time of test.
 - d. Type of test performed (Functional or Performance).
 - e. Test method.
 - f. Test conditions.
 - g. Test results.
 - h. Signature spaces for Contractor and Engineer as witness.
5. Cleaning and Checking: Prior to beginning functional testing:
 - a. Calibrate testing equipment in accordance with manufacturer's instructions.
 - b. Inspect and clean equipment, devices, connected piping, and structures to ensure they are free of foreign material.
 - c. Lubricate equipment in accordance with manufacturer's instructions.
 - d. Turn rotating equipment by hand when possible to confirm that equipment is not bound.

- e. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
 - f. Check power supply to electric-powered equipment for correct voltage.
 - g. Adjust clearances and torque.
 - h. Test piping for leaks.
6. Ready-to-test determination will be by Engineer based at least on the following:
- a. Acceptable Operation and Maintenance Data.
 - b. Notification by Contractor of equipment readiness for testing.
 - c. Receipt of Manufacturer's Certificate of Proper Installation, if so specified.
 - d. Adequate completion of work adjacent to, or interfacing with, equipment to be tested.
 - e. Availability and acceptability of manufacturer's representative, when specified, to assist in testing of respective equipment.
 - f. Satisfactory fulfillment of other specified manufacturer's responsibilities.
 - g. Equipment and electrical tagging complete.
 - h. Delivery of all spare parts and special tools.

B. Functional Testing:

- 1. Conduct as specified in individual Specification sections.
- 2. Notify Owner and Engineer in writing at least 10 days prior to scheduled date of testing.
- 3. Prepare Equipment Test Report summarizing test method and results.
- 4. When, in Engineer's opinion, equipment meets functional requirements specified, such equipment will be accepted for purposes of advancing to performance testing phase, if so required by individual Specification sections. Such acceptance will be evidenced by Engineer/Owner's signature as witness on Equipment Test Report.

C. Performance Testing:

- 1. Conduct as specified in individual Specification sections.
- 2. Notify Engineer and Owner in writing at least 10 days prior to scheduled date of test.
- 3. Performance testing shall not commence until equipment has been accepted by Engineer as having satisfied functional test requirements specified.
- 4. Type of fluid, gas, or solid for testing shall be as specified.
- 5. Unless otherwise indicated, furnish labor, materials, and supplies for conducting the test and taking samples and performance measurements.

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6. Prepare Equipment Test Report summarizing test method and results.
7. When, in Engineer's opinion, equipment meets performance requirements specified, such equipment will be accepted as conforming to Contract requirements. Such acceptance will be evidenced by Engineer's signature on Equipment Test Report.

3.02 STARTUP OF UNIT PROCESSES

- A. Prior to unit process startup, equipment within unit process shall be accepted by Engineer as having met functional and performance testing requirements specified.
- B. Make adjustments, repairs, and corrections necessary to complete unit process startup.
- C. Startup shall be considered complete when, in opinion of Engineer, unit process has operated in manner intended for 5 continuous days without significant interruption. This period is in addition to functional or performance test periods specified elsewhere.
- D. Significant Interruption: May include any of the following events:
 1. Failure of Contractor to provide and maintain qualified onsite startup personnel as scheduled.
 2. Failure to meet specified functional operation for more than 2 consecutive hours.
 3. Failure of any critical equipment or unit process that is not satisfactorily corrected within 5 hours after failure.
 4. Failure of any noncritical equipment or unit process that is not satisfactorily corrected within 8 hours after failure.
 5. As determined by Engineer.
- E. A significant interruption will require startup then in progress to be stopped. After corrections are made, startup test period to start from beginning again.

3.03 FACILITY PERFORMANCE DEMONSTRATION

- A. When, in the opinion of Engineer, startup of all unit processes has been achieved, sequence each unit process to the point that facility is operational.
- B. Demonstrate proper operation of required interfaces within and between individual unit processes.

- C. After facility is operating, complete performance testing of equipment and systems not previously tested.
- D. Certify, on the Facility Performance Demonstration/Certification Form, that facility is capable of performing its intended function(s), including fully automatic operation.

3.04 SUPPLEMENTS

- A. Supplement listed below, following “End of Section,” is a part of this Specification:
 - 1. Facility Performance Demonstration/Certification Form.

END OF SECTION

FACILITY PERFORMANCE DEMONSTRATION/CERTIFICATION FORM

OWNER: _____ **PROJECT:** _____

Unit Processes Description (List unit processes involved in facility startup):

Unit Processes Startup Sequence (Describe sequence for startup, including computerized operations, if any):

Contractor Certification that Facility is capable of performing its intended function(s), including fully automatic operation:

Contractor: _____ **Date:** _____, 20__

Engineer: _____ **Date:** _____, 20__
(Authorized Signature)

SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.01 GENERAL

- A. Unless otherwise specified, Work shall conform to requirements of Section 1 through Section 5 of ACI 301, Specifications for Structural Concrete.
1. Environment concrete structures are included in the scope of the Work.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Concrete Institute (ACI):
 - a. 301, Specifications for Structural Concrete.
 2. ASTM International Standards (ASTM):
 - a. A1034/A1034M, Standard Test Methods for Testing Mechanical Splices for Steel Reinforcing Bars.
 - b. A1094/A1094M, Standard Specification for Continuous Hot-Dip Galvanized Steel Bars for Concrete Reinforcement.
 - c. C1761/C1761M, Standard Specification for Lightweight Aggregate for Internal Curing of Concrete.
 - d. C1797, Standard Specification for Ground Calcium Carbonate and Aggregate Mineral Fillers for use in Hydraulic Cement Concrete.
 3. NSF International (NSF): NSF/ANSI 61, Drinking Water System Components - Health Effects.

1.03 DEFINITIONS

- A. Unless otherwise specified, definitions shall be in accordance with Paragraph 1.3, Definitions, of ACI 301 and Section 03 30 00, Cast-in-Place Concrete.
1. Water-cementitious materials ratio (w/cm): Ratio of mass of water, excluding that absorbed by the aggregate, to the mass of cementitious materials in a mixture, stated as a decimal.

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1.04 DESIGN REQUIREMENTS

- A. Design formwork in accordance with ACI 301 and ACI 318 to provide concrete finishes specified in Section 03 30 00, Cast-in-Place Concrete.
- B. Unless otherwise specified, limit deflection of facing materials for concrete surfaces to comply with ACI 301. Limit deflection of facing materials to comply with tolerance limits established by Contract Documents and with tolerances required by equipment manufacturers. Coordinate tolerance requirements with equipment manufacturers.
- C. Form liner and concrete mixtures shall be compatible. Coordinate compatibility between form liner manufacturer and concrete producer.

1.05 SUBMITTALS

- A. Unless otherwise specified, submittals shall be in accordance with ACI 301, Article 2.1.2 *Submittals*.
- B. Action Submittals:
 - 1. Form-Facing Materials - Submittal is not required.
 - 2. Construction and Movement Joints - Submittal is not required.
 - 3. Testing for Formwork Removal - Submittal is not required.
 - 4. Manufacturer's Product Data on Formwork Release Agent for Use on Each Form-Facing Material - Submittal is not required.
 - 5. Manufacturer's Product Data on Form Liner Proposed for Use with Each Formed Surface - Submittal is not required.
 - 6. Manufacturer's Data Sheet for Form Ties
 - 7. Manufacturer's Data Sheet for Formwork Materials Not Listed Elsewhere in Contract Documents, That Are to Be Left in Place Within Work.
 - 8. Manufacturer's Product Data on Form Liner Proposed for Use with Each Formed Surface.
 - 9. Manufacturer's Product Data on Formwork Release Agent for Use on Surfaces in Contact with Form Liner.
- A. Informational Submittals:
 - 1. Reshoring and Backshoring Procedure - Submittal is not required.

1.06 DESIGN REQUIREMENTS

- A. Quality Control: Unless otherwise specified, submittals shall be in accordance with ACI 301, Article 6.1.4 Quality Control.

PART 2 PRODUCTS

2.01 FORM MATERIALS

A. Wall Forms and Underside of Slabs and Beams:

1. Materials: Plywood, hard plastic finished plywood, overlaid waterproof particle board, or steel in “new and undamaged” condition, of sufficient strength and surface smoothness to produce specified finish. Use plywood forms when using form liners. Plywood may be of lower finish grade when used in conjunction with form liners.
2. Where steel forms or form liners are used, treat steel surfaces to prevent rusting using products approved for use on steel forms.
3. Circular Structure:
 - a. Wall forms shall conform to circular shape of structure.
 - b. Straight panels may be substituted for circular forms provided panels do not exceed 2 feet in horizontal width and angular deflection is no greater than 3-1/2 degrees per joint.

B. Column Forms:

1. Rectangular Columns: As specified for walls.
2. Circular Columns: Fabricated steel or fiber-reinforced plastic with bolted sections or spirally wound laminated fiber form. Internally treat with release agent for full height of column.

C. Form Liners:

1. Material: As required by tank manufacturer.
2. Manufacturing Tolerance: Overall dimensions within 0.125 inch at time of manufacture.
3. Controlled Permeability Form Liner:
 - a. Consists of filter fabric bonded to backing grid with documented ability to improve concrete surface.
 - b. Properties:
 - 1) Maximum Pore Size: Less than 0.050 mm.
 - 2) Water Retention Capacity: 1.30 liters per square meter without drainage, minimum.
 - 3) Absorbency: 0.1 liter per square meter, maximum.
 - 4) Compression: Less than 10 percent under a pressure of 200 kPa.
 - 5) Tensile Strength at 5 Percent Elongation: 8 kN/square meter, minimum.
 - c. Manufacturer and Product: Dupont; Zemdrain MD.

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- D. Sandblasted Surface Forms: Medium-density overlay plywood for flat concrete surfaces to be sandblasted.
- E. Painted Surface Forms: High-density overlay plywood for flat concrete surfaces to be painted.
- F. All Other Forms: Materials as specified for wall forms.

2.02 ACCESSORIES

- A. Form Release Agent:
 - 1. Material:
 - a. Shall not bond with, stain, or adversely affect concrete surfaces.
 - b. Shall not impair subsequent treatments of concrete surfaces when applied to forms or form liners.
 - c. Ready-to-use water based material formulated to reduce or eliminate surface imperfections.
 - d. Contain no mineral oil or organic solvents.
 - 2. Manufacturers and Products: Not for surfaces exposed to potable water.
 - a. BASF, Shakopee, MN; MBT MasterFinish RL 211.
 - b. Cresset Chemical Company; Crete-Lease 20-VOC-Xtra.
 - 3. Manufacturers and Products: For use with potable water structures. Environmentally safe, meeting local, state, and federal regulations and usable in potable water facilities. Certified as meeting NSF 61.
 - a. Atlas Tech Products; Atlas Bio-Guard.
 - b. Dayton Superior; Clean Strip J1EF.
 - c. Hill and Griffith Company; Grifcote LV-50-Plus.
- B. Rustication Grooves and Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.
- C. Form Snap-Ties:
 - 1. Material: Stainless steel.
 - 2. Spreader Inserts:
 - a. Conical or spherical type.
 - b. Design to maintain positive contact with forming material.
 - c. Furnish units that will leave no metal closer than 1.5 inches to concrete surface when forms, inserts, and tie ends are removed.
 - 3. Wire ties not permitted.
 - 4. Flat bar ties for panel forms; furnish plastic or rubber inserts with minimum 1.5-inch depth and sufficient dimensions to permit patching of tie hole.

D. Form Snap-Ties with Water Stop:

1. For water-holding structures, basements, pipe galleries, and accessible spaces below finish grade, furnish one of the following:
 - a. Integral steel water stop 0.103-inch thick and 0.625-inch diameter tightly and continuously welded to tie.
 - b. Neoprene water stop 3/16-inch thick and 15/16-inch diameter whose center hole is one-half diameter of tie, or molded plastic water stop of comparable size.
 - c. Orient water stop perpendicular to tie and symmetrical about center of tie.
 - d. Design ties to prevent rotation or disturbance of center portion of tie during removal of ends and to prevent water leaking along tie.

E. Through-Bolts:

1. At Contractor's option, may be used as alternate to form snap-tie or form snap-tie with water stop.
2. Tapered minimum 1-inch diameter at smallest end.
3. Elastic Vinyl Plug for Through-Bolt Tie Holes:
 - a. Design and size of plug to allow insertion with tool to enable plug to elongate and return to original length and diameter upon removal; forms watertight seal.
 - b. Manufacturers and Products:
 - 1) Dayton Superior, Miamisburg, OH; A58 Sure Plug.
 - 2) Greenstreak Group, Inc., St Louis, MO; X-Plug.

PART 3 EXECUTION

3.01 FORM SURFACE PREPARATION

- A. Prior to coating surface, thoroughly clean form surfaces that will be in contact with concrete or that have been in contact with previously cast concrete, dirt, and other surface contaminants.
- B. Exposed Wood Forms in Contact with Concrete: Apply form release agent as recommended by manufacturer.
- C. Steel Forms: Apply form release agent as soon as they are cleaned to prevent discoloration of concrete from rust.
- D. Form Liner Forms:
 1. Prepare forms as recommended by manufacturer.
 2. Provide liners in full sheets and locate seams as shown on approved Shop Drawings.

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3. Anchor liners to formwork as recommended by liner manufacturer.
4. Clean form liner after each use and use only form release agents approved by form liner manufacturer.

3.02 ERECTION

- A. General: In accordance with ACI 301, unless otherwise specified.
- B. Beveled Edges (Chamfer):
 1. Form 3/4-inch bevels at concrete edges, unless otherwise shown.
 2. Where beveled edges on existing adjacent structures are other than 3/4 inch, obtain Engineer's approval of size prior to placement of beveled edge.
- C. Wall Forms:
 1. Do not reuse forms with damaged surfaces.
 2. Locate form ties and joints in uninterrupted uniform pattern.
 3. Inspect form surfaces prior to installation to ensure conformance with specified tolerances.
- D. Forms Supporting Form Liners:
 1. Construct to structurally withstand deflection, movement, leakage, high hydraulic pressures resulting from rapid filling and heavy-high frequency vibration.
 2. Lay out form joints and ties in uniform pattern, unless otherwise shown.
- E. Form Liner Installation:
 1. Protect form liners from extended exposure to sunlight and from high surface temperatures during installation.
 2. Handle, cut, and install form liners in accordance with form liner manufacturer's instructions and recommendations.
 3. Place form liners with level and square, unless otherwise noted and in accordance with specified patterns and joints.
 4. Maintain required concrete cover between form liner and steel reinforcement.
- F. Curb, Sidewalk, and Driveway Forms:
 1. Provide standard steel or wood forms.
 2. Set forms to true lines and grades, and securely stake in position.

G. Form Tolerances:

1. Provide forms in accordance with ACI 117 and ACI 318, and the following tolerances for finishes specified:
 - a. See the Schedule of Concrete Finishes in Section 03 30 00, Cast-in-Place Concrete, for beam, column, and wall types related to required form tolerances.
 - b. Wall Tolerances:
 - 1) Straight Vertical or Horizontal Wall Surface: Flat planes within tolerance specified.
 - 2) Wall Type W-A:
 - a) Plumb within 1/4 inch in 10 feet or within 1 inch from top to bottom for walls over 40 feet high.
 - b) Depressions in Wall Surface: Maximum 5/16 inch when 10-foot straightedge is placed on high points in all directions.
 - 3) Wall Type W-B:
 - a) Plumb within 1/8 inch in 10 feet or within 1/2 inch from top to bottom for walls over 40 feet high.
 - b) Depressions in Wall Surface: Maximum 1/8 inch when 10-foot straightedge is placed on high points in all directions.
 - 4) Thickness: Maximum 1/4 inch minus or 1/2 inch plus from dimension shown.
 - 5) Form Offset: Between adjacent pieces of formwork, facing material shall not exceed 1/8 inch for architectural concrete, otherwise 1/4 inch.
 - c. Beams and Columns Tolerances:
 - 1) Exposed Straight Horizontal and Vertical Surfaces: Flat planes within tolerances specified.
 - 2) Lateral Alignment:
 - a) Centerlines shall be within plus or minus 1/2 inch from dimensions shown.
 - b) At intersections, centerlines shall intersect within plus or minus 1/2 inch of dimensions shown.
 - 3) Beam Type B-A:
 - a) Physical Dimensions: Maximum 1/4 inch minus or 1/2 inch plus from dimension shown.
 - b) Elevations: Within plus or minus 1/2 inch, except where tops of beams become part of finished slab. In this case refer to slab tolerances.
 - 4) Column Type C-A:
 - a) Physical Dimensions: Maximum 1/4 inch minus or 1/2 inch plus from dimension shown.
 - b) Plumb within 1/4 inch in 10 feet in all directions with maximum 1/2 inch out-of-plumb at top with respect to bottom.

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3.03 FORM REMOVAL

- A. Nonsupporting forms, sides of beams, walls, columns, and similar parts of Work, may be removed after cumulatively curing at not less than 50 degrees F for 24 hours from time of concrete placement if:
 - 1. Concrete is sufficiently hard so as not to sustain damage by form removal operations.
 - 2. Curing and protection operations are maintained.
- B. Elevated Structural Slabs or Beams: In accordance with ACI 318, Chapter 6, and at such time as concrete has reached compressive strength equal to 80 percent of specified 28-day compressive strength as determined by test cylinders.
- C. Forms with Form Liners: Remove formwork in accordance with form liner manufacturer's recommendations. Use consistent form liner removal timing to avoid variations in concrete color. Avoid damaging formed profiles.
- D. Form Ties: Remove conical inserts or through bolts and plug holes as specified in Section 03 30 00, Cast-in-Place Concrete.

3.04 MANUFACTURER'S SERVICES

- A. Provide form liner manufacturer's representative at Site for installation assistance, and inspection.

3.05 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 03 15 00
CONCRETE JOINTS AND ACCESSORIES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. ASTM International (ASTM):
 - a. A36/A36M, Specification for Carbon Structural Steel.
 - b. A615/A615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - c. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - d. A767/A767M, Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
 - e. C920, Specification for Elastomeric Joint Sealants.
 - f. D226, Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
 - g. D227, Specification for Coal-Tar Saturated Organic Felt Used in Roofing and Waterproofing.
 - h. D994, Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
 - i. D1056, Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
 - j. D1171, Standard Guide for Evaluating Nonwoven Fabrics.
 - k. D1751, Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - l. D1752, Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - m. D2240, Standard Test Method for Rubber Property – Durometer Hardness.
 2. Corps of Engineers (COE): CRD-C-572, Corps of Engineers Specifications for Polyvinylchloride Waterstop.
 3. NSF International (NSF): 61, Drinking Water System Components - Health Effects.

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1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. Waterstop: Details of splices, method of securing and supporting waterstop in forms to maintain proper orientation and location during concrete placement.
 - b. Construction Joints, Expansion Joints and Control Joints: Layout and location for each type. Include joints locations shown on Drawings, additional required joint locations and any proposed alternate locations.
2. Product Data:
 - a. Waterstops.
 - b. Bond breaker.
 - c. Premolded joint fillers.
 - d. Pourable joint fillers.
 - e. Preformed control joints.
 - f. Epoxy-coated dowels.
 - g. Roofing felt.
 - h. Accessories not specified in other sections.
3. Samples: PVC waterstop splice, joint, and fabricated cross of each size, shape, and fitting of waterstop.

B. Informational Submittals:

1. Certification:
 - a. Joint Filler(s) for Potable Water Structures: Confirmation material is certified to meet requirements of NSF 61.
 - b. Letter stating compatibility between liquids being contained and materials used for:
 - 1) Waterstops.
 - 2) Joint fillers.
 - c. Manufacturer's application instructions for:
 - 1) Bonding agent.
 - 2) Bond breaker.
2. Manufacturer's written instructions for product shipment, storage, handling, installation/application, and repair for:
 - a. Waterstops.
 - b. Bond breaker.
 - c. Bonding agent.
 - d. Premolded joint fillers.
 - e. Pourable joint fillers (sealant proportions not required as products used only as a filler).
 - f. Preformed control joints.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Acceptance at Site: Verify delivered materials are in accordance with Specifications, regulatory agencies, and Manufacturer's product data sheets prior to unloading and storing onsite.
- B. Storage: Store materials under tarps to protect from oil, dirt, and sunlight or as required by Manufacturer.

PART 2 PRODUCTS

2.01 HYDROPHILIC WATERSTOP

- A. For use at construction joints only, where new concrete is placed against existing concrete and as shown on Drawings.
- B. Material shall be a nonbentonite hydrophilic rubber compound.
- C. Manufacturers and Products:
 - 1. Greenstreak Plastic Products, St. Louis, MO; Hydrotite CJ-1020-2K with Leakmaster LV-1 adhesive and sealant.
 - 2. Adeka Ultra Seal, JLM Associates, Spearfish, SD; MC-2010M with 3M-2141 adhesive and P-201 sealant.

2.02 BOND BREAKER

- A. Tape for Joints: Adhesive-backed glazed butyl or polyethylene tape. Same width as joint that will adhere to premolded joint material or concrete surface.
- B. Use bond prevention material as specified in Section 03 30 00, Cast-in-Place Concrete, except where bond breaker tape is specifically called for on Drawings.

2.03 PREMOLDED JOINT FILLER

- A. Bituminous Type: ASTM D994 or ASTM D1751.
- B. Sponge Rubber:
 - 1. Neoprene, closed-cell, expanded; ASTM D1056, Type 2C5, with compression deflection, 25 percent deflection (limits), 119 kPa to 168 kPa (17 psi to 24 psi) minimum. Use in joints for potable and nonpotable water containment structures.
 - 2. Manufacturer and Product: Monmouth Rubber and Plastics, Corp, Long Branch, NJ; Durafoam DK5151.

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2.04 BUILDING PREFORMED CONTROL JOINT

- A. One-Piece, Flexible, Polyvinyl Chloride Joint Former:
 - 1. Manufacturer and Product: WR Meadows, Inc., Hampshire, IL; Keyway.
- B. One-Piece Galvanized Steel Strip with Preformed Groove:
 - 1. Manufacturer and Product: BoMetals, Inc. Carrollton, GA; QuickKey or ProKey Joint.
- C. Furnish in full-length, unspliced pieces.

2.05 POURABLE JOINT FILLERS

- A. General:
 - 1. Although product is a sealant, it is being specified as a filler to prevent debris accumulation and allow expansion and contraction under shrinkage and thermal loads. It does not need to meet proportional sealant geometry requirements.
 - 2. For Potable Water Containment structures, meet requirements of NSF 61.

2.06 ACCESSORIES

- A. Steel Reinforcement: As specified in Section 03 21 00, Steel Reinforcement.
- B. Nails: Galvanized, as required for securing premolded joint filler.
- C. Galvanized Rebar at Control Joints: ASTM A767/A767M and ASTM A615/A615M Grade 60 prior to galvanizing.

PART 3 EXECUTION

3.01 GENERAL

- A. Commence concrete placement after joint preparation is complete.
- B. Time Between Concrete Pours: As specified in Section 03 30 00, Cast-in-Place Concrete.

3.02 SURFACE PREPARATION

- A. Construction Joints: Prior to placement of abutting concrete, clean contact surface.
 - 1. Remove laitance and spillage from steel reinforcement and dowels.
 - 2. Roughen surface to minimum of 1/4-inch amplitude:
 - a. Sandblast after concrete has fully cured.
 - b. Water blast after concrete has partially cured.
 - c. Green cut fresh concrete with high-pressure water and hand tools.
 - 3. Perform cleaning so as not to damage waterstop, if one is present.

- B. Expansion Joint:
 - 1. Use wire brush or motorized device to mechanically roughen and thoroughly clean concrete surfaces on each side of joint from plastic waterstop to top of joint.
 - 2. Use dry, high-pressure air to remove dust and foreign material, and dry joint.
 - 3. Prime surfaces as required before placing joint filler.
 - 4. Avoid damage to waterstop.

- C. Contraction Joint and Control Joint:
 - 1. Coat concrete surfaces above and below plastic waterstop with bond breaker.
 - 2. Do not damage or coat waterstop.

- D. Construction Joint with Hydrophilic Waterstop:
 - 1. Follow hydrophilic waterstop manufacturer's written instructions.
 - 2. Clean debris, dirt, dust, and foreign material from concrete surface. Concrete surface must be smooth, clean, and dry. Grind concrete as required.

3.03 INSTALLATION OF WATERSTOPS

- A. General:
 - 1. Continuous waterstop shall be installed in all construction joints in walls and slabs of water holding basins and channels and in walls of belowgrade structures, unless specifically noted otherwise.
 - 2. Join waterstop at intersections to provide continuous seal.

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3. Center waterstop on joint.
4. Secure waterstop in correct position.
5. Repair or replace damaged waterstop.
6. Place concrete and vibrate to obtain impervious concrete in vicinity of joints.

B. Hydrophilic Waterstop:

1. Install in accordance with manufacturer's written instructions.
2. Provide minimum of 2-1/2 inches of concrete cover over waterstop. When structure has two layers of steel reinforcement, locate centered between layers of steel or as shown.
3. Apply adhesive to concrete surface and allow to dry for specified time before applying waterstop strip.
4. Lap ends of waterstop strip together at splices and corners and join with sealant.
5. Verify that waterstop is anchored firmly in place before placing concrete. Do not allow vibrator to come into contact with waterstop.
6. Lap hydrophilic waterstop 2 feet minimum with intersecting plastic waterstops.

3.04 EXPANSION JOINT INSTALLATION

A. Premolded Joint Filler:

1. Sufficient in width to completely fill joint space where shown.
2. Install per manufacturer's written instructions.
3. If waterstop is in joint, cut premolded joint filler to butt tightly against waterstop and concrete face.
4. Precut premolded joint filler to required depth at locations where joint filler or sealant is to be applied.
5. Form cavities for joint filler with either precut, premolded joint filler, or smooth removable accurately shaped material. Entire joint above waterstop, in slabs, shall be formed and removed so that entire space down to waterstop can be filled with the pourable joint filler.
6. Vibrate concrete thoroughly along joint form to produce dense, smooth surface.

B. Bituminous Type Premolded Joint Filler:

1. Drive nails approximately 1 foot 6 inches on center through filler, prior to installing, to provide anchorage embedment into concrete during concrete placement.
2. Secure premolded joint filler in forms before concrete is placed.
3. Install in walkways, at changes in direction, at intersections, at each side of driveway entrances, and at 45-foot intervals, maximum.

C. Sponge Rubber Joint Filler: Install per manufacturer's written instructions.

D. Pourable Joint Filler:

1. General:

a. Install in accordance with the manufacturer's written instructions, except as specified below:

- 1) Apply primer prior to pouring joint filler.
- 2) Fill entire joint above the waterstop with joint filler as shown.
- 3) Use masking tape on top of slabs at sides of joints; clean spillage. Remove masking tape afterwards.
- 4) Sealant products used as fillers need not meet sealant geometry parameters. Do not use backing rods.

3.05 CONTRACTION JOINT INSTALLATION

A. Place bond breaker above and below waterstop.

B. Vibrate concrete thoroughly along the joint form to produce a dense, smooth surface. Do not roughen surface.

3.06 CONTROL JOINT INSTALLATION

A. Vibrate concrete thoroughly along the joint form to produce a dense, smooth surface. Do not roughen surface.

B. Install bond breaker to concrete surfaces above and below waterstop.

3.07 PREFORMED CONTROL JOINTS

A. Use only where specifically shown; do not use in water-holding basins.

B. Locate slightly below top of slab.

C. Install in accordance with manufacturer's written instructions in straight, full-length pieces.

D. Steel Strip Type with Preformed Groove: Brace to withstand pressure of concrete during and after placement using only approved stakes and other secondary installation materials.

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3.08 MANUFACTURER'S SERVICES

- A. Provide manufacturer's representative at Site for installation assistance, inspection, and certification of proper installation for products specified.

3.09 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

**SECTION 03 21 00
STEEL REINFORCEMENT**

PART 1 GENERAL

1.01 GENERAL

- A. Steel reinforcement shall comply with ACI 301 and as modified in the following.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Concrete Institute (ACI):
 - a. 117, Specification for Tolerances for Concrete Construction and Materials.
 - b. 301, Specifications for Structural Concrete.
 - c. SP-66, Detailing Manual.
 2. American Welding Society (AWS): D1.4/D1.4M, Structural Welding Code - Reinforcing Steel.
 3. ASTM International (ASTM):
 - a. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - b. A706/A706M, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
 - c. A767/767M, Standard Specification for Zinc-Coated (Galvanized) Steel bars for Concrete Reinforcement
 - d. A775/A775M, Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
 - e. A1064/A1064M, Standard Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 4. Concrete Reinforcing Steel Institute (CRSI):
 - a. Placing Reinforcing Bars.
 - b. Manual of Standard Practice.
 5. International Code Council (ICC): Evaluation Services Report.

1.03 SUBMITTALS

- A. Action Submittals:
1. Shop Drawings prepared in accordance with ACI 301 and ACI SP-66:
 - a. Bending lists.
 - b. Placing drawings.
 2. Welded, metallic sleeve splice, and mechanical threaded connection.

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B. Informational Submittals:

1. Lab test reports for steel reinforcement showing stress-strain curves and ultimate strengths.
2. Mechanical Threaded Connections:
 - a. Current ICC Evaluation Services Report or equivalent code agency report listing findings to include acceptance, special inspection requirements, and restrictions.
 - b. Verification device threads have been tested and meet requirements for thread quality, in accordance with manufacturer's published methods.
 - c. Manufacturer's instructions.
3. Test results of field testing.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with ACI 301 and recommendations of CRSI Placing Reinforcing Bars.

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing Bars:

1. Includes stirrups, ties, and spirals.
2. ASTM A767/767M, Grade 60, for galvanized bars.

B. Mechanical Splices and Connections:

1. Capable of developing in tension or compression.
2. Specific product within the system/series shall be certified to comply with Type 2 mechanical splice requirements in accordance with ACI 318 and IBC.
3. Shall be configured such that concrete cover over coupler complies with specified minimum cover for steel reinforcement, and maintains position of reinforcement within specified placement tolerances.
4. Manufacturers and Products:
 - a. Erico International Corporation, Solon, OH; CADWELD or nVent LENTON Mechanical Splice System.
 - b. Dayton Superior Corporation, Miamisburg, OH; 100- through 400-Series.

C. Mechanical Anchors for Steel Reinforcing:

1. Furnish metal mechanical anchor with internal threads engaging threaded ends of bars.
2. Mechanical anchors shall be classified as Class HA per ASTM A970.
3. Specific product within the system/series shall be certified to comply with Type 2 mechanical splice requirements in accordance with ACI 318 and IBC.
4. Manufacturers and Products:
 - a. Erico Products, Inc, Cleveland, OH; D14 nVent Lenton Terminator or DR14 nVent Ultimate Terminator Mechanical Anchors.
 - b. Dayton Superior Corporation, Miamisburg, OH; D252L End Anchors.

D. Welded Wire Fabric:

1. ASTM A1064, using wire of 75 ksi minimum tensile strength.
2. Furnish flat sheets only, rolled sheets not permitted.

2.02 ACCESSORIES

A. Tie Wire:

1. Black, soft-annealed 16-gauge wire.
2. Nylon-, epoxy-, or plastic-coated wire.

B. Bar Supports and Spacers:

1. Use precast concrete bar supports or all-plastic bar supports and side form spacers, unless noted otherwise. Do not use other types of supports or spacers.
2. Bar supports shall have sufficient strength and stiffness to carry loads without failure, displacement, or significant deformation. Space bar supports so minimum concrete cover is maintained for reinforcing between supports.
3. Use only precast concrete bar supports where concrete surfaces are exposed to weather, earth, water, chloride intrusion, or corrosive chemicals. Bar supports shall be nonconductive and have geometry and bond characteristics that deter movement of moisture from the surface to the reinforcement.

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4. Precast concrete supports shall have same minimum strength and shall be made from same materials as that of the concrete in which they are to be embedded. Precast concrete supports shall be cast and properly cured for at least 7 days before use and shall have a wire or other device cast into each block for the purpose of attaching them securely to steel reinforcement.
5. In Beams, Columns, Walls, and Slabs Exposed to View after Form Removal: Use small precast concrete blocks made of same color as concrete in which they are embedded. All-plastic bar supports and side form spacers may be used, except where surface is exposed as described above.
6. Design and fabricate special bar supports for top reinforcing bars in slabs where standard bar supports do not possess necessary geometry, strength, or stiffness.
7. Use supports made of dielectric material for epoxy-coated reinforcing bars supported from formwork.
8. Plastic Bar Supports: Manufactured by Aztec Concrete Accessories, Bloomington, CA.
9. Precast Concrete Supports:
 - a. Total bond precast, high-performance concrete bar supports as supplied by:
 - 1) Dayton Superior, Miamisburg, OH, Dobies.

PART 3 EXECUTION

3.01 PREPARATION

- A. Notify Engineer when reinforcing is ready for inspection and allow sufficient time for inspection prior to placing concrete.
- B. Clean reinforcing bars of loose mill scale, oil, earth, and other contaminants.
- C. Coat wire projecting from precast concrete bar supports with dielectric material, epoxy, or plastic.

3.02 INSTALLATION

- A. Bundle or space bars, instead of field bending where construction access through reinforcing is necessary.
- B. Splicing:
 1. Minimum length of lap splices shall comply with table in Contract Documents.
 2. Use lap splices, unless otherwise shown or permitted in writing by Engineer.

3. Welded Splices: Accomplish by full penetration groove welds and develop a minimum of 125 percent of yield strength of bar.
 4. Stagger splices in adjacent bars where indicated.
- C. Mechanical Splices and Connections:
1. Use only in areas specifically approved in writing by Engineer.
 2. Install threaded rods as recommended by manufacturer with threads totally engaged into coupling sleeve and in accordance with ICC Evaluation Services Report or equivalent code agency report.
 3. For metal sleeve splice, follow manufacturer's installation recommendations.
 4. Maintain minimum edge distance and concrete cover.
- D. Tying Reinforcing Bars:
1. Tie every other intersection on mats made up of Nos. 3, 4, 5, and 6 bars to hold them firmly at required spacing.
 2. Bend tie wire away from concrete surface to provide clearance of 1 inch from surface of concrete to tie wire.
- E. Reinforcement Around Openings: On each side and above and below pipe or opening, place an equivalent area of steel bars to replace steel bars cut for opening. Extend steel reinforcing a standard lap length beyond opening at each end.
- F. Straightening and Rebending: Field bending of steel reinforcement bars is not permitted.
- G. Unless permitted by Engineer, do not cut reinforcing bars in field.

3.03 WELDED WIRE FABRIC INSTALLATION

- A. Use only where specifically shown.
- B. Extend fabric to within 2 inches of edges of slab and lap splices at least 1-1/2 courses of fabric or minimum 8 inches.
- C. Tie laps and splices securely at ends and at least every 24 inches with tie wire.
- D. Place welded wire fabric on concrete blocks and rigidly support equal to that provided for reinforced bars. Do not use broken concrete, brick, or stone.
- E. Do not use fabric that has been rolled. Install flat sheets only.

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3.04 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
1. American Concrete Institute (ACI):
 - a. 117, Specification for Tolerances for Concrete Construction and Materials.
 - b. 301, Specifications for Structural Concrete.
 - c. 305.1, Specification for Hot Weather Concreting.
 - d. 306.1, Standard Specification for Cold Weather Concreting.
 - e. 350.1, Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures.
 - f. CP-1, Technical Workbook for ACI Certification of Concrete Field Testing Technician – Grade 1.
 2. ASTM International (ASTM):
 - a. C31/C31M, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - b. C33/C33M, Standard Specification for Concrete Aggregates.
 - c. C39/C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - d. C94/C94M, Standard Specification for Ready-Mixed Concrete.
 - e. C109/C109M, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
 - f. C143/C143M, Standard Test Method for Slump of Hydraulic-Cement Concrete.
 - g. C150/C150M, Standard Specification for Portland Cement.
 - h. C157/C157M, Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
 - i. C227, Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method).
 - j. C231/C231M, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 - k. C260/C260M, Standard Specification for Air-Entraining Admixtures for Concrete.
 - l. C494/C494M, Standard Specification for Chemical Admixtures for Concrete.
 - m. C595/C595M, Standard Specification for Blended Hydraulic Cements.

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- n. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 - o. C881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
 - p. C979/C979M, Standard Specification for Pigments for Integrally Colored Concrete.
 - q. C989, Standard Specification for Slag Cement for Use in Concrete and Mortars.
 - r. C1012/C1012M, Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution.
 - s. C1017/C1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
 - t. C1074, Standard Practice for Estimating Concrete Strength by the Maturity Method.
 - u. C1077, Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.
 - v. C1218/C1218M, Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
 - w. C1240, Standard Specification for Silica Fume Used in Cementitious Mixtures.
 - x. C1260, Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
 - y. C1293, Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
 - z. C1567, Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
 - aa. C1582/C1582M, Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete.
 - bb. C1602/C1602M, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
 - cc. D4580, Standard Practice for Measuring Delaminations in Concrete Bridge Decks by Sounding.
 - dd. E329, Standard Specification for Agencies Engaged in Construction Inspection, Special Inspection, or Testing Materials Used in Construction.
 - ee. E1155, Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers.
3. National Ready Mixed Concrete Association (NRMCA).

1.02 DEFINITIONS

- A. Cold Weather: When ambient temperature is below 40 degrees F or is approaching 40 degrees F and falling.
- B. Contractor's Licensed Design Engineer: Individual representing Contractor who is licensed to practice engineering as defined by statutory requirements of professional licensing laws in state or jurisdiction in which Project is to be constructed.
- C. Defective Area: Surface defects that include honeycomb, rock pockets, indentations, and surface voids greater than 3/16-inch deep, surface voids greater than 3/4 inch in diameter, cracks in liquid containment structures and below grade habitable spaces that are 0.005-inch wide and wider, and cracks in other structures that are 0.010-inch wide and wider, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances and include but are not limited to fins, form pop-outs, and other projections. At exposed concrete, defective areas also include texture irregularities, stains, and other color variations that cannot be removed by cleaning.
- D. Exposed Concrete: Concrete surface that can be seen inside or outside of structure regardless of whether concrete is above water, dry at all times, or can be seen when structure is drained.
- E. Hot Weather: As defined in ACI 305.1.
- F. Hydraulic Structure: Liquid containment structure.
- G. New Concrete: Less than 60 days old.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Mix Designs:
 - a. Contain proportions of materials and admixtures to be used on Project, signed by mix designer.
 - b. Documentation of average strength for each proposed mix design in accordance with ACI 301.
 - c. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for the following:
 - 1) Portland cement.
 - 2) Fly ash.
 - 3) Slag cement.

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- 4) Silica Fume.
 - 5) Aggregates, including specified class designation for coarse aggregate.
 - 6) Admixtures.
 - 7) Concrete producer has verified compatibility of constituent materials in design mix.
- d. Test Reports:
- 1) Cement: Chemical analysis report.
 - 2) Supplementary Cementitious Materials: Chemical analysis report and report of other specified test analyses.
 - 3) Water-Soluble Chloride-Ion Content in Hardened Concrete: Unless otherwise permitted, in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.
- e. Aggregates:
- 1) Coarse Aggregate Gradation: List gradings and percent passing through each sieve.
 - 2) Fine Aggregate Gradation: List gradings and percent passing through each sieve.
 - 3) Percent of fine aggregate weight to total aggregate weight.
 - 4) Deleterious substances in fine aggregate per ASTM C33/C33M, Table 2.
 - 5) Deleterious substances in coarse aggregate per ASTM C33/C33M, Table 4.
 - 6) Test Reports:
 - a) Alkali Aggregate Reactivity: Aggregate shall be classified as nonpotentially reactive in accordance with Article Concrete Mix Design. Include documentation of test results per applicable standards.
- f. Admixtures: Manufacturer's catalog cut sheets and product data sheets for each admixture used in proposed mix designs.
2. Product Data: Specified ancillary materials.
3. Detailed plan for curing and protection of concrete placed and cured in cold weather. Details shall include, but not be limited to, the following:
- a. Procedures for protecting subgrade from frost and accumulation of ice or snow on reinforcement, other metallic embeds, and forms prior to placement.
 - b. Procedures for measuring and recording temperatures of reinforcement and other embedded items prior to concrete placement.
 - c. Methods for temperature protection during placement.
 - d. Types of covering, insulation, housing, or heating to be provided.
 - e. Curing methods to be used during and following protection period.
 - f. Use of strength accelerating admixtures.

- g. Methods for verification of in-place strength.
- h. Procedures for measuring and recording concrete temperatures.
- i. Procedures for preventing drying during dry, windy conditions.
- 4. Detailed plan for hot weather placements including curing and protection for concrete placed in ambient temperatures over 80 degrees F. Plan shall include, but not be limited to, the following:
 - a. Procedures for measuring, and recording temperatures of reinforcement and other embedded items prior to concrete placement.
 - b. Use of retarding admixture.
 - c. Methods for controlling temperature of reinforcement and other embedded items and concrete materials before and during placement.
 - d. Types of shading and wind protection to be provided.
 - e. Curing methods, including use of evaporation retardant.
 - f. Procedures for measuring and recording concrete temperatures.
 - g. Procedures for preventing drying during dry, windy conditions.
- 5. Concrete repair techniques.

B. Informational Submittals:

- 1. Preinstallation Conference minutes.
- 2. Manufacturer's application instructions for bonding agent and bond breaker.
- 3. Manufacturer's Certificate of Compliance to specified standards:
 - a. Bonding agent.
 - b. Bond breaker.
 - c. Repair materials.
- 4. Statement of Qualification:
 - a. Batch Plant: Certification as specified herein.
 - b. Mix designer.
 - c. Installer.
 - d. Testing agency.
- 5. Field test reports.
- 6. Recorded temperature data from concrete placement where specified.
- 7. Liquid tightness test results.
- 8. Concrete Delivery Tickets:
 - a. For each batch of concrete before unloading at Site.
 - b. In accordance with ASTM C94/C94M, including requirements 14.2.1. through 14.2.10.
 - c. Indicate amount of mixing water withheld and maximum amount that may be permitted to be added at Site.

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1.04 QUALITY ASSURANCE

- A. Concrete construction shall conform to requirements of ACI 117 and ACI 301, except as modified herein.
- B. Qualifications:
 - 1. Batch Plant: NRMCA Program for Certification of Ready-Mixed Concrete Production Facilities or approved equivalent program.
 - 2. Mix Designer: Person responsible for developing concrete mixture proportions certified as NRMCA Concrete Technologist Level 2 or DOT certified mix designer in jurisdiction of the Work. Requirement may be waived if individual is Contractor's Licensed Design Engineer.
 - 3. Flatwork Finisher: Unless otherwise permitted, at least one person on finishing crew shall be certified as an ACI Flatwork Finisher, or equivalent.
 - 4. Testing Agency: Unless otherwise permitted, an independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.
 - a. Where field testing is required of Contractor, personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 - b. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- C. Mockup Panels:
 - 1. Construct one panel for each form liner type specified in Section 03 10 00, Concrete Forming and Accessories.
 - 2. Construct in accordance with requirements of Contract Documents to demonstrate wall finish Type W-7.
 - a. Dimensions: 10 feet by 8 feet, minimum.
 - 3. Before concrete work starts, construct panels with specified materials, forming systems, reinforcing details, and leakage prevention techniques.
 - 4. Show architectural details, joints, form ties, form liners, and rebar spacers to produce finished surface required.
 - 5. Test form release agent on one mockup panel to ensure no adverse effects are caused on form or form liner materials.
 - 6. Cast panels from minimum of 3-cubic-yard truck mixer load.
 - 7. Surface finish and color shall be uniform in appearance to Samples.

8. Approved panels shall establish standards of quality by which Work will be judged.
9. Replace panels if not representative of Work as specified.
10. Panels may be incorporated into Work if approved by Engineer.
11. Use mockup panel(s) or Engineer-selected portion of as-cast wall surface hidden from view to develop and test patching techniques and mixes.
 - a. Obtain Engineer approval prior to using material to repair project structures.
 - b. Demonstrate application, curing, and finishing procedures of repair material.
 - c. Approved repairs shall establish standards of quality by which Work will be judged.

D. Preinstallation Conference:

1. Required Meeting Attendees:
 - a. Contractor, including pumping, placing and finishing, and curing subcontractors.
 - b. Ready-mix producer.
 - c. Admixture representative.
 - d. Testing and sampling personnel.
 - e. Engineer.
2. Schedule and conduct prior to incorporation of respective products into Project. Notify Engineer of location and time.
3. Agenda shall include:
 - a. Admixture types, dosage, performance, and redosing at Site.
 - b. Mix designs, test of mixes, and Submittals.
 - c. Placement methods, techniques, equipment, consolidation, and form pressures.
 - d. Slump and placement time to maintain slump.
 - e. Finish, curing, and water retention.
 - f. Protection procedures for weather conditions.
 - g. Other specified requirements requiring coordination.
4. Conference minutes as specified in Section 01 31 19, Project Meetings.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cementitious Materials:

1. Cement:
 - a. Portland Cement: Unless otherwise specified, conform to requirements of ASTM C150/C150M.

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- b. Blended Hydraulic Cement:
 - 1) Unless otherwise specified, conform to requirements of ASTM C595/C595M.
 - 2) Portland cement used in blended hydraulic cement, conform to requirements of ASTM C150/C150M.
 - c. Furnish from one source.
 - 2. Supplementary Cementitious Materials (SCM):
 - a. Fly Ash (Pozzolan): Class F and Class C fly ash in accordance with ASTM C618, except as modified herein:
 - 1) Shall not be produced from process that has utilized hazardous or potentially hazardous materials.
 - 2) ASTM C618, Table 1, Loss on Ignition: Unless permitted otherwise, maximum 3 percent.
 - b. Slag Cement: In accordance with ASTM C989, Grade 100 or Grade 120.
 - 1) Shall not be produced from process that has utilized hazardous or potentially hazardous materials.
 - c. Silica Fume: ASTM C1240.
- B. Aggregates: Furnish from one source for each aggregate type used in a mix design.
- 1. Normal-Weight Aggregates:
 - a. In accordance with ASTM C33/C33M, except as modified herein.
 - 1) Class Designation: 4S unless otherwise specified.
 - b. Free of materials and aggregate types causing popouts, discoloration, staining, or other defects on surface of concrete.
 - c. Alkali Silica Reactivity: See Article Concrete Mix Design.
 - 2. Fine Aggregates:
 - a. Clean, sharp, natural sand.
 - b. ASTM C33/C33M.
 - c. Limit deleterious substances in accordance with ASTM C33/C33M, Table 2 and as follows:
 - 1) Limit material finer than 75- μ m (No. 200) sieve to 5 percent mass of total sample.
 - 2) Limit coal and lignite to 1.0 percent.
 - 3. Coarse Aggregate:
 - a. Natural gravels, combination of gravels and crushed gravels, crushed stone, or combination of these materials containing no more than 15 percent flat or elongated particles (long dimension more than five times the short dimension).
 - b. Limit deleterious substances in accordance with ASTM C33/C33M, Table 4 for specified class designation.

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- C. Admixtures: Unless otherwise permitted, furnish from one manufacturer.
1. Characteristics:
 - a. Compatible with other constituents in mix.
 - b. Contain at most, only trace amount chlorides in solution.
 - c. Do not use admixtures known to be toxic after concrete is 30 days.
 - d. Furnish type of admixture as recommended by manufacturer for anticipated temperature ranges.
 2. Air-Entraining Admixture: ASTM C260/C260M.
 3. Water-Reducing Admixture: ASTM C494/C494M, Type A or Type D.
 - a. Manufacturers and Products:
 - 1) BASF Admixtures Inc., Shakopee, MN; Pozzolith Series or PolyHeed Series.
 - 2) Euclid Chemical Co., Cleveland, OH; Eucon Series.
 - 3) W. R. Grace & Co., Cambridge, MA; Daracem Series or Mira Series.
 4. Retarding Admixture: ASTM C 494/C 494M, Type B.
 5. Accelerating Admixture: ASTM C 494/C 494M, Type C.
 6. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F or Type G.
 - a. Manufacturers and Products:
 - 1) BASF Admixtures Inc., Shakopee, MN; Glenium Series, PS 1460, or Rheobuild 1000.
 - 2) Euclid Chemical Co., Cleveland, OH; Eucon Series or Plastol Series.
 - 3) W. R. Grace & Co., Cambridge, MA; ADVA Series, Daracem Series, or EXP 950.
 7. Plasticizing Admixture: ASTM C1017/C1017M, Type I or Type II.
 8. Corrosion Inhibiting Admixtures: ASTM C1582/C1582M.
 9. Do not use calcium chloride as an admixture.
 10. Admixtures with no standard, ASTM or other, designation may be used where permitted.
- D. Water and Ice: Mixing water for concrete and water used to make ice shall be potable water, unless alternative sources of water are permitted.
1. Water from alternative sources shall comply with requirements of ASTM C1602/C1602M, and concentration of chemicals in combined mixing water shall be less than:
 - a. Chloride Content: 1,000 ppm.
 - b. Sulfate Content as SO₄: 3,000 ppm.
 - c. Alkalis as (Na₂O + 0.658 K₂O): 600 ppm.
 - d. Total Solids by Mass: Less than 50,000 ppm.

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2.02 ANCILLARY MATERIALS

A. Bonding Agent: Unless otherwise specified, in accordance with the following:

1. ASTM C881/C881M, Type V.
2. Two-component, moisture insensitive, 100 percent solids epoxy.
3. Consult manufacturer for surface finish, pot life, set time, vertical or horizontal application, and forming restrictions.
4. Manufacturers and Products:
 - a. BASF Building Systems Inc., Shakopee, MN; Concreive Standard LVI.
 - b. Euclid Chemical Co., Cleveland, OH; Euco # 352 Epoxy System LV.
 - c. Prime Resins, Conyers, GA; Prime Bond 3000 to 3900 Series.
 - d. Sika Chemical Corp., Lyndhurst, NJ; Sikadur 32 Hi-Mod.

B. Bond Breaker:

1. Nonstaining type, providing positive bond prevention.
2. Manufacturers and Products:
 - a. Dayton Superior Corporation, Kansas City, KS; EDOCO Clean Lift Bond Breaker.
 - b. Nox-Crete Products Group, Omaha, NE; Silcoseal Select.

C. Repair Material:

1. Contain only trace amounts of chlorides and other chemicals that can potentially cause steel to oxidize.
2. Where repairs of exposed concrete are required, prepare mockup using proposed repair materials and methods, for confirmation of appearance compatibility prior to use.
3. Obtain Manufacturer's Certificate of Compliance that products selected are appropriate for specific applications.
4. Repair mortar shall be Site mixed.
5. Prepare concrete substrate and mix, place, and cure repair material in accordance with manufacturer's written recommendations.
6. Manufacturers and Products:
 - a. BASF Building Systems Inc., Shakopee, MN; MasterEmaco S Series products.
 - b. Sika Chemical Corp., Lyndhurst, NJ; SikaTop Series.

D. Crack Repair:

1. Obtain Letter of Certification from manufacturer's technical representative, that products selected are appropriate for the specific applications.
2. Prepare concrete substrate and mix, place, and cure repair material in accordance with manufacturer's written recommendations.
3. Use part epoxy injection resin for structural crack repairs.
 - a. Manufacturers:
 - 1) BASF Construction Chemicals, LLC-Building Systems Shakopee, MN; MasterInject Series.
 - 2) Euclid Chemical Co., Cleveland, OH.; Euco Series (#452).
 - 3) Sika Chemical Corp., Lyndhurst, NJ.; Sikadur Series.
4. Use hydrophilic polyurethane injection resin for non-structural crack repairs.
 - a. Manufacturers:
 - 1) BASF Construction Chemicals, LLC-Building Systems Shakopee, MN; MasterInject 1210 IUG.
 - 2) Euclid Chemical Co., Cleveland, OH.; Dural Aqua-Fil.
 - 3) Sika Chemical Corp., Lyndhurst, NJ.; SikaFix HH Hydrophilic.
 - 4) Prime Resins, Inc., Conyers, GA.; Prime Flex 900 XLV.

2.03 CONCRETE MIX DESIGN

A. General:

1. See Supplement at the end of this section for mix design requirements for each class of concrete used on Project.
2. Prepare design mixtures for each type and strength of concrete, selecting and proportioning ingredients in accordance with requirements of ACI 301, unless otherwise specified.
3. Selection of constituent materials and products in mix design are optional, unless specified otherwise.
4. Unless otherwise permitted, use water-reducing admixture or water-reducing admixture and high-range, water-reducing admixture, or plasticizing admixture in pumped concrete, in concrete with a water-cementitious materials ratio below 0.50, and in concrete that is part of a liquid-containment structure.
5. Unless otherwise permitted, use water-reducing admixture and high-range, water-reducing admixture, or plasticizing admixture in columns, piers, pilasters, and walls.

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6. Use water-reducing admixture or high-range, water-reducing admixture, or plasticizing admixture to achieve fresh properties that facilitate handling, placing, and consolidating of concrete, and specified hardened properties.
7. Use water-reducing and retarding admixture when anticipated high temperatures, low humidity, or other adverse placement conditions can adversely affect fresh properties of concrete.
8. Unless otherwise specified, desired fresh properties of concrete shall be determined by Contractor, and coordinated with concrete producer. Fresh properties of concrete shall remain stable to satisfaction of Contractor, for duration of placement and consolidation, and shall remain in conformance with requirements of Contract Documents.

B. Potential alkali-aggregate reactivity of concrete:

1. Do not use aggregates known to be susceptible to alkali-carbonate reaction (ACR).
2. Aggregates shall have been tested to determine potential alkali-aggregate reactivity in concrete in accordance with ASTM C1260 or ASTM C1567.
 - a. Aggregates that indicate expansion greater than 0.10 percent at 16 days after casting shall not be used unless they have been shown to be nondeleteriously reactive in accordance with ASTM C227 or ASTM C1293, with less than 0.04 percent expansion at 1 year for cement-aggregate combinations or less than 0.04 percent expansion at 2 years for combinations with pozzolan or slag.
 - b. Alkali content of cement used in proposed concrete mixture shall not be greater than alkali content of cement used in test for potential alkali-aggregate reactivity.
 - c. Use low-alkali cement or incorporate pozzolans into concrete mixture as necessary to satisfy testing for potential alkali reactivity. Alternately, a chemical inhibitor such as a lithium based admixture may be proposed.

C. Proportions:

1. Design mix to meet aesthetic, durability, and strength requirements.
2. Where fly ash is included in mix, minimum fly ash content shall be a minimum of 15 percent of weight of total cementitious materials.

D. Slump Range at Site:

1. Prior to submitting mix design, consult with concrete producer and select a target slump value at point of delivery, for each application of each design mix. Unless otherwise permitted, target slump value will then be enforced for duration of Project. Unless otherwise permitted, target slump value is 4 inches at point of delivery, for concrete without high-range, water reducing admixture.
2. Design mixes that include a high-range, water-reducing or a plasticizing admixture shall have a minimum slump of 2 inches prior to addition of admixture. Unless otherwise permitted, slump shall be 8 inches maximum at point of delivery, for concrete with a high-range, water-reducing admixture.
3. Slump tolerance shall meet requirements of ACI 117.

E. Combined Aggregate Gradation:

1. Combined Gradation Limits: Fine aggregate shall be in range of 36 percent to 40 percent of total aggregate weight.

2.04 CONCRETE MIXING

A. General: In accordance with ACI 301, except as modified herein.

B. Truck Mixers:

1. For every truck, test slump of samples taken per ASTM C94/C94M, paragraph 12.5.1.
2. Where specified slump is more than 4 inches, and if slump tests differ by more than 2 inches, discontinue use of truck mixer, unless causing condition is corrected and satisfactory performance is verified by additional slump tests.

2.05 SOURCE QUALITY CONTROL

A. Source Quality Control Inspection: Engineer shall have access to and have right to inspect batch plants, cement mills, and supply facilities of suppliers, manufacturers, and Subcontractors, providing products included in this section.

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PART 3 EXECUTION

3.01 PLACING CONCRETE

- A. Preparation: Meet requirements ACI 301, except as modified herein.
- B. Inspection: Notify Engineer and Special Inspector at least 1 full working day in advance before starting to place concrete.
- C. Placement into Formwork:
 - 1. Reinforcement: Secure in position before placing concrete.
 - 2. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 1.5 feet deep, except for slabs which shall be placed full depth. Place and consolidate successive layers prior to initial set of first layer to prevent cold joints.
 - 3. Placement frequency shall be such that lift lines will not be visible in exposed concrete finishes.
 - 4. Use placement devices, for example chutes, pouring spouts, and pumps as required to prevent segregation.
 - 5. Vertical Free Fall Drop to Final Placement:
 - a. Forms 8 Inches or Less Wide: 5 feet.
 - b. Forms Wider than 8 Inches: 8 feet, except as specified.
 - 6. For placements where drops are greater than specified, use placement device such that free fall below placement device conforms to required value.
 - a. Limit free fall to prevent segregation caused by aggregates hitting steel reinforcement.
 - 7. Do not use aluminum conveying devices.
 - 8. Provide sufficient illumination in the interior of forms so concrete deposition is visible, permitting confirmation of consolidation quality.
 - 9. Trowel and round off top exposed edges of walls with 1/4-inch radius steel edging tool.
 - 10. Cure concrete as specified in Section 03 39 00, Concrete Curing.
- D. Conveyor Belts and Chutes:
 - 1. Design and arrange ends of chutes, hopper gates, and other points of concrete discharge throughout conveying, hoisting, and placing system for concrete to pass without becoming segregated.
 - 2. Do not use chutes longer than 50 feet.

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3. Minimum Slopes of Chutes: Angled to allow concrete to readily flow without segregation.
 4. Conveyor Belts:
 - a. Approved by Engineer.
 - b. Wipe clean with device that does not allow mortar to adhere to belt.
 - c. Cover conveyor belts and chutes.
- E. Retempering: Not permitted for concrete where cement has partially hydrated.
- F. Pumping of Concrete:
1. Provide standby pump, conveyor system, crane and concrete bucket, or other system onsite during pumping, for adequate redundancy to ensure completion of concrete placement without cold joints in case of primary placing equipment breakdown.
 2. Minimum Pump Hose (Conduit) Diameter: 4 inches.
 3. Replace pumping equipment and hoses (conduits) that are not functioning properly.
- G. Maximum Size of Concrete Placements:
1. Limit size of each placement to allow for strength gain and volume change as a result of shrinkage.
 2. Locate expansion, control, and contraction joints where shown on Drawings.
 3. Construction Joints: Unless otherwise shown or permitted, locate construction joints as follows:
 - a. Locate construction joints as shown on Drawings or where approved in joint location submittal required in Section 03 15 00, Concrete Joints and Accessories.
 - b. Provide vertical construction joints in walls and slabs at maximum spacing of 40 feet, unless shown or approved otherwise.
 - c. When vertical expansion, contraction, or control joint spacing does not exceed 60 feet, intermediate construction joints are not required.
 - d. Uniformly space vertical construction joints within straight sections of walls and slabs, avoiding penetrations.
 4. Consider beams, girders, brackets, column capitals, and haunches as part of floor or roof system and place monolithically with floor or roof system.
 5. Should placement sequence result in cold joint located below finished water surface, install waterstop in joint.

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H. Minimum Time between Adjacent Placements:

1. Construction or Control Joints: 7 days unless otherwise specified.
2. Construction joint between top of footing or slab, and column or wall: As soon as can safely be done without damaging previously cast concrete or interrupting curing thereof, but not less than 24 hours.
3. Expansion or Contraction Joints: 1 day.
4. For columns and walls with a height in excess of 10 feet, wait at least 2 hours before depositing concrete in beams, girders, or slabs supported thereon.
5. For columns and walls 10 feet in height or less, wait at least 1 hour prior to depositing concrete in beams, girders, brackets, column capitals, or slabs supported thereon.

I. Consolidation and Visual Observation:

1. Consolidation Equipment and Methods: ACI 301.
2. Provide at least one standby vibrator in operable condition at Site prior to placing concrete.
3. Provide sufficient windows in forms or limit form height to allow for concrete placement through windows and for visual observation of concrete.
4. Vibrate concrete in vicinity of joints to obtain impervious concrete.

J. Hot Weather:

1. Prepare ingredients, mix, place, cure, and protect in accordance with ACI 301, ACI 305.1, and as follows:
 - a. Maintain concrete temperature below 95 degrees F at time of placement, or furnish test data or other proof that admixtures and mix ingredients do not produce flash set plastic shrinkage, or cracking as a result of heat of hydration. Cool ingredients before mixing to maintain fresh concrete temperatures as specified or less.
 - b. Provide for windbreaks, shading, fog spraying, sprinkling, ice, wet cover, or other means as necessary to maintain concrete at or below specified temperature.
2. Concrete Curing: As specified in Section 03 39 00, Concrete Curing.

K. Cold Weather Placement:

1. Unless otherwise permitted, shall be in accordance with requirements of ACI 306.1 and as follows:
 - a. Cold weather requirements shall apply when ambient temperature is below 40 degrees F or approaching 40 degrees F and falling.
 - b. Do not place concrete over frozen earth or against surfaces with frost or ice present. Frozen earth shall be thawed to acceptance of Engineer.
 - c. Unless otherwise permitted, do not place concrete in contact with surfaces less than 35 degrees F; requirement is applicable to all surfaces including reinforcement and other embedded items.
 - d. Provide supplemental external heat as needed when other means of thermal protection are unable to maintain minimum surface temperature of concrete as specified in ACI 306.1.
 - e. Maintain minimum surface temperature of concrete as specified in ACI 306.1 for no less than 3 days during cold weather conditions.
 - f. Cure concrete as specified in Section 03 39 00, Concrete Curing.
 - 1) Protect concrete from freezing until end of curing period and until concrete has attained a compressive strength of 3,500 psi or design compressive strength if less than 3,500 psi.
2. Provide maximum and minimum temperature sensors placed on concrete surfaces spaced throughout Work to allow monitoring of concrete surface temperatures representative of Work. Unless otherwise permitted, record surface temperature of concrete at least once every 12 hours during specified curing period.
3. External Heating Units: Do not exhaust heater flue gases directly into enclosed area as it causes concrete carbonation as a result of concentrated carbon dioxide.
4. Maintain curing conditions as specified in Section 03 39 00, Concrete Curing.

3.02 CONCRETE BONDING

- A. Construction Joints in New Concrete Members: Prepare surface of construction joint as specified in Section 03 15 00, Concrete Joints and Accessories.

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3.03 REPAIRING CONCRETE

- A. Repair defective areas of concrete.
 - 1. Cut edges perpendicular to surface at least 1/2 inch deep. Do not feather edges. Soak area with water for 24 hours.
 - 2. Patch with specified repair material.
 - 3. Repair concrete surfaces using specified materials. Select system, submit for review, and obtain approval from Engineer prior to use.
 - 4. Develop repair techniques with material manufacturer on surface that will not be visible in final construction prior to starting actual repair work and show how finish color will blend with adjacent surfaces. Obtain approval from Engineer.
 - 5. Obtain quantities of repair material and manufacturer's detailed instructions for use to provide repair with finish to match adjacent surface or apply sufficient repair material adjacent to repair to blend finish appearance.
 - 6. Repair of concrete shall provide structurally sound surface finish, uniform in appearance or upgrade finish by other means until acceptable to Engineer.

- B. Inject cracks that leak.
 - 1. When crack repair is deemed by Engineer as requiring a structural repair, use part epoxy injection resin.
 - 2. When crack repair is deemed by Engineer as requiring a nonstructural repair, use hydrophilic polyurethane injection resin.

3.04 CONCRETE WALL FINISHES

- A. Type W-1 (Ordinary Wall Finish):
 - 1. Patch tie holes.
 - 2. Knock off projections.
 - 3. Repair defective areas.
 - 4. Inject cracks in accordance with requirements of Section 03 64 23, Crack Repair Epoxy Injection Grouting.

- B. Type W-2 (Smooth Wall Finish):
 - 1. Patch tie holes.
 - 2. Grind off fins and other projections.
 - 3. Repair defective areas to provide smooth uniform appearance.
 - 4. Inject cracks in accordance with requirements of Section 03 64 23, Crack Repair Epoxy Injection Grouting.

C. Type W-3 (Controlled Permeability Form Liner):

1. Apply Controlled Permeability Form Liner, as specified in Section 03 10 00, Concrete Forming and Accessories, to each face of wall section.
2. Patch tie holes.
3. Grind off fins and other projections.
4. Repair defective areas to provide smooth uniform appearance.

D. Type W-10 (Fractured Fin Wall Finish):

1. Form exterior surface of walls with approved form liner.
2. Use stainless steel form ties and place at valleys.
3. Patch form tie holes.
4. Achieve final texture by light sandblast and then breaking off tips of ridge with light bushhammering, or other approved process.
5. Same person starting bushhammering shall complete process for any given structure and match approved mockup panel.

3.05 CONCRETE SLAB FINISHES

A. General:

1. Use manual screeds, vibrating screeds, or roller compacting screeds to place concrete level and smooth.
2. Do not use “jitterbugs” or other special tools designed for purpose of forcing coarse aggregate away from surface and allowing layer of mortar, which will be weak and cause surface cracks or delamination, to accumulate.
3. Finish slab in accordance with specified slab finish.
4. Do not dust surfaces with dry materials nor add water to surfaces.
5. Cure concrete as specified in Section 03 39 00, Concrete Curing.

B. Type S-1 (Steel Troweled Finish):

1. Finish by screeding and floating with straightedges to bring surfaces to required finish elevation.
2. Wood float to true, even plane with no coarse aggregate visible.
3. Use sufficient pressure on wood floats to bring moisture to surface.
4. After surface moisture has disappeared, hand steel trowel concrete to produce smooth, smooth dense surface, free from trowel marks.
5. Provide light steel-troweled finish (two trowelings) at air-entrained slabs. Provide hard steel-troweled finish (ringing sound from the trowel) for nonair-entrained slabs.

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6. Do not use dry cement or additional water during troweling, nor will excessive troweling be permitted.
 7. Power Finishing:
 - a. Approved power machine may be used in lieu of or in addition to hand finishing in accordance with directions of machine manufacturer.
 - b. Do not use power machine when concrete has not attained necessary set to allow finishing without introducing high and low spots in slab.
 - c. Do first steel troweling for slab S-1 finish by hand.
- C. Type S-2 (Wood Float Finish):
1. Finish slab to receive fill and mortar setting bed by screeding with straightedges to bring surface to required finish plane.
 2. Wood float finish to compact and seal surface.
 3. Remove laitance and leave surface clean.
 4. Coordinate with other finish procedures.
- D. Type S-3 (Underside Elevated Slab Finish): When forming is removed, grind off projections on underside of slab and repair defective areas, including small shallow air pockets where schedule of concrete finishes requires:
1. Prepare surfaces to match Type W-2 (Smooth Wall Finish).
- E. Type S-5 (Broomed Finish):
1. Finish as specified for Type S-1 floor finish, except use only a light-steel troweled finish, and then finish surface by drawing fine-hair broom lightly across surface.
 2. Broom in same direction and parallel to expansion joints, or, in case of inclined slabs, perpendicular to slope, except for round roof slab, broom surface in radial direction.
- F. Type S-6 (Sidewalk Finish):
1. Slope walks down 1/4 inch per foot away from structures, unless otherwise shown.
 2. Strike off surface by means of strike board and float with wood or cork float to true plane, then flat steel trowel before brooming.
 3. Broom surface at right angles to direction of traffic or as shown.
 4. Lay out sidewalk surfaces in blocks, as shown or as directed by Engineer, with grooving tool.

G. Concrete Curbs:

1. Float top surface of curb smooth, and finish all discontinuous edges with steel edger.
2. After concrete has taken its initial set, remove front form and give exposed vertical surface an ordinary wall finish, Type W-1.

3.06 CONCRETE SLAB TOLERANCES

A. Slab Tolerances:

1. Exposed Slab Surfaces: Comprise of flat planes as required within tolerances specified.
2. Slab Finish Tolerances and Slope Tolerances: Crowns on floor surface not too high as to prevent 10-foot straightedge from resting on end blocks, nor low spots that allow block of twice the tolerance in thickness to pass under supported 10-foot straightedge.
3. Slab Type S-A: Steel gauge block 5/16 inch thick.
4. Slab Type S-B: Steel gauge block 1/8 inch thick.
5. Slab Type S-A and S-B: Finish Slab Elevation: Slope slabs to floor drain and gutter, and shall adequately drain regardless of tolerances.
6. Thickness: Maximum 1/4 inch minus or 1/2 inch plus from thickness shown. Where thickness tolerance will not affect slope, drainage, or slab elevation, thickness tolerance may exceed 1/2 inch plus.

B. Slab Elevation and Thickness:

1. Finish Slab Elevation: Slope slabs to floor drains and gutter. Slabs shall adequately drain regardless of tolerances.
2. Thickness: Maximum 1/4 inch minus or 1/2 inch plus from thickness shown. Where thickness tolerance will not affect slope, drainage, or slab elevation, thickness tolerance may exceed 1/2 inch plus.

3.07 BEAM AND COLUMN FINISHES

A. Type B-1: Match wall Type W-1.

B. Type B-2: Match wall Type W-2.

C. Type B-3:

1. Repair rock pockets.
2. Fill air voids.
3. Match wall Type W-2.

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- D. Type C-1: Match wall Type W-1.
- E. Type C-2: Match wall Type W-2.
- F. Type C-3:
 - 1. Fill air pockets.
 - 2. Match wall Type W-3.

3.08 BACKFILL AGAINST STRUCTURES

- A. Do not backfill against walls until concrete has obtained specified 28-day compressive strength.
- B. Refer to General Structural Notes on the Drawings for additional requirements, including elevated slab and diaphragm completion prior to backfill.
- C. Unless otherwise permitted, place backfill simultaneously on both sides of structure, where such fill is required, to prevent differential pressures.

3.09 CLEANING AND STERILIZING OF POTABLE WATER BASINS

- A. Clean and sterilize structures for potable water as specified in Section 33 13 00, Disinfection of Water Utility Distribution Facilities.

3.10 FIELD QUALITY CONTROL

- A. General:
 - 1. Provide adequate facilities for safe storage and proper curing of concrete test specimens onsite for first 24 hours, and for additional time as may be required before transporting to test lab.
 - 2. Unless otherwise specified, sample concrete for testing for making test specimens, from point of delivery.
 - 3. When concrete is pumped, sample and test air content at point of delivery and at point of placement.
 - a. For Each Concrete Mixture: Provided results of air content tests for first load of the day are within specified limits, testing need only be performed at point of delivery for subsequent loads of that concrete mixture except that testing should be performed at point of placement every 4 hours.
 - 4. Evaluation will be in accordance with ACI 301 and Specifications.

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5. Test specimens shall be made, cured, and tested in accordance with ASTM C31/C31M and ASTM C39/C39M.
6. Frequency of testing may be changed at discretion of Engineer.
7. Pumped Concrete: Take concrete samples for slump, ASTM C143/C143M, and test specimens, ASTM C31/C31M and ASTM C39/C39M, at placement (discharge) end of line.
8. If measured air content at delivery is greater than specified limit, check test of air content will be performed immediately on a new sample from delivery unit. If check test fails, concrete has failed to meet requirements of Contract Documents. If measured air content is less than lower specified limit, adjustments will be permitted in accordance with ASTM C94/C94M, unless otherwise specified. If check test of adjusted mixture fails, concrete has failed to meet requirements of Contract Documents. Concrete that has failed to meet requirements of Contract Documents shall be rejected.

B. Concrete Strength Test:

1. Unless otherwise specified, one specimen at age of 7 days for information, and two 6-inch diameter or when permitted three 4-inch diameter test specimens at age of 28 days for acceptance.
2. If result of 7-day concrete strength test is less than 50 percent of specified 28-day strength, extend period of moist curing specified in Section 03 39 00, Concrete Curing, by 7 additional days.
3. Provide a minimum of one spare test specimen per sample. Test spare cylinder as directed by Engineer.

C. Liquid Tightness Tests:

1. Purpose: To determine integrity and liquid-tightness of finished exterior and interior concrete surfaces of liquid containment structures.
2. Test the following structures for liquid-tightness: Water Tower.
3. Potable water for initial tightness test shall be provided by Contractor.
 - a. Water source will be City Water (Well 6 using new water main).
 - b. Provide means to transport water to structure to be tested.
 - c. If additional tightness tests are required due to failure to meet criteria, provide water for subsequent tests.
4. After testing has been completed, dispose of test water in a manner approved by Owner.
5. Liquid-Tightness Test Requirement:
 - a. Perform tightness tests in accordance with ACI 350.1 and as specified herein.

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- b. Do not place backfill or install brick facing, grout topping slab, coatings, or other work that will cover concrete surfaces until tightness testing has been completed and approved.
 - c. Measure evaporation, precipitation, and temperature as specified.
 6. Measure water surface at two points 180 degrees apart when possible where attachments, such as ladders exist, at 24-hour intervals.
 7. Acceptance Criteria:
 - a. Acceptance of the containment structure shall be based on criteria for both Part 1 and Part 2. Containment structures shall be retested until they meet the required Part 1 and Part 2 criteria.
 - b. Part 1, Qualitative: If any water is observed on the containment structure surfaces, exterior to the contained liquid, where moisture can be picked up on a dry hand, the containment structure shall be considered to have failed Part 1 of the test.
 - c. Part 2, Quantitative:
 - 1) Volume loss shall not exceed 0.050 percent of contained liquid volume per 24-hour period, adjusted for evaporation, precipitation, and temperature
 - 2) Acceptance that structure has passed Part 2 of the tightness test shall be based on total volume loss at end of specified test period.
 8. Repairs When Test Fails:
 - a. Dewater structure; fill leaking cracks with crack repair epoxy as specified.
 - b. Patch areas of damp spots previously recorded, and repeat water leakage test in its entirety until structure successfully passes test.
- D. High-Range, Water-Reducer (Superplasticizer) Admixture Segregation Test: Test each truck prior to use on Project.
 1. Segregation Test Objective: Concrete with 4-inch to 8-inch slump shall stay together when slumped. Segregation is assumed to cause mortar to flow out of mix even though aggregate may stay piled enough to meet slump test.
 2. Test Procedure: Make slump test and check for excessive slump and observe to see if mortar or moisture flows from slumped concrete.
 3. Reject concrete if mortar or moisture separates and flows out of mix.
- E. Cold Weather Placement Tests:
 1. During cold weather concreting, cast cylinders for field curing as follows. Use method that will produce greater number of specimens:
 - a. Six extra test cylinders from last 100 cubic yards of concrete.
 - b. Minimum three specimens for each 2 hours of placing time or for each 100 cubic yards.

2. These specimens shall be in addition to those cast for lab testing.
3. Protect test cylinders from weather until they can be placed under same protection provided for concrete of structure that they represent.
4. Keep field test cylinders in same protective environment as parts of structure they represent to determine if specified strength has been obtained.
5. Test cylinders in accordance with applicable sections of ASTM C31/C31M and ASTM C39/C39M.
6. Use test results to determine specified strength gain prior to falsework removal or for prestressing.

F. Tolerances:

1. Walls: Measure and inspect walls for compliance with tolerances specified in Section 03 10 00, Concrete Forming and Accessories.
2. Slab Finish Tolerances and Slope Tolerances:
 - a. Make floor flatness measurements day after floor is finished and before shoring is removed to eliminate effects of shrinkage, curing, and deflection.
 - b. Support 10-foot long straightedge at each end with steel gauge blocks of thicknesses equal to specified tolerance.
 - c. Compliance with designated limits in four of five consecutive measurements is satisfactory, unless defective conditions are observed.

3.11 MANUFACTURER'S SERVICES

- A. Provide representative at Site in accordance with Section 01 43 33, Manufacturers' Field Services, for installation assistance, inspection, and certification of proper installation for concrete ingredients, mix design, mixing, and placement.
 1. Concrete Producer Representative:
 - a. Observe how concrete mixes are performing.
 - b. Be present during first placement of each type of concrete mix.
 - c. Assist with concrete mix design, performance, placement, weather problems, and problems as may occur with concrete mix throughout Project, including instructions for redosing.
 - d. Establish control limits on concrete mix designs.
 - e. Provide equipment for control of concrete redosing for air entrainment or high-range, water-reducing admixture, superplasticizers, at Site to maintain proper slump and air content if needed.

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2. Admixture Manufacturer's Representative: Available for consultations as required to ensure proper installation and performance of specified products.
3. Bonding Agent Manufacturer's Representative: Available for consultations as required to ensure proper installation and performance of specified products.

3.12 PROTECTION OF INSTALLED WORK

- A. After curing as specified in Section 03 39 00, Concrete Curing, and after applying final floor finish, cover slabs with plywood or particle board or plastic sheeting or other material to keep floor clean and protect it from material and damage as a result of other construction work.
- B. Repair areas damaged by construction, using specified repair materials and approved repair methods.

3.13 SCHEDULE OF CONCRETE FINISHES

- A. Form Tolerances: As specified in Section 03 10 00, Concrete Forming and Accessories.
- B. Special Floor Finishes: As specified in Section 03 35 00, Concrete Finishing.
- C. Provide concrete finishes as scheduled:

Area	Type of Finish	Required Form Tolerances
Exterior Wall Surfaces		
Above grade/exposed (above point 6" below finish grade)	W-2	W-B
Backfilled/waterproofed (below point 6" below finish grade)	W-1	W-A
Backfilled/not waterproofed (below point 6" below final grade)	W-1	W-A
Walls to receive cementitious coatings	W-4	W-B

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Area	Type of Finish	Required Form Tolerances
Interior Wall Surfaces		
Open top water-holding tanks and basins/not painted or coated	W-2	W-A
Water-holding tanks, channels, and basins/painted or coated	W-5	W-A
Covered water-holding tanks and basins/not painted or coated	W-1	W-A
Buildings, pipe galleries, and other dry areas/not painted or coated	W-2	W-A
Buildings, pipe galleries, and other dry areas/painted or coated	W-5	W-A
Exterior Slabs		
Roof slab/covered with roofing material	S-1	S-A
Water-holding tanks and basins/top of wall	S-5	S-B
Top of footing	S-2	S-A
Other water-holding tanks and basins	S-1	S-A
Sidewalks	S-6	S-B
Other exterior slabs	S-5	S-A
Interior Slabs		
Buildings, pipe galleries, and other dry areas	S-1	S-B
Underside of elevated slabs	S-3	S-A
Beams and Columns		
Beams/not coated	B-2	B-A
Columns/not coated	C-2	C-A

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3.14 SUPPLEMENTS

- A. Requirements of concrete mix designs following “End of Section,” are a part of this Specification and supplement requirements of Part 1 through Part 3 of this section:
1. Concrete Mix Design, Class 5000F2S1P2C2.
 2. Concrete Mix Design, Class 4500F2S1P1C1.
 3. Concrete Mix Design, Class 4500F2S1P1C2.

END OF SECTION

CONCRETE MIX DESIGN, CLASS 5000F2S1P2C2

- A. Mix Locations: Hydraulic Structures.
- B. Exposure Categories and Classifications: F2S1P2C2.
- C. Mix Properties:
 - 1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.40.
 - 2. Minimum concrete compressive strength (f'c) shall be 4,000 psi at 28 days and 5,000 psi at 56 days.
 - 3. Air-entraining admixtures are prohibited in concrete mixtures and total air content shall not be greater than 3 percent, for the following:
 - a. Slabs to receive hard-troweled finish.
 - 4. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

Nominal Maximum Aggregate Size in.‡	Air Content (%)*
3/8	7.5
1/2	7.0
3/4	6.0
1	6.0
1-1/2	5.5
2§	5.0
3§	4.5

‡See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations.

*Tolerance of air content is +1-1/2 percent.

§Air contents apply to total mixture. When testing concretes, however, aggregate particles larger than 1-1/2 inches are to be removed by sieving and air content will be measured on sieved fraction (tolerance on air content as delivered applies to this value). Air content of total mixture is computed from value measured on the sieved fraction passing the 1-1/2-inch sieve in accordance with ASTM C231/C231M.

- 5. Limit supplementary cementitious materials measured as a percent of weight of total cementitious materials in mix design, as follows:
 - a. Fly Ash and other Pozzolans: 25 percent.

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- b. Slag Cement: 50 percent.
 - c. Silica Fume: 10 percent.
 - d. Combined Fly Ash and other Pozzolans and Slag Cement, Slag Cement, and Silica Fume: 50 percent, with fly ash and other pozzolans not exceeding 25 percent, and silica fume not exceeding 10 percent.
 - e. Combined Fly Ash and other Pozzolans and Silica Fume: 35 percent, with fly ash and other pozzolans not exceeding 25 percent, and silica fume not exceeding 10 percent.
 - f. Total cementitious materials include ASTM C150/C150M and ASTM C595/C595M cement.
 - 1) Fly ash and other pozzolans in Type IP, blended cement, ASTM C595/C595M.
 - 2) Slag used in the manufacture of an IS blended cement, ASTM C595/C595M.
 - 3) Silica fume, ASTM C1240, present in blended cement.
6. Provide cementitious materials in accordance with one of the following:
- a. ASTM C150/C150M Type II; inclusion of supplementary cementitious materials in design mix is optional.
 - b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
 - 1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
 - 2) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
 - c. ASTM C595/C595M Type IP or Type IS (less than 70), tested to comply with moderate sulfate resistance option (MS).
 - 1) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
7. Unless otherwise permitted, minimum cementitious materials content in mix design shall be as follows:
- a. 515 pounds per cubic yard for concrete with 1-1/2-inch nominal maximum size aggregate.
 - b. 535 pounds per cubic yard for 1-inch nominal maximum size aggregate.
 - c. 560 pounds per cubic yard for 3/4-inch nominal maximum size aggregate.
 - d. 580 pounds per cubic yard for 1/2-inch nominal maximum size aggregate.

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- e. 600 pounds per cubic yard for 3/8-inch nominal maximum size aggregate.
 - f. Unless otherwise permitted, limit cementitious materials content to 100 pounds per cubic yard greater than specified minimum cementitious materials content in mix design.
8. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent, unless otherwise specified.
- a. Regardless of assigned C Exposure Class, for prestressed and post-tensioned concrete: 0.06 percent.
 - b. Limits are stated in terms of chloride ions in percent by weight of cement.
 - c. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.
- D. Refer to PART 1 through PART 3 of this section for additional requirements.

CONCRETE MIX DESIGN, CLASS 4500F2S1P1C1

- A. Mix Locations: Typical unless noted otherwise.
- B. Exposure Categories and Classifications: F2S1P1C1.
- C. Mix Properties:
 - 1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.45.
 - 2. Minimum concrete compressive strength (f'c) shall be 4,000 psi at 28 days and 4,500 psi at 56 days.
 - a. Air-entraining admixtures are prohibited in concrete mixtures and total air content shall not be greater than 3 percent, for the following:
 - 1) Slabs to receive a hard-troweled finish.
 - b. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

Nominal Maximum Aggregate Size in. ‡	Air Content (%)*
3/8	7.5
1/2	7.0
3/4	6.0
1	6.0
1-1/2	5.5
2§	5.0
3§	4.5

‡See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations.

*Tolerance of air content is +1-1/2 percent.

§Air contents apply to total mixture. When testing concretes, however, aggregate particles larger than 1-1/2 inches are to be removed by sieving and air content will be measured on sieved fraction (tolerance on air content as delivered applies to this value). Air content of total mixture is computed from value measured on sieved fraction passing 1-1/2-inch sieve in accordance with ASTM C231/C231M.

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3. Provide cementitious materials in accordance with one of the following:
 - a. ASTM C150/C150M Type II; inclusion of supplementary cementitious materials in design mix is optional.
 - b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
 - 1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
 - 2) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
 - 3) ASTM C595/C595M Type IP or Type IS (less than 70), tested to comply with moderate sulfate resistance option (MS).
 4. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent, unless otherwise specified.
 - a. Limits are stated in terms of chloride ions in percent by weight of cement.
 - b. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.
- D. Refer to PART 1 through PART 3 of this section for additional requirements.

CONCRETE MIX DESIGN, CLASS 4500F2S1P1C2

- A. Mix Locations: Concrete curbs and sidewalks.
- B. Exposure Categories and Classifications: F2S1P1C2.
- C. Mix Properties:
 - 1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.42.
 - 2. Minimum concrete compressive strength (f'c) shall be 3,500 psi at 28 days and 4,500 psi at 56 days.
 - 3. Air-entraining admixtures are prohibited in concrete mixtures and total air content shall not be greater than 3 percent, for the following:
 - a. Slabs to receive hard-troweled finish.
 - b. Slabs to receive dry shake floor hardener.
 - c. Slabs to receive topping placed monolithically as two-course floor on top of plastic concrete.
 - 4. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

Nominal Maximum Aggregate Size in. ‡	Air Content (%)*
3/8	7.5
1/2	7.0
3/4	6.0
1	6.0
1-1/2	5.5
2§	5.0
3§	4.5

‡See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations.

*Tolerance of air content is +1-1/2 percent.

§Air contents apply to total mixture. When testing concretes, however, aggregate particles larger than 1-1/2 inches are to be removed by sieving and air content will be measured on the sieved fraction (tolerance on air content as delivered applies to this value). Air content of total mixture is computed from value measured on the sieved fraction passing the 1-1/2-inch sieve in accordance with ASTM C231/C231M.

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5. Limit supplementary cementitious materials measured as a percent of weight of total cementitious materials in a mix design, as follows:
 - a. Fly Ash and other Pozzolans: 25 percent.
 - b. Slag Cement: 50 percent.
 - c. Silica Fume: 10 percent.
 - d. Combined Fly Ash and other Pozzolans and Slag Cement, Slag Cement, and Silica Fume: 50 percent, with fly ash and other pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
 - e. Combined Fly Ash and other Pozzolans and Silica Fume: 35 percent, with fly ash and other pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
 - f. Total cementitious materials include ASTM C150/C150M and ASTM C595/C595M cement.
 - 1) Fly ash and other pozzolans in Type IP, blended cement, ASTM C595/C595M.
 - 2) Slag used in the manufacture of an IS blended cement, ASTM C595/C595M.
 - 3) Silica fume, ASTM C1240, present in blended cement.
6. Provide cementitious materials in accordance with one of the following:
 - a. ASTM C150/C150M Type II.
 - b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
 - 1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
 - 2) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
 - c. ASTM C595/C595M Type IP or Type IS (less than 70), tested to comply with moderate sulfate resistance option (MS).
 - 1) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
7. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent, unless otherwise specified.
 - a. Limits are stated in terms of chloride ions in percent by weight of cement.
 - b. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.

D. Refer to PART 1 through PART 3 of this section for additional requirements.

**SECTION 03 35 00
CONCRETE FINISHING**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM): C109, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-In. or 50-Mm Cube Specimens).

1.02 SUBMITTALS

- A. Action Submittals: Manufacturer's product data sheet(s).
- B. Informational Submittals:
 - 1. Agenda: Conference prior to slab placement.
 - 2. Manufacturer's written procedures for slab preparation, product application, protection of finished surface, and post-application cleanup.
 - 3. Product manufacturers representatives' names and phone numbers.
 - 4. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for products to be furnished.
 - 5. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.
 - 6. Statement of Qualifications:
 - a. Manufacturer's Product Service Record.
 - b. Application personnel.
 - c. Manufacturer's representative.
 - 7. Manufacturer's installation instructions.
 - 8. Manufacturer's written instructions for maintenance and repair of floor finishes installed.

1.03 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer's Product Service Record: Five previous projects at least 5 years old where product was used at representative coverage per square foot.

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2. Floor Product Manufacturer: Manufacture components of floor material, except the epoxy, in own plant and under control of trained quality control manager.
 3. Application Personnel: Four previous projects of successful installation of specified materials or manufacturer's training.
- B. Preinstallation Training: Manufacturer-approved training of application personnel and quality control inspectors for these floor finishes.
- C. Conference Prior to Slab Placement:
1. Conducted by Contractor.
 2. Agenda:
 - a. Concrete mix design.
 - b. Placing techniques.
 - c. Finishing techniques.
 - d. Equipment required for these procedures.
 3. Attendees:
 - a. Contractor's superintendent.
 - b. Subcontractor's representative involved in slab installation and finishing.
 - c. Engineer.

PART 2 PRODUCTS

2.01 CLEAR LIQUID SEALER DUST PROOFER

- A. Colorless, aqueous solution of zinc and magnesium fluorosilicate.
- B. Each gallon of solution shall contain a minimum of 2 pounds of fluorosilicate compound.
- C. Manufacturers:
 1. Master Builders Co., Cleveland, OH.
 2. Sonneborn, Minneapolis, MN.
 3. Euclid Chemical Co., Cleveland, OH.

PART 3 EXECUTION

3.01 CLEAR LIQUID SEALER DUST PROOFER APPLICATION

- A. Before application, thoroughly cure floors to receive treatment for minimum 28 days, keep clean, unpainted, free from membrane curing compounds, and perfectly dry with all Work above them completed.

- B. Apply hardener evenly to surface, using three coats, allowing 24 hours between coats.
 - 1. First coat 1/3 strength, second coat 1/2 strength, and third coat 2/3 strength, mix with water.
 - 2. Apply each coat so as to remain wet on surfaces for 15 minutes.
 - 3. Apply approved treatment in accordance with manufacturer's instructions.
 - 4. After final coat is completed and dry, remove surplus hardener from surface by scrubbing and mopping with water.

3.02 TESTS AND INSPECTION

- A. Vapor Transmission Test: Conduct test on new and existing concrete to show that no surface moisture exists prior to application of specified special floor treatment, as follows:
 - 1. Place polyethylene plastic sheet, minimum 4 feet by 4 feet and sealed along four sides with duct tape to prevent moisture transmission by evaporation, over concrete floor area for 24 hours.
 - 2. Indication of moisture transmission will be apparent by accumulation of moisture on enclosed surface of polyethylene plastic sheet.
 - 3. Do not apply concrete bonding agent until test results indicate moisture is not being transmitted from concrete surface.
- B. Strength Tests: Test metallic aggregate topping for compressive strength by making 2-inch by 2-inch cubes in accordance with ASTM C109.
- C. Epoxy Joint Filler:
 - 1. Allow 90 days after slab placement before filling joints.
 - 2. Mix and install in accordance with manufacturer's instructions.
 - 3. Fill contraction or construction joints in areas receiving armored joint treatment.

3.03 MANUFACTURER'S SERVICES

- A. Provide manufacturer's representative at Site in accordance with Section 01 43 33, Manufacturers' Field Services, for installation assistance, inspection and certification of proper installation, and training of application personnel.
 - 1. Technical assistance with design and adjustment of concrete mixes to receive floor finishes and toppings.
 - 2. Technical assistance to assure and certify application and installation of system being used.

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3. Consultation, direction, and certification of mockup, for full-scale application of floor finishes, and at other times as needed.
4. Attendance at the conference prior to slab placement to finalize proper methods and procedures.

END OF SECTION

**SECTION 03 39 00
CONCRETE CURING**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Concrete Institute (ACI): 308.1, Specification for Curing Concrete.
 2. ASTM International (ASTM):
 - a. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - b. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
 3. NSF International: 61, Drinking Water System Components – Health Effects.

1.02 SUBMITTALS

- A. Action Submittals:
1. Manufacturers' data indicating compliance with the requirements specified herein for the following products:
 - a. Exposed aggregate finish retardant on formed surface.
 - b. Evaporation retardant.
 - c. Curing compound.
 - d. Penetrating water repellent sealer.
 2. Curing methods proposed for each type of element such as slab, walls, beams, and columns in each facility.
- B. Informational Submittals:
1. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for the following:
 - a. Curing compound showing moisture retention requirements.
 - b. Retardants for exposed aggregate finish.

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PART 2 PRODUCTS

2.01 MATERIALS

A. Curing Compound:

1. Water-based, high-solids content, nonyellowing, curing compound meeting requirements of ASTM C1315 Type I, Class A.
2. Manufacturers and Products:
 - a. Euclid Chemical Co., Cleveland, OH; Super Diamond Clear VOX.
 - b. WR Meadows, Inc., Hampshire, IL; VOCOMP-30.
 - c. Vexcon Chemical, Inc.; Philadelphia, PA; Starseal 1315.
 - d. Dayton Superior; Safe Cure and Seal 1315 EF.
 - e. BASF Construction Chemicals., Shakopee, MN; MasterKure CC 200WB.
 - f. Euclid Chemical Co., Cleveland, OH; EucoCure VOX.
 - g. Euclid Chemical Co., Cleveland, OH; Kurez VOX White Pigmented.

B. Evaporation Retardant:

1. Optional: Fluorescent fugitive dye color tint that disappears completely upon drying.
2. Manufacturers and Products:
 - a. BASF Construction Chemicals, Shakopee, MN; MasterKure ER 50.
 - b. Euclid Chemical Co., Cleveland, OH; Eucobar.

C. Penetrating Water Repellent Sealer: Water based, ready to use, single component, silane/siloxane, penetrating, clear water repellent sealer.

1. Viscosity: 50 cps.
2. Flash Point: 200 degrees F.
3. NCHRP No. 244 Reduction in Chloride Content:
 - a. Average: 82 percent.
 - b. Minimum Required: 75 percent.
4. NCHRP No. 244 Reduction in Weight Gain:
 - a. 21 Days: 85 percent.
 - b. VOCs: 50 g/l.
 - c. Depth of Penetration: 1/4 inch.
5. Manufacturers and Products:
 - a. BASF Construction Chemicals, Shakopee MN; MasterProtect H 400.
 - b. Euclid Chemical Co.; Baracade WB 244.

D. Water: Clean and potable, containing less than 500 ppm of chlorides.

PART 3 EXECUTION

3.01 CONCRETE CURING

A. General:

1. Cure all concrete in accordance with project specifications and ACI308.1.
2. Where surfaces are to receive coatings, painting, cementitious material, or other similar finishes, use only water curing procedures. Refer to Interior Finish Schedule for surfaces to receive coatings.
3. Use only water curing on potable water structures.
4. Where curing compound cannot be used, water curing as described below or special methods using moisture shall be agreed upon by Engineer prior to placing concrete.
5. As required in Section 03 30 00, Cast-in-Place Concrete, if result of 7-day concrete strength test is less than 50 percent of specified 28-day strength, extend period of moist curing specified below, by 7 additional days.

B. Use one of the following methods as approved by Engineer:

1. Vertical Surfaces
 - a. Method 1: Leave concrete forms in place and keep surfaces of forms and concrete wet for 7 days.
 - b. Method 2: Continuously sprinkle with water 100 percent of exposed surfaces for 7 days starting immediately after removal of forms.
 - c. Method 3: Apply curing compound, where allowed, immediately after removal of forms.
2. Horizontal Surfaces:
 - a. Method 1: Protect surface by water ponding for 7 days.
 - b. Method 2: Cover with burlap or cotton mats and keep continuously wet for 7 days.
 - c. Method 3: Cover with 1-inch layer of wet sand, earth, or sawdust, and keep continuously wet for 7 days.
 - d. Method 4: Continuously sprinkle exposed surface for 7 days.
 - e. Method 5: Apply curing compound, where allowed, immediately after final finishing when surface will no longer be damaged by traffic.

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3.02 EVAPORATION RETARDANT APPLICATION

- A. Use on flatwork when environmental conditions are anticipated to cause rapid drying of the concrete surface. Do not use evaporation retardant on potable water structures, unless product is NSF 61 approved.
- B. Spray onto surface of fresh flatwork concrete immediately after screeding to react with surface moisture.
- C. Reapply as needed to ensure a continuous moist surface until final finishing is completed.

3.03 PENETRATING WATER REPELLENT SEALER APPLICATION

- A. Apply to floor slabs.
- B. Before application and with Work above completed, water cure concrete walls and floors for a minimum of 28 days to receive sealer, keep clean, unpainted, and free from membrane curing compounds.
- C. Concrete to receive penetrating sealer shall be dry for a minimum 24 hours immediately prior to application.
- D. Apply per manufacturer's recommendations utilizing low pressure airless spray equipment.
 - 1. Actual coverage and number of coats to be determined by field test sample application and water absorption testing. Final approval by Owner is required.
- E. Apply at a coverage rate of 125 square feet per gallon to 200 square feet per gallon. Cure penetrating sealer on slabs for the minimum time recommended by manufacturer prior to allowing foot or vehicular traffic.

3.04 MANUFACTURER'S SERVICES

- A. Provide manufacturer's representative at Site for installation assistance, inspection, and certification of proper installation for products specified.
- B. Provide penetrating water repellent sealer manufacturer's representative to demonstrate proper application of product.
- C. Provide curing compound manufacturer's representative to demonstrate proper application of curing compound to show coverage in one coat.

END OF SECTION

**SECTION 03 62 00
GROUTING**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. ASTM International (ASTM):
 - a. C230, Standard Specification for Flow Table for Use in Tests of Hydraulic Cement.
 - b. C307, Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.
 - c. C531, Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
 - d. C579, Standard Test Methods for Compressive Grout Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
 - e. C882, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
 - f. C939, Standard Test Method for Flow of Grout for Placed-Aggregate Concrete (Flow Cone Method).
 - g. C940, Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Placed-Aggregate Concrete in the Laboratory.
 - h. C1107/C1107M, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 - i. C1181, Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.
 - j. D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.

1.02 SUBMITTALS

- A. Action Submittals:
1. Product data of grouts.
 2. Proposed method for keeping existing concrete surfaces wet prior to placing nonshrink grout.
 3. Forming method for fluid grout placements.
 4. Curing method for grout.

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B. Informational Submittals:

1. Manufacturer's Written Instructions:
 - a. Adding fiber reinforcing to batching.
 - b. Mixing of grout.
2. Manufacturer's proposed training schedule for grout work.
3. Manufacturer's Certificate of Compliance in accordance with Section 01 61 00, Common Product Requirements.
 - a. Grout free from chlorides and other corrosion-causing chemicals.
 - b. Nonshrink grout properties of Category II and Category III, verifying expansion at 3 days or 14 days will not exceed the 28-day expansion and nonshrink properties are not based on gas or gypsum expansion.
4. Manufacturer's Certificate of Proper Installation.
5. Statements of Qualification: Grout manufacturer's representative.
6. Test Reports:
 - a. Test report for 24-hour evaluation of nonshrink grout.
 - b. Test results and service report from demonstration and training session.
 - c. Field test reports and laboratory test results for field-drawn Samples.
7. List of Contractor's equipment installation staff trained by grout manufacturer's representative in:
 - a. Nonshrink grout installation and curing.
 - b. Epoxy grout installation and curing.

1.03 QUALIFICATIONS

- A. Grout Manufacturer's Representative: Authorized and trained representative of grout manufacturer. Minimum of 1-year experience that has resulted in successful installation of grouts similar to those for this Project.
- B. For grout suppliers not listed herein, provide completed 24-hour Evaluation of Nonshrink Grout Test Form, attached at the end of this section. Provide independent testing laboratory test results for testing conducted within last 18 months.

PART 2 PRODUCTS

2.01 NONSHRINK GROUT AND EPOXY GROUT SCHEDULE

- A. Furnish nonshrink grout (Category I, II, and III) and epoxy grout for applications as indicated in the following schedule:

Application	Temperature Range	Max. Placing Time	
	40 deg F to 100 deg F	20 Min.	Greater Than 20 Min.
Column baseplates single-story	I or II		II
Machine bases 25 hp or less	II	II	II
Bases for precast wall sections	II	II	II
Precast base joints higher than one story	II	II	II
Form Tie-Through bolt openings	II	II	II
Machine bases 26 hp and up	III or Epoxy Grout	III or Epoxy Grout	III or Epoxy Grout
Baseplates and/or soleplates with vibration, thermal movement, etc.	III or Epoxy Grout	III or Epoxy Grout	III or Epoxy Grout

2.02 NONSHRINK GROUT

- A. Category I:
1. Nonmetallic and nongas-liberating.
 2. Prepackaged natural aggregate grout requiring only the addition of water.
 3. Test in accordance with ASTM C1107/C1107M:
 - a. Grout shall have flowable consistency.
 - b. Flowable for 15 minutes.

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4. Grout shall not bleed at maximum allowed water.
5. Minimum strength of flowable grout, 3,000 psi at 3 days, 5,000 psi at 7 days, and 7,000 psi at 28 days.
6. Manufacturers and Products:
 - a. BASF Building System, Inc., Shakopee, MN; MasterFlow 100.
 - b. Euclid Chemical Co., Cleveland, OH; NS Grout.
 - c. Dayton Superior Corp., Miamisburg, OH; 1107 Advantage Grout.
 - d. US MIX Co., Denver, CO; US SPEC GP Grout.
 - e. Five Star Products Inc., Fairfield, CT; Five Star Grout.

B. Category II:

1. Nonmetallic, nongas-liberating.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
4. Test in accordance with ASTM C1107/C1107M:
 - a. Fluid consistency 20 seconds to 30 seconds in accordance with ASTM C939.
 - b. Temperatures of 40 degrees F, 80 degrees F, and 90 degrees F.
5. 1 hour after mixing, pass fluid grout through flow cone with continuous flow.
6. Minimum strength of fluid grout, 3,500 psi at 1 day, 4,500 psi at 3 days, and 7,500 psi at 28 days.
7. Maintain fluid consistency when mixed in 1-yard to 9-yard loads in ready-mix truck.
8. Manufacturers and Products:
 - a. BASF Building Systems, Inc., Shakopee, MN; MasterFlow 928.
 - b. Five Star Products Inc., Fairfield, CT; Five Star Fluid Grout 100.
 - c. Euclid Chemical Co., Cleveland, OH; Hi Flow Grout.
 - d. Dayton Superior Corp., Miamisburg, OH; Sure Grip High Performance Grout.
 - e. US MIX Co., Denver, CO; US SPEC MP Grout.

C. Category III:

1. Metallic and nongas-liberating.
2. Prepackaged aggregate grout requiring only the addition of water.
3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
4. Test in accordance with ASTM C1107/C1107M:
 - a. Fluid consistency 20 seconds to 30 seconds in accordance with ASTM C939.
 - b. Temperatures of 40 degrees F and 100 degrees F.

5. 1 hour after mixing, pass fluid grout through flow cone with continuous flow.
6. Minimum strength of fluid grout, 4,000 psi at 1 day, 5,000 psi at 3 days, and 9,000 psi at 28 days.
7. Maintain fluid consistency when mixed in 1-yard to 9-yard loads in ready-mix truck.
8. Manufacturer and Product:
 - a. BASF Building Systems, Inc., Shakopee, MN; MasterFlow 885.
 - b. Euclid Chemical Co, Cleveland, OH; Hi-Flow Metallic Grout.

2.03 EPOXY GROUT

- A. High-strength, nonshrink, high-temperature epoxy grouting material developed for the support of heavy equipment with vibratory loads.
- B. Three-component mixture of a two-component epoxy resin system (100 percent solids) with a graded, precision aggregate blend.
- C. Premeasured, prepackaged system.
- D. Flowable.
- E. Minimum compressive strength in accordance with ASTM C579 Method B, 9,500 psi at 75 degrees F at 7 days, 11,000 psi at post cure.
- F. Maximum creep resistance in accordance with ASTM C1181 at 600 psi, 140 degrees F; 6.0×10^{-3} in/in.
- G. Minimum bond strength in accordance with ASTM C882, 2,000 psi.
- H. Minimum tensile strength in accordance with ASTM C307, 2,000 psi.
- I. Maximum coefficient of thermal expansion in accordance with ASTM C531 at 73 degrees F to 210 degrees F, 23.0×10^{-6} in/in/degrees F.
- J. Working Time: Minimum 2 hours at 50 degrees F; 1.5 hours at 70 degrees F; 50 minutes at 90 degrees F.
- K. Good chemical resistance.
- L. Good effective bearing area.
- M. Noncorrosive.
- N. Moisture insensitive.

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- O. Modify resin and aggregate content where recommended by epoxy grout manufacturer to provide desired epoxy grout flow properties.
- P. Manufacturer and Product:
 - 1. BASF Building System, Inc., Shakopee MN; MasterFlow 648.
 - 2. Euclid Chemical Co., Cleveland, OH; E³-G.
 - 3. Dayton Superior Corp., Miamisburg, OH; Pro-Poxy 2000 Normal Set.
 - 4. Five Star Products Inc., Fairfield, CT; DP Epoxy Grout.

PART 3 EXECUTION

3.01 GROUT

- A. General: Mix, place, and cure grout in accordance with grout manufacturer's representative's training instructions.
- B. Epoxy Grout: Concrete slab shall be fully cured for 28 days to ensure excess water has evaporated. Test concrete surface for moisture in accordance with ASTM D4263 before epoxy grout is placed.
- C. Form Tie-Through Bolt Holes: Provide nonshrink grout, Category II, fill space with dry pack dense grout hammered in with steel tool and hammer. Through-bolt holes; coordinate dry pack dense grout application with vinyl plug in Section 03 10 00, Concrete Forming and Accessories, and bonding agent in Section 03 30 00, Cast-in-Place Concrete.
- D. Form Snap-Tie Hole: Fill tie hole in accordance with requirements of Section 03 30 00, Cast-in-Place Concrete.

3.02 GROUTING MACHINERY FOUNDATIONS

- A. Block out original concrete or finish off at distance shown below bottom of machinery base with grout. Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any soft material. Surface roughness in accordance with manufacturer's written instructions.
- B. Clean metal surfaces of all paint, oil, grease, loose rust, and other foreign material that will be in contact with grout.
- C. Sandblast to bright metal all metal surfaces in contact with epoxy grout in accordance with manufacturer's written instructions.
- D. Set machinery in position and wedge to elevation with steel wedges, or use cast-in leveling bolts. Remove wedges after grout is set and pack void with grout.

- E. Form with watertight forms at least 2 inches higher than bottom of plate.
- F. Fill space between bottom of machinery base and original concrete in accordance with manufacturer's representative's training instructions.
- G. If grout cannot be placed from one edge and flowed to the opposite edge, air vents shall be provided through the plate to prevent air entrapment.
- H. Radius all corners of grout pad.
- I. Install expansion joints for epoxy grout placement in accordance with manufacturer's written instructions.

3.03 TANK FOUNDATIONS

- A. Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any soft material. Surface roughness in accordance with manufacturer's written instructions.
- B. Clean metal surfaces of all paint, oil, grease, loose rust and other foreign material that will be in contact with grout.
- C. Set tank in position and wedge to elevation with steel wedges, or use cast-in leveling bolts. Remove wedges after grout is set and pack void with grout.
- D. Form with watertight forms at least 2 inches higher than bottom of plate.
- E. Fill space between bottom of tank base and original concrete in accordance with manufacturer's representative's training instructions.

3.04 FIELD QUALITY CONTROL

- A. General:
 - 1. Performed by Project representative's inspection staff.
 - 2. Perform the following quality control inspections. The grout manufacturer's representative shall accompany the Project representative's inspection staff on the first installation of each size and type of equipment.
- B. Evaluation and Acceptance of Nonshrink Grout:
 - 1. Inspect the surface preparation of concrete substrates onto which nonshrink grout materials are to be applied, for conformance to the specified application criteria including, but not limited to, substrate profile, degree of cleanliness, and moisture.

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2. Inspect preparation and application of nonshrink grout form work for conformance to the manufacturer's recommendations.
3. Conduct a final review of completed nonshrink grout installation for conformance to these Specifications.
4. Provide a flow cone and cube molds with restraining plates onsite. Continue tests during Project as demonstrated by grout manufacturer's representative.
5. Perform flow cone and bleed tests, and make three 2-inch by 2-inch cubes for each 25 cubic feet of each type of nonshrink grout used. Use restraining caps for cube molds in accordance with ASTM C1107/C1107M.
6. For large grout applications, make three additional cubes and one more flow cone test. Include bleed test for each additional 25 cubic feet of nonshrink grout placed.
7. Consistency: As specified in Article Nonshrink Grout. Flow cone test in accordance with ASTM C939. Grout with consistencies outside range requirements shall be rejected.
8. Segregation: As specified in Article Nonshrink Grout. Grout when aggregate separates shall be rejected.
9. Nonshrink grout cubes shall test equal to or greater than minimum strength specified.
10. Strength Test Failures: Nonshrink grout work failing strength tests shall be removed and replaced.
11. Perform bleeding test in accordance with ASTM C940 to demonstrate grout will not bleed.
12. Store cubes at 70 degrees F.
13. Independent testing laboratory shall prepare, store, cure, and test cubes in accordance with ASTM C1107/C1107M.
14. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

C. Evaluation and Acceptance of Epoxy Grout:

1. Inspect ambient conditions during various phases of epoxy grouting installation for conformance with the epoxy grout manufacturer's requirements.
2. Inspect the surface preparation of concrete substrates onto which epoxy grout materials are to be applied, for conformance to the specified application criteria including, but not limited to, substrate profile, degree of cleanliness, and moisture.
3. Inspect the surface preparation of the metallic substrates onto which the epoxy primer is to be applied.
4. Inspect the epoxy-primed metallic substrate for coverage and adhesion.

5. Inspect preparation and application of epoxy grout form work for conformance to the manufacturer's recommendation.
6. Verify consistency obtained is sufficient for the proper field placement at the installed temperatures.
7. Inspect and record that the "pot life" of epoxy grout materials is not exceeded during the installation.
8. Inspect epoxy grout for cure.
9. Inspect and record that localized repairs made to grout voids are in conformance with the specification requirements.
10. Conduct a final review of completed epoxy grout installation for conformance to these Specifications.
11. Compression tests and fabrication of specimens for epoxy grout shall be made in accordance to ASTM C579, Method B, at intervals during construction as selected by the Project representative. A set of three specimens shall be made for testing at 7 days, and each earlier time period as appropriate.
12. Independent testing laboratory shall prepare, store, cure, and test cubes in accordance with ASTM C579.
13. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

3.05 MANUFACTURER'S SERVICES

A. General:

1. Coordinate demonstrations, training sessions, and applicable Site visits with grout manufacturer's representative. Allow 2-week notice to grout manufacturer's representative for scheduling purposes.
2. Provide and conduct onsite, demonstration and training sessions for bleed tests, mixing, flow cone measurement, cube testing, application, and curing for each category and type of grout.
3. Necessary equipment and materials shall be available for demonstration.
4. Conduct training prior to equipment mount installation work on equipment pads.
5. Training for each type of grout shall be not less than 4 hours' duration.

B. Nonshrink Grout Training:

1. Training is required for all Type II and Type III grout installations.
2. Provide nonshrink grout installation training by the qualified grout manufacturer's representative for Contractor's workers that will be installing nonshrink grout for baseplates and equipment mounts. Schedule training to allow Engineer's attendance.

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3. Mix nonshrink grouts to required consistency, test, place, and cure on actual Project, such as, baseplates and form tie-through bolt holes to provide actual on-the-job training.
4. Use minimum of two bags for each grout Category II and Category III. Mix grout to fluid consistency and conduct flow cone and two bleed tests, make a minimum of six cubes for testing of two cubes at 1 day, 3 days, and 28 days. Use remaining grout for final Work.
5. Include recommended grout curing methods in the training.
6. Mix and demonstrate patching through-bolt holes and blockouts for gate guides, and similar items.
7. Transport test cubes to independent test laboratory and obtain test reports.
8. Training by manufacturer's representative does not relieve Contractor of overall responsibility for this portion of the work.
9. Submit a list of attendees that have been satisfactorily trained to perform epoxy grout installation for equipment mounting.

C. Epoxy Grout Training:

1. Provide epoxy grout installation training by the qualified epoxy grout manufacturer's representative for Contractor's workers that will be installing epoxy grout for equipment mounts. Schedule training to allow Engineer's attendance.
2. Include training in:
 - a. Performance testing such as compressive strength testing of the epoxy grout.
 - b. All aspects of using the products, from mixing to application.
3. Transport test cubes to independent test laboratory and obtain test reports.
4. Training by manufacturer's representative does not relieve Contractor of overall responsibility for this portion of the work.
5. Submit a list of attendees that have been satisfactorily trained to perform epoxy grout installation for equipment mounting.

3.06 SUPPLEMENTS

- A. The supplement listed below, following "End of Section," is part of this Specification.
 1. 24-hour Evaluation of Nonshrink Grout Test Form and Grout Testing Procedures.

END OF SECTION

SUPPLEMENT 1

(Test Lab Name)

(Address)

(Phone No.)

24-HOUR EVALUATION OF NONSHRINK GROUT TEST FORM

OBJECTIVE: Define standard set of test procedures for an independent testing laboratory to perform and complete within a 24-hour period.

SCOPE: Utilize test procedures providing 24-hour results to duplicate field grouting demands. Intent of evaluation is to establish grout manufacturer's qualifications.

PRIOR TO TEST: Obtain three bags of each type of grout.

1. From intended grout supplier for Project.
2. Three bags of grout shall be of same lot number.

ANSWER THE FOLLOWING QUESTIONS FOR GROUT BEING TESTED FROM LITERATURE, DATA, AND PRINTING ON BAG:

- A. Product data and warranty information contained in company literature and data? Yes _____ No _____
- B. Literature and bag information meet specified requirements? Yes _____ No _____
- C. Manufacturer guarantees grout as specified in Article Guarantee? Yes _____ No _____
- D. Guarantee extends beyond grout replacement value and allows participation with Contractor in replacing and repairing defective areas? Yes _____ No _____
- E. Water demands and limits printed on bag? Yes _____ No _____
- F. Mixing information printed on the bag? Yes _____ No _____
- G. Temperature restrictions printed on bag? Yes _____ No _____

*Rejection of a grout will occur if one or more answers are noted NO.

GROUT TESTING PROCEDURES

A. Bagged Material:

- 1. List lot numbers. _____
- 2. List expiration date. _____
- 3. Weigh bags and record weight. _____

Owner’s Representative will disqualify grout if bag weights have misstated measure plus or minus 2 pounds by more than one out of three bags. (Accuracy of weights is required to regulate amount of water used in mixing since this will affect properties.)

B. Mixing and Consistency Determination:

- 1. Mix full bag of grout in 10-gallon pail.
- 2. Use electric drill with a paddle device to mix grout (jiffy or jiffler type paddle).
- 3. Use maximum water allowed per water requirements listed in bag instructions.
- 4. Mix grout to maximum time listed on bag instructions.
- 5. In accordance with ASTM C939 (flow cone) determine time of mixed grout through the flow cone. _____ seconds
- 6. Add water to attain 20- to 30-second flow in accordance with ASTM C939.
- 7. Record time of grout through cone at new water demand. _____ seconds
- 8. Record total water needed to attain 20- to 30-second flow. _____ pounds
- 9. Record percent of water. _____ percent

C. When fluid grout is specified and additional water is required beyond grout manufacturer’s listed maximum water, ASTM C1107/C1107M will be run at new water per grout ratio to determine whether grout passes using actual water requirements to be fluid. Use new water per grout ratio on remaining tests.

D. Bleed Test:

- 1. Fill two gallon cans half full of freshly mixed grout at ambient temperatures for each category and at required consistency for each.
- 2. Place one can of grout in tub of ice water and leave one can at ambient temperature.
- 3. Cover top of both cans with glass or plastic plate preventing evaporation.
- 4. Maintain 38 degrees F to 42 degrees F temperature with grout placed in ice and maintain ambient temperature for second container for 1 hour.

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- 5. Visually check for bleeding of water at 15-minute intervals for 2 hours.
- 6. Perform final observation at 24 hours.

If grout bleeds a small amount at temperatures specified, grout will be rejected.

E. Extended Flow Time and Segregation Test (for Category II and Category III):

- 1. Divide the remaining grout into two 3-gallon cans. Place the cans into the 40-degree F and 90-degree F containers and leave for 20, 40, and 60 minutes. Every 20 minutes remove and check for segregation or settlement of aggregate. Use a gloved hand to reach to the bottom of the can, if more than 1/4 inch of aggregate has settled to the bottom or aggregate has segregated into clumps reject the grout.
- 2. Right after the settlement test mix the grout with the drill mixer for 10 seconds. Take a ASTM C939 flow cone test of grout and record flow time. Maintain this process for 1 hour at ambient temperatures of 40 degrees F and 90 degrees F.
 - a. 20 min _____, sec. @ 40 degrees F.
 - b. 40 min _____, sec. @ 40 degrees F.
 - c. 60 min _____, sec. @ 40 degrees F.
 - d. 20 min _____, sec. @ 90 degrees F.
 - e. 40 min _____, sec. @ 90 degrees F.
 - f. 60 min _____, sec. @ 90 degrees F.

All Category II and Category III grout that will not go through the flow cone with continuous flow after 60 minutes will be disqualified.

_____	_____
Qualified	Disqualified

F. 24-hour Strength Test:

- 1. Using grout left in mixing cans in accordance with ASTM C1107/C1107M for mixing and consistency determination test and for extended time flow test, make minimum of nine cube samples.
- 2. Store cubes at 70 degrees F for 24 hours.
- 3. Record average compressive strength of nine cubes at 24 hours.

Grout will be disqualified if 24-hour compressive strengths are less than 2,500 psi for grouts claiming fluid placement capabilities.

Grouts that have not been disqualified after these tests are qualified for use on the Project for the application indicated in Nonshrink Grout Schedule.

_____	_____
Signature of Independent Testing Laboratory	Date Test Conducted

**SECTION 05 05 23
WELDING**

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Society of Mechanical Engineers (ASME):
 - a. BPVC SEC V, Nondestructive Examination.
 - b. BPVC SEC IX, Welding and Brazing Qualifications.
2. American Society of Nondestructive Testing (ASNT): SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing.
3. ASTM International (ASTM): A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
4. American Welding Society (AWS):
 - a. A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 - b. A3.0, Standard Welding Terms and Definitions.
 - c. D1.1/D1.1M, Structural Welding Code - Steel.
 - d. D1.8/D1.8M, Structural Welding Code - Seismic Supplement.
 - e. D1.2/D1.2M, Structural Welding Code - Aluminum.
 - f. D1.3/1.3M, Structural Welding Code - Sheet Steel.
 - g. D1.4/D1.4M, Structural Welding Code - Reinforcing Steel.
 - h. D1.6/D1.6M, Structural Welding Code - Stainless Steel.
 - i. QC1, Standard for AWS Certification of Welding Inspectors.

1.02 DEFINITIONS

A. CJP: Complete Joint Penetration.

B. CWI: Certified Welding Inspector.

1. Contractor's Welding Inspector: Contractor's CWI acts for, and on behalf of, the Contractor for all inspection and quality matters within the scope of the Contract Documents. Contractor is required to provide a welding inspector to oversee welding operations and be responsible for visual inspection and necessary correction of all deficiencies in materials and workmanship required to meet referenced welding codes. This type of Quality Control Inspection is not classified as Special Inspection.
2. Verification Inspector: CWI who acts on behalf of the Owner. This type of independent inspection and testing is the prerogative of the Owner, who may perform this function, or waive independent verification inspection if it is not required by the building official and building code.

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- C. MT: Magnetic Particle Testing.
- D. NDE: Nondestructive Examination.
- E. NDT: Nondestructive Testing.
- F. PJP: Partial Joint Penetration.
- G. PQR: Procedure Qualification Record.
- H. PT: Liquid Penetrant Testing.
- I. RT: Radiographic Testing.
- J. UT: Ultrasonic Testing.
- K. VT: Visual Inspection/Testing.
- L. WPQ: Welder/Welding Operator Performance Qualification Record.
- M. WPS: Welding Procedure Specification.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Shop and field WPSs and PQRs.
 - b. NDT procedure specifications prepared in accordance with ASME BPVC SEC V.
 - c. Welding Data (Shop and Field): Submit welding data together with Shop Drawings as a complete package.
 - 1) Show on Shop Drawings, or on a weld map, complete information regarding base metal specification designation, location, type, size, and extent of welds with reference called out for WPS and NDE numbers in tails of combined welding and NDE symbols as indicated in AWS A2.4.
 - 2) Clearly distinguish between shop and field welds.
 - 3) Indicate, by welding symbols or sketches, details of welded joints and preparation of base metal. Provide complete joint welding details showing bevels, groove angles, and root openings for welds.
 - 4) Welding and NDE Symbols: In accordance with AWS A2.4.
 - 5) Welding Terms and Definitions: In accordance with AWS A3.0.

B. Informational Submittals:

1. WPQs.
2. CWI credentials.
3. Testing agency personnel credentials.
4. CWI visual inspection (VT) reports.
5. Welding Documentation: Submit on forms in referenced welding codes.

1.04 QUALIFICATIONS

- A. WPSs: In accordance with AWS D1.1/D1.1M (Annex M Forms) for shop or field welding; or ASME BPVC SEC IX (Forms QW-482 and QW-483) for shop welding only.
- B. WPQs: In accordance with AWS D1.1/D1.1M (Annex M Forms); or ASME BPVC SEC IX (Form QW-484).
- C. CWI: Certified in accordance with AWS QC1, and having prior experience with specified welding codes. Alternate welding inspector qualifications require prior approval by Engineer.
- D. Testing Agency: Personnel performing tests shall be NDT Level II certified in accordance with ASNT SNT-TC-1A.

1.05 SEQUENCING AND SCHEDULING

- A. Unless otherwise specified, Submittals required in this section shall be submitted and approved prior to commencement of welding operations.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

- A. Fabricator's CWI shall be present whenever shop welding is performed. CWI shall perform inspection at suitable intervals, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:
 1. Verifying conformance of specified job material and proper storage.
 2. Monitoring conformance with approved WPS.
 3. Monitoring conformance of WPQ.
 4. Inspecting weld joint fit-up and performing in-process inspection.
 5. Providing 100 percent visual inspection of welds.
 6. Coordinating with nondestructive testing personnel and reviewing NDE test results.
 7. Maintaining records and preparing reports documenting that results of CWI VT and subsequent NDE testing comply with the Work and referenced welding codes.

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PART 3 EXECUTION

3.01 GENERAL

- A. Welding and Fabrication by Welding: Conform to governing welding codes referenced in attached Welding and Nondestructive Testing Table.
- B. Qualify welding procedure specifications for notch toughness by limiting heat input; conduct charpy testing of weld metal and heat-affected zone as part of the welding procedure qualification. Conduct charpy tests on full-size specimens in accordance with ASTM A370 at a test temperature of 30 degrees F. The minimum average energy of the test coupons shall not be less than 25 foot-pounds.

3.02 NONDESTRUCTIVE WELD TESTING REQUIREMENTS

- A. Quality Control Inspection:
 - 1. All Welds: 100 percent VT by Contractor's CWI.
 - 2. Acceptance Criteria:
 - a. Structural Pipe and Tubing: AWS D1.1/D1.1M, Paragraph 9.25.
 - b. All Other Structural Steel: AWS D1.1/D1.1M, Paragraph 6.9, Visual Inspection, Statically Loaded Nontubular Connections.
 - c. Stud Connections: AWS D1.1/D1.1M, Paragraph 7.8.1.
- B. Nondestructive Testing Requirements:
 - 1. NDT frequency shall be as specified below, as required by referenced welding codes, or as specified in the attached table. In case there is a conflict, the higher frequency level of NDT shall apply.
 - a. Nontubular Connections:
 - 1) CJP Butt Joint Groove Welds: 10 percent random RT. Use UT for CJP butt joint groove welds that cannot be readily radiographed.
 - 2) All Other CJP Groove Welds: 10 percent random UT.
 - 3) Fillet Welds and PJP Groove Welds: 10 percent random PT or MT.
 - b. Tubular Connections:
 - 1) CJP butt joint groove welds made from one side without backing: 100 percent RT or UT in accordance with AWS D1.1/D1.1M, Paragraph 9.26.2 requirements.
 - 2) CJP Butt Joint Groove Welds made without backing or back-gouging: 10 percent random RT. Use UT for CJP butt joint groove welds that cannot be readily radiographed.
 - 3) All Other CJP Groove Welds: 10 percent random UT.
 - 4) Fillet Welds and PJP Groove Welds: 10 percent random PT or MT.

2. NDT Procedures and Acceptance Criteria:
 - a. Nontubular Connections:
 - 1) RT: Perform in accordance with AWS D1.1/D1.1M, Clause 6, Part E. Acceptance criteria per AWS D1.1/D1.1M, Paragraph 6.12.1.
 - 2) UT: Perform in accordance with AWS D1.1/D1.1M, Clause 6, Part F. Acceptance criteria per AWS D1.1/D1.1M, Paragraph 6.13.1.
 - 3) PT and MT:
 - a) Perform on fillet and PJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 6.14.4 and Paragraph 6.14.5.
 - b) Acceptance criteria per AWS D1.1/D1.1M, Paragraph 6.9, Visual Inspection, Statically Loaded Nontubular Connections.
 - b. Tubular Connections:
 - 1) RT: Comply with requirements for Nontubular Connections and additional requirements of AWS D1.1/D1.1M, Clause 9, Paragraph 9.28 and Paragraph 9.29.
 - 2) UT: Comply with requirements for Nontubular Connections and additional requirements of AWS D1.1/D1.1M, Clause 9, Paragraph 9.27.
 - 3) PT and MT:
 - a) Perform on fillet and PJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 6.14.4 and Paragraph 6.14.5.
 - b) Acceptance criteria per AWS D1.1/D1.1M, Paragraph 9.25.

3.03 FIELD QUALITY CONTROL

- A. CWI shall be present whenever field welding is performed. CWI shall perform inspection, at suitable intervals, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:
 1. Verify conformance of specified job material and proper storage.
 2. Monitor conformance with approved WPS.
 3. Monitor conformance of WPQ.
 4. Inspect weld joint fit-up and perform in-process inspection.
 5. Provide 100 percent visual inspection of all welds in accordance with Subparagraph Quality Control Inspection.
 6. Supervise nondestructive testing personnel and evaluating test results.
 7. Maintain records and prepare report confirming results of inspection and testing comply with the Work.

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3.04 WELD DEFECT REPAIR

- A. Repair and retest rejectable weld defects until sound weld metal has been deposited in accordance with appropriate welding codes.

3.05 SUPPLEMENTS

- A. The supplement listed below, following “End of Section,” is a part of this specification.
 - 1. Welding and Nondestructive Testing Table.

END OF SECTION

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Welding and Nondestructive Testing						
Specification Section	Governing Welding Codes or Standards	Submit WPS	Submit WPQ	Onsite CWI Req'd	Submit Written NDT Procedure Specifications	NDT Requirements
05 50 00 Metal Fabrications	AWS D1.1/D1.1M, Structural Welding Code-Steel or AWS D1.2/D1.2M, Structural Welding Code - Aluminum or AWS D1.6/D1.6M, Structural Welding Code - Stainless Steel	Yes	Yes	Yes	Yes	100% VT; also see Section 05 50 00
33 16 19 Elevated Potable- Water Storage Tanks	ASME BPV Code, Section IX or AWS D1.1/D1.1M, Structural Welding Code - Steel	Yes	Yes	Yes	Yes	100% VT and AWWA D100; also see Section 33 16 19

**SECTION 05 50 00
METAL FABRICATIONS**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. The Aluminum Association, Inc. (AA): The Aluminum Design Manual.
 2. American Galvanizers Association (AGA):
 - a. Inspection of Hot-Dip Galvanized Steel Products.
 - b. Quality Assurance Manual.
 3. American Iron and Steel Institute (AISI): Stainless Steel Types.
 4. American Ladder Institute (ALI): A14.3, Ladders - Fixed - Safety Requirements.
 5. American National Standards Institute (ANSI).
 6. American Society of Safety Engineers (ASSE): A10.11, Safety Requirements for Personnel and Debris Nets.
 7. American Welding Society (AWS):
 - a. D1.1/D1.1M, Structural Welding Code - Steel.
 - b. D1.2/D1.2M, Structural Welding Code - Aluminum.
 - c. D1.6/D1.6M, Structural Welding Code - Stainless Steel.
 8. ASTM International (ASTM):
 - a. A36/A36M, Standard Specification for Carbon Structural Steel.
 - b. A48/A48M, Specification for Gray Iron Castings.
 - c. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - d. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - e. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - f. A143/A143M, Standard for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 - g. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - h. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - i. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

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- j. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- k. A276, Standard Specification for Stainless Steel Bars and Shapes.
- l. A283/A283M, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
- m. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- n. A325, Standard Specification for Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength.
- o. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
- p. A384/A384M, Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
- q. A385/A385M, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
- r. A489, Standard Specification for Carbon Steel Lifting Eyes.
- s. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- t. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- u. A563, Standard Specification for Carbon and Alloy Steel Nuts.
- v. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- w. A780/A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- x. A786/A786M, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
- y. A793, Standard Specification for Rolled Floor Plate, Stainless Steel.
- z. A967, Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.
- aa. A992/A992M, Standard Specification for Structural Steel Shapes.
- bb. A1085, Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
- cc. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- dd. B308/B308M, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
- ee. B429/B429M, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

- ff. B632/B632M, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
- gg. C881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- hh. D1056, Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
- ii. F436, Standard Specification for Hardened Steel Washers.
- jj. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
- kk. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- ll. F594, Standard Specification for Stainless Steel Nuts.
- mm. F844, Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.
- nn. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- 9. NSF International (NSF): 61, Drinking Water System Components—Health Effects.
- 10. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR 1910.27, Fixed Ladders.
 - b. 29 CFR 1926.105, Safety Nets.
 - c. 29 CFR 1926.502, Fall Protection Systems Criteria and Practices.
- 11. Specialty Steel Industry of North America (SSINA):
 - a. Specifications for Stainless Steel.
 - b. Design Guidelines for the Selection and Use of Stainless Steel.
 - c. Stainless Steel Fabrication.
 - d. Stainless Steel Fasteners.

1.02 DEFINITIONS

- A. Anchor Bolt: Cast-in-place anchor; concrete or masonry.
- B. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.
- C. Exterior Area: Location not protected from weather by building or other enclosed structure.
- D. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or washdown, nor where wall or roof slab is common to a water-holding or earth-retaining structure.

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- E. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or washdown, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.
- F. Submerged: Location at or below top of wall of open water-holding structure, such as basin or channel, or wall, ceiling or floor surface inside a covered water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered.

1.03 SUBMITTALS

A. Action Submittals:

- 1. Shop Drawings: Metal fabrications, including welding and fastener information.
- 2. Samples: Color samples of abrasive stair nosings.

B. Informational Submittals:

- 1. Pre-engineered Ladders: Letter of certification that ladder meets OSHA 29 CFR 1910.27 requirements.
- 2. Passivation method for stainless steel members.
- 3. Galvanized coating applicator qualifications.
- 4. Hot-Dip Galvanizing: Certificate of compliance signed by galvanizer, with description of material processed and ASTM standard used for coating.

1.04 QUALITY ASSURANCE

A. Qualifications:

- 1. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Insofar as practical, factory assemble specified items. Package assemblies, which have to be shipped unassembled to protect materials from damage and tag to facilitate identification and field assembly.
- B. Package stainless steel items to provide protection from carbon impregnation.
- C. Protect painted coatings and hot-dip galvanized finishes from damage as a result of metal banding and rough handling. Use padded slings and straps.
- D. Store fabricated items in dry area, not in direct contact with ground.

PART 2 PRODUCTS

2.01 GENERAL

- A. For hot-dip galvanized steel that is exposed to view and does not receive paint, limit the combined phosphorus and silicon content to 0.04 percent. For steels that require a minimum of 0.15 percent silicon (such as plates over 1.5 inches thick for ASTM A36/A36M steel), limit maximum silicon content to 0.21 percent and phosphorous content to 0.03 percent.
- B. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference
Steel Wide Flange Shapes	A992/992M
Other Steel Shapes and Plates	A36/A36M or A572/A572M, Grade 50 or A992/A992M for other steel shapes
Steel Pipe	A500, Grade B
Hollow Structural Sections (HSS)	A500/A500M, Grade C
Aluminum:	
Aluminum Plates	B209, Alloy 6061-T6
Aluminum Structural Shapes	B308/B308M, Alloy 6061-T6
Stainless Steel:	
Bars and Angles	A276, AISI Type 316 (316L for welded connections)
Shapes	A276, AISI Type 304 (304L for welded connections)
Steel Plate, Sheet, and Strip	A240/A240M, AISI Type 316 (316L for welded connections)
Bolts, Threaded Rods, Anchor Bolts, and Anchor Studs	F593, AISI Type 316, Group 2, Condition SH
Nuts	F594, AISI Type 316, Condition CW
Steel Bolts and Nuts:	
Carbon Steel	A307 bolts, with A563 nuts
High-Strength	A325, Type 1 bolts, with A563 nuts

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Item	ASTM Reference
Anchor Bolts and Rods	F1554, Grade 36, with weldability supplement S1.
Eyebolts	A489
Threaded Rods	A36/A36M
Flat Washers (Unhardened)	F844
Flat and Beveled Washers (Hardened)	F436
Thrust Ties for Steel Pipe:	
Threaded Rods	A193/A193M, Grade B7
Nuts	A194/A194M, Grade 2H
Plate	A283/A283M, Grade D
Welded Anchor Studs	A108, Grades C-1010 through C-1020
Aluminum Bolts and Nuts	F468, Alloy 2024-T4
Cast Iron	A48/A48M, Class 35

- C. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, zinc-plated steel, and aluminum material types as indicated in Fastener Schedule at end of this section.

2.02 ANCHOR BOLTS AND ANCHOR BOLT SLEEVES

A. Cast-In-Place Anchor Bolts:

1. Headed type, unless otherwise shown on Drawings.
2. Material type and protective coating as shown in Fastener Schedule at end of this section.

B. Anchor Bolt Sleeves:

1. Plastic:
 - a. Single unit construction with corrugated sleeve.
 - b. Top of sleeve shall be self-threading to provide adjustment of threaded anchor bolt projection.
 - c. Material: High-density polyethylene.
2. Fabricated Steel: ASTM A36/A36M.

2.03 POST-INSTALLED CONCRETE ANCHORS

- A. See Section 05 05 19, Post-Installed Anchors.

2.04 STUD SHEAR CONNECTORS

- A. Headed anchor studs (HAS), or threaded anchor studs (TAS), or stud shear connectors, as indicated on Drawings.

1. Carbon Steel: ASTM A108, Standard Quality Grades 1010 through 1020, inclusive either semikilled or killed aluminum or silicon dioxidation, unless indicated otherwise.
2. Stainless Steel: ASTM F593, AISI Type 316, Condition CW, where indicated.

- B. Manufacturers:

1. Nelson Stud Welding, FabriSteel Co., Elyria, OH.
2. Stud Welding Associates, Inc., Elyria, OH.

2.05 EMBEDDED STEEL SUPPORT FRAMES FOR FLOOR PLATE AND GRATING

- A. Steel angle support frames to be embedded in concrete shall be stainless steel, ASTM A276, AISI Type 316, unless indicated otherwise.

- B. Welded anchors for stainless steel support frames shall also be stainless steel.

2.06 FLOOR PLATE

- A. Material:

1. Galvanized Steel: Carbon steel, ASTM A786/A786M, commercial grade, hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
2. Stainless Steel: ASTM A793, AISI Type 304.
3. Aluminum: ASTM B632/B632M, Alloy 6061-T6.

- B. Minimum Thickness:

1. Steel: 1/4 inch, unless shown otherwise on Drawings.
2. Aluminum: 3/8 inch, unless shown otherwise on Drawings.

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- C. Surface: Raised-lug pattern or diamond tread, unless shown otherwise on Drawings.
- D. Slip-Resistant Surface:
 - 1. Provide where indicated on Drawings.
 - 2. Manufacturers and Products:
 - a. IKG/Borden, Clark, NJ; MEBAC 2.
 - b. W.S. Molnar Co., Detroit, MI; SLIPNOT Grade 2–Medium.

2.07 LADDERS

- A. Fabricate ladders with rails, rungs, landings, and cages to meet applicable requirements of OSHA, CFR Part 1910.27, and ALI A14.3.
 - 1. Design ladder for concentrated load of 200 pounds imposed by user concentrated at points that will cause maximum stress in structural member being considered.
 - 2. Include weight of ladder and attached appurtenances together with live load in design of rails and fastenings.
 - 3. Self-closing gates at landings.
- B. Flat Bar Ladder:
 - 1. Punch rails, pass rungs through rails, and weld on outside.
 - 2. Weld brackets to ladder for fastening ladder to wall.
 - 3. Hot-dip galvanize steel after fabrication in accordance with ASTM A123/A123M and ASTM A385/A385M.
 - 4. ASTM A276, AISI Type 316L stainless steel.
- C. Aluminum Pre-engineered Pipe Ladder:
 - 1. Rungs:
 - a. Aluminum extrusions of Alloy 6063-T6.
 - b. Nonslip grip surface, 1-inch wide flat top, and semicircular bottom with mill finish.
 - c. Diamondback, finish to match rails, as manufactured by Alcoa Building Products, Inc., Sidney, OH.
 - 2. Side Rails: ASTM B429/B429M, Alloy 6063-T6, 1-1/2 inches, Schedule 40 pipe with anodized finish, AA M32-C22-A41.
 - 3. Ladder Attachments and Cage Assembly Fasteners: Stainless steel.
 - 4. Welded, pop riveted, or glued construction is not acceptable.
 - 5. Fabricate to longest length as practical but not to exceed 24 feet.
 - 6. Furnish support attachments to side rails at 6 feet maximum spacing.
 - 7. Manufacturer: Thompson Fabricating Co. Inc., Tarrant, AL.

D. Ladder Safety Post:

1. Telescoping tubular, spring balanced and automatically locking in raised position, with release lever for unlocking.
2. Post: Stainless steel, AISI Type 304.
3. Hardware: Stainless steel, AISI Type 316.
4. Furnish dissimilar metal protective coatings at connections.
5. Manufacturer and Product: Bilco Co., New Haven, CT; "Ladder Up" to fit ladder rungs.

2.08 SAFETY CLIMB DEVICE

A. General:

1. Conforms to ALI A14.3 and OSHA CFR Part 1910.27.
2. Belt and harness shall withstand minimum drop test of 250 pounds in 6-foot free fall.
3. Fall Prevention System Material: Stainless steel, AISI Type 316.

B. Components and Accessories:

1. Main Components: Sleeve or trolley, safety harness, and carrier or climbing rail.
2. Ladder rung clamps with stainless steel, AISI Type 316, mounting brackets and hardware.
3. Removable extension kit with tiedown rod or trolley gate, mandrel, and carrier rail for ladders under manholes and hatches.

C. Manufacturers and Products:

1. Miller by Honeywell, Franklin, PA; Miller Saf-T-Climb.
2. TS Products, Cambridge, Ontario, Canada; TS Safety Rail System.

2.09 FALL ARREST ANCHORS

A. General:

1. Conforms to OSHA CFR Part 1926.502.
2. Minimum Breaking Strength: 5,000 pounds.
3. Material: Stainless steel, AISI Type 304.

B. Components and Accessories:

1. Forged combination eye and base assembly with headed anchor bolt, backer plate, lock washer, and nut.
2. Suitable for embedment in concrete wall or slab.

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C. Manufacturers and Products:

1. Thaler Metal Industries, Buffalo, NY; FARA Wall Anchor.
2. Rose Manufacturing Company, Pittsburgh, PA; Anchorage Connector.

2.10 ACCESSORIES

A. Antiseizing Lubricant for Stainless Steel Threaded Connections:

1. Suitable for potable water supply.
2. Resists washout.
3. Manufacturers and Products:
 - a. Bostik, Middleton, MA; Neverseez.
 - b. Saf-T-Eze Div., STL Corp., Lombard, IL; Anti-Seize.

B. Neoprene Gasket:

1. ASTM D1056, 2C1, soft, closed-cell neoprene gasket material, suitable for exposure to sewage and sewage gases, unless otherwise shown on Drawings.
2. Thickness: Minimum 1/4 inch.
3. Furnish without skin coat.
4. Manufacturer and Product: Monmouth Rubber and Plastics Corporation, Long Branch, NJ; Durafoam DK1111LD.

2.11 FABRICATION

A. General:

1. Finish exposed surfaces smooth, sharp, and to well-defined lines.
2. Furnish necessary rabbets, lugs, and brackets so work can be assembled in neat, substantial manner.
3. Conceal fastenings where practical; where exposed, flush countersink.
4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
5. Grind cut edges smooth and straight. Round sharp edges to small uniform radius. Grind burrs, jagged edges, and surface defects smooth.
6. Fit and assemble in largest practical sections for delivery to Site.

B. Materials:

1. Use steel shapes, unless otherwise noted.
2. Steel to be hot-dip galvanized: Limit silicon content to less than 0.04 percent or to between 0.15 percent and 0.25 percent.
3. Fabricate aluminum in accordance with AA Specifications for Aluminum Structures—Allowable Stress Design.

C. Welding:

1. Weld connections and grind exposed welds smooth. When required to be watertight, make welds continuous.
2. Welded fabrications shall be free from twisting or distortion caused by improper welding techniques.
3. Steel: Meet fabrication requirements of AWS D1.1/D1.1M, Section 5.
4. Aluminum: Meet requirements of AWS D1.2/D1.2M.
5. Stainless Steel: Meet requirements of AWS D1.6/D1.6M.
6. Welded Anchor Studs: Prepare surface to be welded and weld with stud welding gun in accordance with AWS D1.1/D1.1M, Section 7, and manufacturer's instructions.
7. Complete welding before applying finish.

D. Painting:

1. Shop prime with rust-inhibitive primer as specified in Section 09 90 00, Painting and Coating, unless otherwise indicated.
2. Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
3. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless indicated otherwise.

E. Galvanizing:

1. Fabricate steel to be galvanized in accordance with ASTM A143/A143M, ASTM A384/A384M, and ASTM A385/A385M. Avoid fabrication techniques that could cause distortion or embrittlement of the steel.
2. Provide venting and drain holes for tubular members and fabricated assemblies in accordance with ASTM A385/A385M.
3. Remove welding slag, splatter, burrs, grease, oil, paint, lacquer, and other deleterious material prior to delivery for galvanizing.
4. Remove by blast cleaning or other methods surface contaminants and coatings not removable by normal chemical cleaning process in the galvanizing operation.
5. Hot-dip galvanize steel members, fabrications, and assemblies after fabrication in accordance with ASTM A123/A123M.

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6. Hot-dip galvanize bolts, nuts, washers, and hardware components in accordance with ASTM A153/A153M. Oversize holes to allow for zinc alloy growth. Shop assemble bolts and nuts.
 7. Galvanized steel sheets in accordance with ASTM A653/A653M.
 8. Galvanize components of bolted assemblies separately before assembly. Galvanizing of tapped holes is not required.
- F. Electrolytic Protection: Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
- G. Fitting: Where movement of fabrications is required or shown, cut, fit, and align items for smooth operation. Make corners square and opposite sides parallel.
- H. Accessories: Furnish as required for a complete installation. Fasten by welding or with stainless steel bolts or screws.

2.12 SOURCE QUALITY CONTROL

- A. Visually inspect all fabrication welds and correct deficiencies.
1. Steel: AWS D1.1/D1.1M, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.
 2. Aluminum: AWS D1.2/D1.2M.
 3. Stainless Steel: AWS D1.6/D1.6M.

PART 3 EXECUTION

3.01 INSTALLATION OF METAL FABRICATIONS

- A. General:
1. Install metal fabrications plumb and level, accurately fitted, free from distortion or defects.
 2. Install rigid, substantial, and neat in appearance.
 3. Install manufactured products in accordance with manufacturer's recommendations.
 4. Obtain Engineer approval prior to field cutting steel members or making adjustments not scheduled.

B. Aluminum:

1. Do not remove mill markings from concealed surfaces.
2. Remove inked or painted identification marks on exposed surfaces not otherwise coated after installed material has been inspected and approved.
3. Fabrication, mechanical connections, and welded construction shall be in accordance with the AA Aluminum Design Manual.

C. Pipe Sleeves:

1. Provide where pipes pass through concrete or masonry.
2. Holes drilled with a rotary drill may be provided in lieu of sleeves in existing walls.
3. Provide center flange for water stoppage on sleeves in exterior or water-bearing walls.
4. Provide rubber caulking sealant or a modular mechanical unit to form watertight seal in annular space between pipes and sleeves.

D. Steel Lintels and Shelf Angles: Provide as required for support of masonry and other construction not attached to structural steel framing, unless otherwise shown on Drawings.

3.02 CAST-IN-PLACE ANCHOR BOLTS

- A. Locate and hold anchor bolts in place with templates at time concrete is placed.
- B. Use anchor bolt sleeves for location adjustment and provide two nuts and one washer per bolt of same material as bolt.
- C. Minimum Bolt Size: 1/2-inch diameter by 12 inches long, unless otherwise shown.

3.03 SAFETY CLIMB DEVICE SYSTEM

- A. Provide for each ladder where unbroken height between levels exceeds 20 feet, or at lesser height where indicated on Drawings.
- B. Install in accordance with manufacturer's instructions.
- C. Furnish additional accessories required to complete system for each ladder.
- D. Furnish one harness for each ladder equipped with safety climb device.

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- E. Furnish pivot section at platforms, landings, and roofs.
- F. When installed to required height, fall prevention system shall be rigid and an integral part of the structure.

3.04 ELECTROLYTIC PROTECTION

- A. Aluminum and Galvanized Steel:
 - 1. Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
 - 2. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless indicated otherwise.
 - 3. Allow coating to dry before installation of the material.
 - 4. Protect coated surfaces during installation.
 - 5. Should coating become marred, prepare and touch up in accordance with paint manufacturer's written instructions.
- B. Titanium: Where titanium equipment is in contact with concrete or dissimilar metal, provide full-face neoprene insulation gasket, 3/32-inch minimum thickness and 70-durometer hardness.
- C. Stainless Steel:
 - 1. During handling and installation, take necessary precautions to prevent carbon impregnation of stainless steel members.
 - 2. After installation, visually inspect stainless steel surfaces for evidence of iron rust, oil, paint, and other forms of contamination.
 - 3. Remove contamination using cleaning and passivation methods in accordance with requirements of ASTM A380 and ASTM A967.
 - 4. Brushes used to remove foreign substances shall utilize only stainless steel or nonmetallic bristles.
 - 5. After treatment, visually inspect surfaces for compliance.

3.05 PAINTING

- A. Painted Galvanized Surfaces: Prepare as specified in Section 09 90 00, Painting and Coating.
- B. Repair of Damaged Hot-Dip Galvanized Coating:
 - 1. Conform to ASTM A780/A780M.
 - 2. For minor repairs at abraded areas, use sprayed zinc conforming to ASTM A780/A780M.

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3. For flame cut or welded areas, use zinc-based solder, or zinc sticks, conforming to ASTM A780/A780M.
 4. Use magnetic gauge to determine thickness is equal to or greater than base galvanized coating.
- C. Field Painting of Shop Primed Surfaces: Prepare surfaces and field finish in accordance with Section 09 90 00, Painting and Coating.

3.06 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. Contractor-Furnished Quality Control:
1. Inspection and testing required in Section 01 45 16.13, Contractor Quality Control.
 2. Manufacturer's Certificate of Compliance per Section 01 61 00, Common Product Requirements, for test results, or calculations, or drawings that ensure material and equipment design and design criteria meet requirements of Section 01 61 00, Common Product Requirements and Section 01 88 15, Anchorage and Bracing.

3.07 FASTENER SCHEDULE

- A. Unless indicated otherwise on Drawings, provide fasteners as follows:

Service Use and Location	Product	Remarks
1. Anchor Bolts Cast Into Concrete for Structural Steel, Metal Fabrications and Castings		
Interior Dry Areas	Hot-dip galvanized steel headed anchor bolts, unless indicated otherwise	
Exterior and Interior Wet Areas	Stainless steel headed anchor bolts	
Submerged and Corrosive Areas	Stainless steel headed anchor bolts with fusion bonded coating	See Section 09 90 00, Painting and Coating

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Service Use and Location	Product	Remarks
2. Anchor Bolts Cast Into Concrete for Equipment Bases		
Interior Dry Areas	Hot-dip galvanized steel headed anchor bolts, unless otherwise specified with equipment	
Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel headed anchor bolts with fusion bonded coating, unless otherwise specified with equipment	See Section 09 90 00, Painting and Coating
3. Post-Installed Anchors: See Section 05 05 19, Post-Installed Anchors		
4. Connections for Structural Steel Framing		
Exterior and Interior Wet and Dry Areas	High-strength steel bolted connections	Use hot-dipped galvanized high-strength bolted connections for galvanized steel framing members.
5. Connections of Aluminum Components		
Submerged, Exterior and Interior Wet and Dry Areas	Stainless steel bolted connections, unless otherwise specified with equipment	
6. All Others		
Exterior and Interior Wet and Dry Areas	Stainless steel fasteners	

B. Antiseizing Lubricant: Use on stainless steel threads.

END OF SECTION

**SECTION 05 52 19
STEEL RAILINGS**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Iron and Steel Institute (AISI): As applicable.
 2. ASTM International (ASTM):
 - a. A36/A36M, Standard Specification for Carbon Structural Steel.
 - b. A: A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - c. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - d. A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - e. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - f. E894, Standard Test method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.
 - g. E935, Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
 - h. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
 3. International Code Council (ICC):
 - a. Florida Building Code 6th Edition (2017).
 - b. Evaluation Services Reports, as applicable.
 4. Occupational Safety and Health Act (OSHA): 29 CFR 1910, Code of Federal Regulations.

1.02 DEFINITIONS

- A. ICC Evaluation Services Report: ICC report on evaluation of manufactured concrete anchor systems.
- B. Railings: This term shall include guardrail systems, handrail systems, platform railing systems, ramp-rail systems, and stair-rail systems. Railings may be comprised of a framework of vertical, horizontal, or inclined members, grillwork or panels, accessories, or combination thereof.
- C. Toeboards: Vertical barrier at floor level usually erected on railings along exposed edges of floor or wall openings, platforms, or ramps to prevent miscellaneous items from falling through.

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1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:

- a. Project-specific scaled plans and elevations of railings and detail drawings. Include railing profiles, sizes, connections, anchorage, size and type of fasteners, and accessories.
- b. Manufacturer's literature and catalog data of railing and components.
- c. Design Data: Where proposed design of post base connections is different than details shown on Drawings, submit calculations or test data for alternate railing anchorages using ICC IBC design loads.

B. Informational Submittals:

1. Manufacturer's assembly and installation instructions.
2. Test Reports: Test data for anchorages may supplement design data submitted for alternate anchorage details. Testing of anchorages shall be in accordance with ASTM E894 and ASTM E935 using applied loads in accordance with the ICC IBC.

1.04 QUALITY ASSURANCE

- ### A. Qualifications: Calculations required for alternate anchorage designs (if proposed) shall be stamped by a registered civil or structural engineer licensed in the state where the Project will be constructed.

1.05 DELIVERY, STORAGE, AND HANDLING

- ### A. Railings adequately packaged and wrapped to prevent scratching and denting during shipment, storage, and installation. Maintain protective wrapping to the extent possible until railing is completely installed.

PART 2 PRODUCTS

2.01 STEEL RAILINGS

A. Pipe Railings/Round HSS:

1. Painted carbon steel, ASTM A500/A500M Grade B.
2. Outside Diameter: 1.900-inch.
3. Wall Thickness:
 - a. Rail: 0.145-inch, minimum.
 - b. Post: 0.200-inch, minimum.

B. Accessories, including railing components, flanges, wall brackets, anchor plates, shall conform to the following:

1. Post Bolted Baseplate: Carbon steel ASTM A36/A36M painted.
2. Wall Brackets:
 - a. Malleable iron, round top, and painted.
 - b. Manufacturers and Products:
 - 1) The Wagner Companies; No. 1765.
 - 2) Julius Blum & Co., Inc.; No. 1382.
3. Rail Terminals (including Wall Returns):
 - a. Round, painted steel, welded to rail, with two 5/16-inch holes for 1/4-inch fasteners.
 - b. Manufacturer: The Wagner Companies.
4. Railing System Gate:
 - a. As specified herein for painted steel pipe.
 - b. Gate Hardware: Painted steel or AISI Type 304 or Type 316 stainless steel.
5. Railing Picket Panels and Clamps:
 - a. Painted steel, solid bar or pipe meeting minimum requirements specified for pipe rails.
 - b. Fasteners: Galvanized steel, painted steel, or stainless steel.
6. Toeboards and Accessories:
 - a. ASTM A36/A36M steel painted.
 - b. Toeboards: Provide slotted holes for expansion and contraction where required.
 - c. Fasteners: Galvanized steel, painted steel, or stainless steel.

C. Miscellaneous Fasteners: Galvanized steel, painted steel or stainless steel.

2.02 ANCHOR BOLTS, FASTENERS, AND CONCRETE ANCHORS

A. Locknuts, Washers, and Screws:

1. Elastic Locknuts, Steel Flat Washers, Round Head Machine Screws (RHMS): Galvanized steel, painted steel or stainless steel.
2. Flat Washers: Molded nylon.

B. Bolts and Nuts for Bolting Railing to Metal Beams: Painted ASTM A325 bolts.

C. Concrete Anchors:

1. Painted steel anchor rods conforming to ASTM F1554, Grade 36.
2. Post-installed anchors shall be in accordance with Section 05 05 19, Post-Installed Anchors, unless otherwise specified herein.
3. Bolt Diameter: 1/2 inch, minimum.

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2.03 FABRICATION OF WELDED STEEL RAILINGS

- A. Shop Assembly:
1. Post spacing and railing details shall be as shown on Drawings.
 2. Post to Baseplate Connection: Field fit-up is required as shown on Drawings.
 3. Alternate Post to Baseplate Connection:
 - a. Field measure elevation of concrete at each post location and determine exact post length so baseplate is on concrete surface.
 - b. Rails shall be in straight alignment when rails to posts and posts to baseplates are welded.
 - c. Field weld posts to baseplates.
 4. Remove burrs from cut edges.
 5. Form elbow bends and wall returns to uniform radius, free from buckles and twists, with finished surfaces smooth.
 6. Cover exposed ends of steel pipe by welding 1/8-inch minimum thickness steel plate in place or use prefabricated fittings.
 7. Welding:
 - a. In accordance with Section 05 05 23, Welding.
 - b. Thoroughly fuse without undercutting or overlap.
 - c. Remove splatter, grind exposed welds to blend, and contour surfaces to match those adjacent.
 - d. Grind welds prior to painting of railing sections.
 8. Furnish explosion prevention holes at closed ends of pipes.
 9. Form and assemble joints exposed to weather to prevent water and moisture from penetrating.
- B. Shop/Factory Finishing: After fabrication paint steel components other than stainless steel components as specified in Section 09 90 00, Painting and Coating.
- C. Tolerances:
1. Cut pipe square within 2 degrees and lengths within 1/8 inch.
 2. Welding: Miter and cope intersections of posts and rails within 2 degrees, fit to within 0.020 inch, and perform continuous welds around joints.
- D. Repair of Defective Work: Remove stains and replace defective Work.

PART 3 EXECUTION

3.01 GENERAL

- A. Where required, provide railing posts longer than needed and field cut to exact dimensions required in order to satisfy vertical variations on actual structure.
- B. Install railing with base that provides plus or minus 1/4-inch vertical adjustment inside base fitting. If adjustment is required in field and exceeds plus or minus 1/4-inch, reduce post length not to exceed beyond bottom of lowest set-screw or bolt in base fitting.
- C. Modification to supporting structure is not permitted where railing is to be attached.
- D. Mount railings only on completed walls. Do not support railings temporarily by means not satisfying structural performance requirements.
- E. Protection from Entrapped Water:
 - 1. Make provisions in exterior and interior installations subject to high humidity to drain water from railing system.
 - 2. For posts mounted in concrete, bends, and elbows occurring at low points drill weep holes of 1/4-inch diameter at lowest possible elevations, one hole per post or rail. Drill hole in plane of rail.

3.02 RAILING INSTALLATION

- A. Expansion Joints:
 - 1. Maximum intervals of 54 feet on center and at structural movement joints.
 - 2. Slip joint with internal sleeve extending 2 inches beyond each side of joint. Provide 1/2-inch slip joint gap to allow for expansion.
 - 3. Fasten to one side using 3/8-inch diameter set-screw. Place set-screw at bottom of pipe.
 - 4. Locate joints within 12 inches of posts. Locate expansion joints in rails that span movement joints in structural walls and floors supporting the posts.
- B. Posts and Rails:
 - 1. Surface Mounted and Side Mounted Posts:
 - a. Bolt post baseplate connectors firmly in place.
 - b. Install to account for small variation in leveling grouts and shims between adjacent posts.

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2. Set posts plumb and aligned to within 1/8 inch in 12 feet.
3. Set rails horizontal or parallel to slope of steps to within 1/8 inch in 12 feet.
4. Install posts and rails in same plane.
5. Remove projections or irregularities and provide a smooth surface for sliding hands continuously along top rail.
6. Use offset rail for use on stairs and platforms if post is attached to web of stringers or structural platform supports.
7. Support 1-1/2-inch rails directly above stairway stringers with offset fittings.

C. Toeboard:

1. Provide at railings, except where 4-inch or higher concrete curbs are installed, at gates, or on stairways unless shown otherwise.
2. Accurately measure in field for correct length; after railing post installation, cut and secure to posts.
3. Dimension between bottom of toeboard and walking surface not to exceed 1/4 inch.
4. Install plumb and aligned to within 1/8 inch in 12 feet.

D. Railing System Gate: Install in accordance with manufacturer's installation instructions.

3.03 FIELD FINISHING

- A. Corrosion Protection: Prevent galvanic action and other forms of corrosion caused from direct contact with concrete and dissimilar metals by coating metal surfaces as specified in Section 09 90 00, Painting and Coating.
- B. Coat metal surfaces as specified in Section 09 90 00, Painting and Coating.

3.04 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. Post-installed anchors supporting railing systems require special inspection.
- B. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

3.05 CLEANING

- A. Wash railing system thoroughly using clean water and soap. Rinse with clean water.
- B. Do not use acid solution, steel wool, or other harsh abrasive.

END OF SECTION

SECTION 09 90 60
SURFACE PREPARATION AND COATING
EXISTING ELEVATED STORAGE TANKS

PART 1 GENERAL

1.01 SCOPE

- A. This Specification covers repair, preparation of surfaces, and completion of painting of all surfaces specified on the following structures:
 - 1. 500,000 Gallon Composite Elevated Tank (CET): All Interior and Exterior Surfaces.
- B. The Contractor shall be responsible for all costs associated with blasting debris sampling and testing, soil sampling and testing (pre-work and post-work), worker protection, environmental pollution control, handling of debris, laboratory analysis and waste disposal.

1.02 WORK INCLUDED

- A. Preparation of surfaces which are to receive finishes:
- B. Disposal of blasting debris.
- C. Tank repairs.
- D. Finish surfaces.
- E. Testing and cleaning.

1.03 RELATED WORK AND APPLICABLE REQUIREMENTS SPECIFIED ELSEWHERE

- A. Bidding Requirements, Contract Form and Conditions of the Contract And General Requirements shall apply to all work included in this section.

1.04 DOCUMENTS AND STANDARDS

- A. Coating manufacturer's printed instructions.
- B. American Society of Testing Materials:
 - 1. ASTM B117, Salt Spray (Fog).
 - 2. ASTM D149, Dielectric Strength.
 - 3. ASTM D4060, Abrasion.

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4. ASTM D4541, Adhesion.
 5. ASTM D4585, Humidity.
 6. ASTM G53, QUV Exposure.
 7. ASTM D 4141, Exterior Exposure (EMMAQUA).
- C. American National Standards Institute/National Sanitation Foundation:
1. ANSI/NSF Standard 61 Listed Drinking Water System Components - Health Effects.
- D. American Water Works Association:
1. AWWA Standard C652-92, Disinfection.
 2. AWWA Standard D100-84, Welded Steel Tanks For Water Storage.
 3. AWWA Standard D102-17, Painting Steel Water Storage Tanks.
- E. Code of Federal Regulations:
1. 29 CFR 1910, Occupational Safety and Health Standards (General Industry Standards).
 2. 29 CFR 1910.1020, Access to Employee Exposure and Medical Records.
 3. 29 CFR 1910.1200, Hazard Communication.
 4. 29 CFR 1926, Safety and Health Regulations for Construction (Construction Industry Standards).
 5. 40 CFR 50, National Primary and Secondary Ambient Air Quality Standards.
 6. 40 CFR 261, Identification and Listing of Hazardous Waste.
 7. 40 CFR 268, Land Disposal Restrictions.
 8. All other Applicable State and Federal Regulations.
- F. National Institute for Occupational Health and Safety: All Applicable Regulations.
- G. Occupational Safety and Health Administration: All Applicable Regulations.
- H. Steel Structures Painting Council (SSPC):
1. SSPC-SP 1, Solvent Cleaning.
 2. SSPC-SP 2, Hand Tool Cleaning.
 3. SSPC-SP 3, Power Tool Cleaning.
 4. SSPC-SP 6, Commercial Blast Cleaning.
 5. SSPC-SP 10, Near White Blast Cleaning.
 6. SSPC Guide 6, Guide for Containing Debris Generated During Paint Removal Operations.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Provide products from a company specializing in the manufacture of high performance coatings with a minimum of 10 years' experience.
2. Applicator shall be trained in application techniques and procedures of coating materials and shall demonstrate a minimum of 5 years successful experience in such application.
 - a. Maintain, throughout duration of application, a crew of painters who are fully qualified to satisfy specified qualifications.
3. Single Source Responsibility:
 - a. Materials shall be products of a single manufacturer or items standard with manufacturer of specified coating materials.
 - b. Provide secondary materials which are produced or are specifically recommended by coating system manufacturer to ensure compatibility of system.

B. Regulatory Requirements: Conform to applicable codes and ordinances for flame, fuel, smoke, and volatile organic compound (VOC) ratings requirements for finishes at time of application.

C. Pre-Installation Meeting:

1. Schedule a conference and inspection to be held on-site before field application of coating systems begins.
2. Conference shall be attended by Contractor, Owner's representative, Engineer, coating applicators, and a representative of coating material manufacturer.
3. Topics to be discussed at meeting shall include:
 - a. A review of Contract Documents and accepted shop drawings shall be made and deviations or differences shall be resolved.
 - b. Review items such as environmental conditions, surface conditions, surface preparation, application procedures, and protection following application. A surface mock-up of the surface preparation requirements for the project, both interior and exterior, shall be prepared by the Contractor. All parties shall agree to the degree of cleanliness and the mock-up shall be preserved for the duration of the Project.
 - c. Establish which areas on-site will be available for use as storage areas and working area.

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4. Pre-construction conference and inspection shall serve to clarify Contract Documents, application requirements and what work should be completed before coating application can begin.
5. Prepare and submit, to parties in attendance, a written report of pre-installation conference. Report shall be submitted within 3 days following conference.

PART 2 PRODUCTS

2.01 QUALITY OF COATINGS

- A. The products in the following Specifications are identified as standards of quality. Contractor may request to submit “or equal” products. No request for substitution will be considered which decreases the film thickness and/or the number of coats to be applied, or which offers a change from the generic type of coating specified. Request for substitution shall contain the following:
 1. Full name of each product.
 2. Descriptive literature.
 3. Directions for use.
 4. Generic type.
 5. Non Volatile content by volume.
 6. Performance data listed in Section 8.
- B. Bidders desiring to use paints other than those specified shall submit their proposal based on the specified materials. Submittals shall include a side by side comparison of the performance attributes of the proposed materials as compared to the specified coatings. In no case will the request be considered unless all information is received, in writing, ten days prior to the bid opening date. In addition, the proposer shall provide a list of not less than 25 tanks, within a 150 mile radius, that have been coated with the proposed system and have rendered satisfactory service for at least five years. All proposed products shall have been commercially available for 15 years or more.

2.02 CERTIFICATIONS

- A. Protective coatings for interior wet application shall be listed by NSF International as approved for potable water contact in accordance with of NSF/ANSI/CAN 600 according to the requirements of NSF/ANSI/CAN 61.

2.03 SHIPPING, STORAGE AND HANDLING

- A. All paints shall be properly prepared by the manufacturer and delivered to the site for field painting in the original unbroken containers with manufacturer's label plainly printed thereon. Type of material to be applied at each location shall be submitted to the Engineer with the manufacturer's written recommendation of the type paint for each item to be painted.
- B. All coatings shall be stored in an enclosed structure to protect them from weather and excessive heat or cold. Flammable coatings must be stored to conform to City, County, State and Federal safety codes for flammable coatings or paint materials. At all times coatings shall be protected from freezing.
- C. All coatings shall be applied in strict accordance with the applicable manufacturer's current printed product data sheet(s) and container labels. Coatings shall not be applied above or below the minimum and/or maximum surface temperatures as stated on the product data sheet(s) and shall not be applied to wet or damp surfaces, in rain, snow, fog or mist. Surface temperature must be at least 5 degrees F above the dew point.
- D. Painting shall be completed well in advance of the probable time of day when condensation will occur and/or the surface temperature is expected to drop below the minimum listed on the applicable product data sheet(s).
- E. Finish coats shall be uniform in color and sheen without streaks, laps, runs, sags or missed areas.
- F. The manufacturer's recommended curing time shall elapse before the next coat is applied. Adequate ventilation shall be provided for proper drying of paints on interior tank surfaces. A minimum of 7 days following the application of the final coat on the interior surfaces shall be allowed before the tank is flushed, disinfected, or filled with water.
- G. Clean-Up: All cloths and waste that might constitute a fire hazard shall be placed in closed metal containers or destroyed at the end of each day. Upon completion of the work, all staging, scaffolding, and containers shall be removed from the site and/or destroyed in an approved and legal manner. Paint spots, oil, or stains upon adjacent surfaces and floors shall be completely removed, and the entire job left clean and acceptable to the Engineer.

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2.04 EXISTING UTILITIES, STRUCTURES AND PROPERTIES

- A. It shall be the responsibility of the contractor to locate and avoid damage to any and all existing water, gas, sewer, electric, telephone, and other utilities, structures, or appurtenances. The Contractor shall repair or pay for all damages caused by his operations or his personnel to existing utilities, structures, appurtenances, or properties, either below ground or above ground and shall settle in full all damage suites which may arise as a result of his operations.

2.05 VENTILATION

- A. It is essential that the solvent vapors released during and after application of coatings be removed from the tank. During coating application, the capacity of ventilating fans shall be at least 300 cfm per gallon of coating applied per hour. Continuous forced ventilation at a rate of at least one complete air change per 4 hours shall be provided for at least 7 days after coating application is completed. Air shall be exhausted from the lowest portions of the tank with the top openings kept open and clear. A minimum of seven days (manufacturers printed instructions shall be followed for cure times at various temperatures) following application of the final coat on the interior shall be allowed before the tank is sterilized or filled with water.

PART 3 PAINTERS LOG AND TESTNG EQUIPMENT

3.01 DAILY LOG

- A. The Contractor shall keep a daily log in which he shall record the following information shall be recorded:
 - 1. Air Temperature: Air temperature readings shall be taken at intervals throughout the day's work. Readings shall be taken at the start of the mornings work, mid-day, and afternoon. Should environmental conditions change, additional reading shall be taken to assure that coatings are being applied under the conditions as outlined by the coating's manufacturer.
 - 2. Surface Temperature: Surface temperatures shall be taken in areas where work is being performed. Surface temperature shall be that as specified by the coating's manufacturer.
 - 3. Material Temperature: Material temperature reading shall be taken prior to the application of the paint.

4. Relative Humidity: Relative humidity readings shall be taken at intervals throughout the day's work. Readings shall be taken at the start of the mornings work, mid-day, and afternoon. Should environmental conditions change, additional reading shall be taken to assure that coatings are being applied under the conditions as outlined by the coating's manufacturer.
5. Dew Point: Dew point readings shall be taken at intervals throughout the day's work. Readings shall be taken at the start of the mornings work, mid-day, and afternoon. Should environmental conditions change, additional reading shall be taken to assure that coatings are being applied under the conditions as outlined by the coating's manufacturer.
6. Blast Profile: Following blasting operations, the Contractor shall take and record the depth of the blast profile. Blast profile measurements shall be taken using Testex X Course Replica Tape. Replica Tape shall be included in the daily log.
7. Detail or Work Performed During the Day: Area where work was performed and the extent of the work performed shall be included in the daily log.

3.02 TESTING EQUIPMENT

- A. In addition to the equipment required to take measurements which will be included in the daily log, The Contractor shall have on the project site the following testing equipment. Equipment shall be in calibration and proper working order.
 1. Dry Film Thickness Measurements Gauge: Dry film thickness reading shall be taken with a properly calibrated (per the manufacturer's instructions) Type 1 (magnetic) or Type 2 (electromagnetic) instrument. Dry film thickness reading will be taken and recorded in the in a frequency and manner as dictated by the Engineer.
 2. High Voltage Holiday Detection Equipment: Interior surfaces, following a minimum of 96 hours cure, shall be holiday detected in accordance with NACE SP0188-99 high voltage holiday detection. Holiday detector shall be a Tinker & Razor model AP/W Holiday D or equal. Areas found to have holidays shall be marked and repaired in accordance with the paint manufacturer's instructions. The Engineer shall be notified of time of testing so that he might be present to witness testing.

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3.03 SURFACE PREPARATION AND PAINTING

- A. Exterior Surface Preparation: Prior to surface preparation, all surfaces shall be cleaned of all oil and grease in accordance with SSPC-SP 1 Solvent Cleaning. All exterior surfaces shall be abrasive blasted to remove all dust, rust, and scale, as well as all other foreign matter and shall result in a surface preparation equal to that of SSPC-SP 10 Near White Blast Cleaned Surface. Surface profile shall be 1.5 - 2.5 mils. After erection, all weld seams and damaged areas shall be abrasive blast cleaned in accordance with SSPC-SP 10 Near White Blast Cleaning. All edges shall be feathered.

3.04 INTERIOR “WET” SURFACE PREPARATION

- A. Prior to surface preparation, all surfaces shall be cleaned of all oil and grease in accordance with SSPC-SP 1 Solvent Cleaning. All interior surfaces shall be abrasive blasted to remove all dust, rust, and scale, as well as all other foreign matter and shall result in a surface preparation equal to that of SSPC-SP 10 Near White Blast Cleaned Surface. Surface profile shall be 1.5 - 2.5 mils. After erection, all weld seams and damaged areas shall be abrasive blast cleaned in accordance with SSPC-SP 10 Near White Blast Cleaning. All edges shall be feathered. All intact remaining shop primer shall be abrasive blast cleaned in accordance with SSPC-SP 7 Brush-Off Blast Cleaning.

3.05 INTERIOR “DRY” SURFACE PREPARATION

- A. Prior to surface preparation, all surfaces shall be cleaned of all oil and grease in accordance with SSPC-SP 1 Solvent Cleaning. All exterior surfaces shall be abrasive blasted to remove all dust, rust, and scale, as well as all other foreign matter and shall result in a surface preparation equal to that of SSPC-SP 10 Near White Blast Cleaned Surface. Surface profile shall be 1.5 - 2.5 mils. After erection, all weld seams and damaged areas shall be abrasive blast cleaned in accordance with SSPC-SP 10 Near White Blast Cleaning. All edges shall be feathered.

3.06 DEBRIS CONTAINMENT AND DISPOSAL DURING PAINT REMOVAL OPERATIONS

- A. The Contractor will be required to contain all blasting debris, as well as paint overspray and/or roller spatter, generated during the performance of the Work. During surface preparation, airborne particulate, and debris from the removal of the paint shall not be permitted to contaminate the air, soil or water surrounding the Work Site. The Contractor will be required to perform any site remediation required due to improper collection and disposal of paint removal debris. The Contractor shall develop a debris containment and disposal plan in accordance with these specifications and federal and state requirements. The Contractor shall submit his plan to the Engineer for written approval prior to starting work.
- B. Containment System: The Contractor shall install a containment system meeting the requirements of Class 3A with a bonnet as specified in the SSPC Guide 6 (12) "Guide for Containing Debris Generated During Paint Removal Operations". Assessment of the containment system will be conducted in accordance with SSPC Guide 6 Section 5.5. All testing required will be paid by the Contractor. The standards and references listed in Section 3A of SSPC Guide 6 (92) shall form and be part of these specifications. The Contractors shall utilize SSPC Guide 6 for the development of the containment system. All workers shall be protected in accordance with all applicable OSHA Standards.
- C. Disposal of Debris: All debris generated shall be disposed of off-site in accordance with all Local, State and Federal regulations.

3.07 COATING SYSTEM

- A. Following surface preparation, all interior and exterior surfaces shall be coated as hereinafter specified. The primer shall be applied in accordance with the recommendations of the manufacturer and not more than eight hours after surface preparation.
- B. Exterior Surfaces:
 - 1. Shop Prime: All surfaces shall receive one full prime coat of Tnemec Series 91 H2O Hydro-Zinc or 94 H2O Hydro-Zinc applied at a rate to achieve 2.5 – 3.5 mils DFT.
 - 2. Field Patch Prime: All field welded areas, as well as any damaged areas, shall be receive one coat of Tnemec Series 91 H2O Hydro-Zinc or 94 H2O Hydro-Zinc applied at a rate to achieve 2.5 – 3.5 mils DFT.

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3. 1st Intermediate: After the prime coat has been properly installed, all exterior surfaces shall receive one intermediate coat of Tnemec Series 20-1255 Pota-Pox applied at a rate to achieve 2.0 – 3.0 mils DFT.
4. 2nd Intermediate: After the prime coat has been properly installed, all exterior surfaces shall receive one intermediate coat of *Tnemec Series 73 Endura-Shield* applied at a rate to achieve 2.0 – 3.0 mils DFT.
5. Finish: Following the intermediate coat, all exterior surfaces shall receive one full finish coat of Tnemec Series 700 HydroFlon applied at a rate to achieve 2.0 – 3.0 mils DFT.
6. Lettering / Logo: Lettering and logos shall be applied using two coats of Tnemec Series 700 HydroFlon applied at a rate to achieve 2.0 – 3.0 mils DFT per coat.
7. The exterior coating system shall have a minimum dry film thickness of 8.5 dry mils.

C. Interior “Wet” Surfaces:

1. Shop Prime: All interior surfaces shall receive one full prime coat of Tnemec Series 91H20 Hydro-Zinc or 94 H20 Hydro-Zinc applied at a rate to achieve 2.5 – 3.5 mils DFT.
2. Field Patch Prime: All field welded areas, as well as any damaged areas, shall be receive one coat of Tnemec Series 91 H20 Hydro-Zinc or 94 H20 Hydro-Zinc applied at a rate to achieve 2.5 – 3.5 mils DFT.
3. Seam Treatment: Following prime coat, all weld seams, ladders, sharp edges, and any other difficult to coat areas shall receive one coat of Tnemec Series N140-1255 Pota-Pox Plus applied, by brush, at a rate to achieve 2.0 – 4.0 mils DFT.
4. Finish: After proper cure of the intermediate coat, all interior surfaces shall receive one full finish coat of Tnemec Series 22 Epoxoline applied at a rate to achieve 25.0 – 35.0 mils DFT.
5. Caulk: Caulk all skip welded areas or lap seams in roof of tank. Caulk joint intersection of shell wall and roof assembly. Caulk material shall be Sika-Flex 1A or Equal.
6. The interior wet coating systems shall have a total dry film thickness of not less than 27.5 mils DFT.

D. Interior “Dry” Surfaces:

1. Shop Prime: All interior surfaces shall receive one full prime coat of Tnemec Series 91H20 Hydro-Zinc or 94 H20 Hydro-Zinc applied at a rate to achieve 2.5 – 3.5 mils DFT.
2. Field Patch Prime: All field welded areas, as well as any damaged areas, shall be receive one coat of Tnemec Series 91 H20 Hydro-Zinc or 94 H20 Hydro-Zinc applied at a rate to achieve 2.5 – 3.5 mils DFT.

3. Seam Treatment: Following prime coat, all weld seams, ladders, sharp edges, and any other difficult to coat areas shall receive one coat of Tnemec Series 20-1255 Pota-Pox applied, by brush, at a rate to achieve 2.0 – 4.0 mils DFT.
4. Finish: After proper cure of the intermediate coat, all interior surfaces shall receive one full finish coat of Tnemec Series 20-15BL Pota-Pox applied at a rate to achieve 4.0 – 6.0 mils DFT.
5. The interior dry coating systems shall have a total dry film thickness of not less than 10.5 mils DFT.

3.08 ACCEPTANCE OF WORK:

- A. Damaged coatings, pinholes, and holidays shall have edges feathered and repaired in accordance with the recommendations of the manufacturer, as approved by the Engineer.
- B. All finish coats, including touch up and damage-repair coats shall be applied in a manner which will present a uniform texture and color-match appearance.
- C. If the item has an improper finish, color, or insufficient film thickness, the surface shall be cleaned and topcoated with the specified material to obtain the specified color and coverage. Specific surface preparation information to be secured from the coating's manufacturer and the Engineer.
- D. All visible areas of chipped, peeled, or abraded paint shall be hand or power-sanded, feathering the edges. The areas shall then be primed and finish coated in accordance with the specifications.
- E. Work shall be free of runs, bridges, shiners, laps, or other imperfections. Evidence of these conditions shall be cause for rejection.
- F. Any defects in the coating system shall be repaired by the Contractor per written recommendations of the coating manufacturer.

3.09 GUARANTEE AND ANNIVERSARY INSPECTION:

- A. All work shall be warranted for a period of two years from the date of completion.
- B. The Owner will notify the Contractor at least 30 days prior to the anniversary date and shall establish a date for the inspection. The tank will be drained and the Owner's representative and the Contractor shall thoroughly inspect all surfaces both inside and out. Any defects in the coating system shall be repaired by the Contractor at no additional cost to the Owner. Should a failure occur to 25 percent of the painted surface, either interior or exterior, the entire surface shall be cleaned and painted in accordance with these Specifications.

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3.10 PRODUCT PERFORMANCE CRITERIA

- A. Provide the following product information and manufacturers published performance data should coatings or coating system be submitted in lieu of the standard of quality established in the project documents. Should the data not be available in a published format, or if the duration of the test does not meet the specified requirement, please respond in the appropriate space with NT (Not Tested).

3.11 ORGANIC ZINC RICH URETHANE PRIMER (INTERIOR & EXTERIOR PRIMER)

- A. Generic Type: Organic Zinc Rich Urethane Primer.
- B. Special Qualifications: Meets the health effects requirements of NSF/ANSI/CAN 600 according to the requirements of NSF/ANSI/CAN 61 for potable water tanks of 1,500 gallons or greater.
- C. Solids By Volume: 63 percent.
- D. Zinc Content: 83 percent by weight. Zinc pigment shall conform to ASTM D520 Type III.
- E. Test Criteria:

Test Criteria	Test Duration	Proposed Product Test Results
ASTM B 117 Salt Spray (Fog)	50,000 hours (Scribed Panel)	Rust @ Scribe: Plane Rust: Blisters:
ASTM G 85 Prohesion	15,000 Hours	Rust @ Scribe: Plane Rust: Blisters:
ASTM D 4585 Humidity	2,000 hours	Rusting: Blistering:
ASTM 4541 Adhesion	Average of Three Tests	Adhesion PSI:
ASTM G8 Cathodic Disbondment	30 Days Exposure	
ASTM D 870 Immersion	140	

3.12 POLYAMIDE EPOXY (EXTERIOR INTERMEDIATE)

- A. Generic Type: Polyamide Epoxy.
- B. Special Qualifications: Certified in accordance with ANSI/NSF Std 61 for contact with potable water in tanks of 6,000 gallons capacity or greater.
- C. Solids By Volume: 56 percent.
- D. Test Criteria:

Test Criteria	Test Duration	Proposed Product Test Results
ASTM B 117 Salt Spray (Fog)	10,000 hours (Scribed Panel)	Rust @ Scribe: Plane Rust: Blisters:
ASTM G 85 Prohesion	15,000 Hours	Rust @ Scribe: Plane Rust: Blisters:
ASTM D 4585 Humidity	4,000 hours	Rusting: Blistering:
ASTM D 4060 Abrasion	CS-17 Wheel 1,000 Gram Load 1,000 Cycles	Report mg Loss / Average of three tests
ASTM 4541 Adhesion	Average of Three Tests	Adhesion PSI:
ASTM G8 Cathodic Disbondment	30 Days Exposure	
Immersion Service (Potable Water)	7 years – No Failure	

3.13 NSF APPROVED EPOXY (INTERIOR FINISH)

- A. Generic Type: Modified Polyamine Epoxy.
- B. Special Qualifications: Meets the health effects requirements of NSF/ANSI/CAN 600 according to the requirements of NSF/ANSI/CAN 61 for potable water tanks of 50 gallons or greater. Also meets the requirements set forth for AWWA C-210-07 testing.
- C. Solids By Volume: 100 percent.

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D. Test Criteria:

Test Criteria	Test Duration	Proposed Product Test Results
ASTM D 5894 Cyclic Salt Fog/UV	10,000 hours	Rust: Blisters:
ASTM D 4585 Humidity	2,000 hours	Rusting: Blistering:
ASTM D 4060 Abrasion	CS-17 Wheel 1,000 Gram Load 1,000 Cycles	Report mg Loss / Average of three tests
ASTM 4541 Adhesion	After 6 months immersion in crude oil @ 275° F	Adhesion PSI:
ASTM G8 Cathodic Disbondment	Method A 30 Days Exposure	
Immersion Service (Potable Water)	2 years – No Failure	
ASTM D 870 Immersion	Potable Water @ 200° F for 6 months	Blistering: Cracking: Rusting: Chalking:
ASTM D 870 Immersion	140° Deionized Water 2,000 Hours	Blistering: Cracking: Rusting:
ASTM D 2240 Hardness	Average of 5 Tests	Report Shore D:
ASTM D 149 Dielectric Strength	Average of 6 Tests	Report Volts.Mil:

3.14 EXTERIOR 2ND INTERMEDIATE COAT

- A. Generic Type: Aliphatic Acrylic Polyurethane.
- B. Solids By Volume: 58 percent.
- C. Test Criteria:

Test Criteria	Test Duration	Proposed Product Test Results
ASTM B117 Salt Spray (Fog)	3,000 hours (Scribed Panel)	Rust @ Scribe: Plane Rust: Blisters:
ASTM G85 Prohesion	15,000 Hours	Rust @ Scribe: Plane Rust: Blisters:
ASTM D4585 Humidity	2,000 hours	Rusting: Blistering:

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Test Criteria	Test Duration	Proposed Product Test Results
ASTM D4060 Abrasion	CS-17 Wheel 1,000 Gram Load 1,000 Cycles	Report mg Loss / Average of three tests
ASTM 4541 Adhesion	Average of Three Tests	Report PSI
ASTM D522 Flexibility	Method A Conical Mandrel	% Elongation:
ASTM D 522 Flexibility	Method B Cylindrical Mandrel	% Gloss Retention: Color Change:
ASTM D 4141, Method C (EMMAQUA)	500 MJ/m ²	Rust @ Scribe: Rust @ Edges:
ASTM D 2794 Impact	Direct Impact	Report in/lbs:

3.15 EXTERIOR FINISH COAT

- A. Generic Type: Fluoropolymer Polyurethane.
- B. Solids By Volume: 60 percent.
- C. Test Criteria:

Test Criteria	Test Duration	Proposed Product Test Results
ASTM B117 Salt Spray (Fog)	10,000 hours (Scribed Panel)	Rust @ Scribe: Plane Rust: Blisters:
ASTM D4585 Humidity	3,000 hours	Rusting: Blistering:
ASTM D4060 Abrasion	CS-17 Wheel 1,000 Gram Load 1,000 Cycles	Report mg Loss / Average of three tests
ASTM 4541 Adhesion	Average of Three Tests	Report PSI
ASTM D4587 QUV Exposure Cycle 4: 8 hours UV – 4 hours condensation	16,000 hours	Gloss Retention:
ASTM D4587 QUV Exposure Cycle 4: 8 hours UV – 4 hours condensation	25,000 hours	Gloss Retention: Color Change: DED FMCII
ASTM D4141 (EMMAQUA) Exterior Exposure	1,500MJ/m ² Exposure	Gloss Retention: Color Change:
ASTM D4141 (EMMAQUA)	2,000MJ/m ² Exposure	Gloss Retention: Color Change:

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Test Criteria	Test Duration	Proposed Product Test Results
Exterior Exposure		
ASTM D4141 (EMMAQUA) Exterior Exposure	3,500MJ/m2 Exposure	Gloss Retention: Color Change:
ASTM D522 Flexibility	Method A Conical Mandrel	Cracking: % Elongation:
ASTM 2794 Impact	Average of Three Trials	Direct Impact:
ASTM D5031 Weatherometer	5,500 hours	% Gloss Retention: Color Change: DED
AAMA 2605	10 Years Exposure	Report: Color Retention: Gloss Retention: Chalking: Erosion:

END OF SECTION

SECTION 26 05 02
BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 RELATED SECTIONS

- A. Requirements specified within this section apply to Division 26, Electrical. Work specified herein shall be performed as if specified in the individual sections.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. National Electrical Contractors Association (NECA): National Electrical Installation Standards.
 - 2. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. Z535.4, Product Safety Signs and Labels.
 - 3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

1.03 ELECTRIC SERVICE DIVISION OF RESPONSIBILITY

- A. Incoming aerial electrical service facilities provided by the serving utility as part of its normal obligation to customers is work provided outside this Contract. Under this Contract, provide customer required service provisions and electrical work including, but not limited to, metering components and associated conduit, and secondary facilities. Schedule and coordinate work of serving utility as required to provide electric service to the Work.

1.04 ELECTRICAL SUMMARY OF WORK

- A. The Project consists of a installing a new above-grade water storage tank. The new water storage tank will include a level transmitter that can be used to control the operation of two (2) existing well pumps. The level transmitter shown shall be provided and installed by the Contractor. The level signal for the water in the new water storage tank will be conveyed to one (1) of the two (2) new hot shot control panels and will be used to automatically start well pumps at other locations. The two (2) new hot shot control panels at this new water storage tank will communicate, via radio, to other existing hot shot control panels to control the operation of two (2) existing well pumps.

ANTIOCH ELEVATED STORAGE TANK

- B. The two (2) hot shot control panels, antenna cable, and the antenna shown to be included in this Contract shall be provided by Panhandle Alarm (Howard Johnson 850-478-2108), but shall be included under the responsibility of the General Contractor. All coordination, materials, and labor required by the Contractor to provide and install the two (2) hotbox control panels, antenna, and antenna cable shall be included in the Bid Price provided by the Contractor.
- C. Panhandle Alarm has provided a Cost Proposal that is attached as a supplement at the end of this Specification. The Cost Proposal outlines the Work that shall be performed by Panhandle Alarm and the Work that shall be performed by the Contractor.
- D. The Work also include providing a new utility service at the Project location. The Contractor shall be responsible for coordinating all of the items required by the local utility.

1.05 SUBMITTALS

- A. Action Submittals:
 - 1. Provide manufacturers' data for the following:
 - a. Electrical service components.
 - b. Nameplates, signs, and labels.
 - 2. Anchorage and bracing drawings and catalog information, as required by Section 01 88 15, Anchorage and Bracing, for loads in Section 01 61 00, Common Product Requirements.
- B. Informational Submittals: Anchorage and bracing calculations, as required by Section 01 88 15, Anchorage and Bracing, for loads in Section 01 61 00, Common Product Requirements.

1.06 QUALITY ASSURANCE

- A. Provide the Work in accordance with NFPA 70. Where required by Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.
- B. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark or label.
- C. Provide materials and equipment acceptable to AHJ for Class, Division, and Group of hazardous area indicated.

1.07 ENVIRONMENTAL CONDITIONS

- A. The following areas are classified nonhazardous and wet. Use materials and methods required for such areas.
 - 1. Outdoor abovegrade areas not covered above.
- B. The following areas are classified as indoor and dry: Open area inside the water storage tank base.
- C. The following areas are not classified. Use dust-tight and oil-tight NEMA 12 materials and methods.
 - 1. Areas not covered above.

PART 2 PRODUCTS

2.01 GENERAL

- A. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.
- B. Material and equipment installed in heated and ventilated areas shall be capable of continuous operation at their specified ratings within an ambient temperature range of 40 degrees F to 104 degrees F.
- C. Materials and equipment installed outdoors shall be capable of continuous operation at their specified rating within the ambient temperature range stated in Section 01 61 00, Common Product Requirements.
- D. Electrical ratings of materials and equipment that are reduced by increased elevation shall be derated as required for Site elevation specified in Section 01 61 00, Common Product Requirements.

2.02 EQUIPMENT FINISH

- A. Manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment in accordance with, light gray color finish as approved by Engineer.

2.03 NAMEPLATES

- A. Material: Laminated plastic.
- B. Attachment Screws: Stainless steel.

ANTIOCH ELEVATED STORAGE TANK

- C. Color: White, engraved to a black core.
- D. Letter Height:
 - 1. Pushbuttons/Selector Switches: 1/8 inch.
 - 2. Other Electrical Equipment: 1/4 inch.

2.04 LEVEL TRANSMITTER, DIRECT SENSING, FLANGE MOUNTED

- 1. General:
 - a. Function: Measure level in a process vessel.
 - b. Type:
 - 1) Capacitive differential pressure cell.
 - 2) Diaphragm for process fluid isolation.
 - 3) Flange mounting.
 - 4) Smart electronics.
 - 5) Two-wire device.
- 2. Service:
 - a. Process Liquid: As noted.
 - b. Process Temperature Range: Minus 20 degrees F to 400 degrees F, unless otherwise noted.
 - c. Ambient Temperature Range: Minus 40 degrees F to 250 degrees F, unless otherwise noted.
 - d. Humidity: 0 percent to 100 percent relative.
- 3. Performance:
 - a. Range: As noted.
 - b. Accuracy: Plus or minus 0.75 percent of span.
- 4. Features:
 - a. Zero Suppression or Elevation: As noted.
 - b. Damping: User-selectable; 0 second to 36 seconds time constant of analog output response to step change input.
 - c. Transmitter: Two-wire, powered from external power supply.
 - d. Zero and Span Adjustments: Local, external, noninteractive, unless otherwise noted.
 - e. Process Wetted Parts: Flanged Process Connection (Transmitter High Pressure Side):
 - 1) Flange Size/Type: 3-inch, Class 150, unless otherwise noted.
 - 2) Process Diaphragm: Type 316 stainless steel, unless otherwise noted.
 - 3) Mounting Flange: Stainless steel, unless otherwise noted.
 - 4) Mounting: Flush, unless otherwise noted.
 - 5) Extension Materials (if extension mount noted): Type 316 stainless steel, unless otherwise noted.

- 6) Extension Length (if extension mount noted): As noted.
- 7) Process Fill Fluid (High Pressure Side): Dow Corning Silicone 200, unless otherwise noted.
- f. Reference Process Connection (Transmitter Low Pressure Side) Configuration (Differential, unless otherwise noted):
 - 1) Drain/Vent: Type 316 stainless steel.
 - 2) Flange Adapter: Stainless steel.
 - 3) Diaphragm Material: Type 316 stainless steel, unless otherwise noted.
 - 4) Sensor Fill Fluid (Low Pressure Side): Silicone, unless otherwise noted.
- g. O-Ring: Glass-filled TFE.
- h. Flange and Adapter Bolts: Type 316 stainless steel, unless otherwise noted.
- i. LCD Meter: If noted.
- j. Integral Transient Protection: If noted.
- 5. Signal Output Interface:
 - a. 4 mA to 20 mA dc for load impedance 0 ohm to 580 ohms minimum at 24V dc supply voltage without load adjustment.
 - b. Superimposed digital signal based on HART protocol.
- 6. Enclosure: NEMA 4X, polyurethane-covered aluminum, unless otherwise noted.
- 7. Manufacturers/Model: Emerson Process Rosemount; 3051L, Liquid Level Transmitter.
- 8. The Contractor shall provide and install a surge suppressor on the analog signal from the level transmitter to the hot shot control panel. The Contractor shall also provide and install a ball valve on the water line to the level transmitter to be able to isolate the level transmitter if required for maintenance.

2.05 SIGNS AND LABELS

- A. Sign size, lettering, and color shall be in accordance with NEMA Z535.4.

PART 3 EXECUTION

3.01 GENERAL

- A. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned. Contractor shall be responsible for actual location of equipment and devices and for proper routing and support of raceways, subject to approval of Engineer.

ANTIOCH ELEVATED STORAGE TANK

- B. Check approximate locations of light fixtures, switches, electrical outlets, equipment, and other electrical system components shown on Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify Engineer in writing.
- C. Install work in accordance with NECA Standard of Installation, unless otherwise specified.
- D. Keep openings in boxes and equipment closed during construction.
- E. Lay out work carefully in advance. Do not cut or notch any structural member or building surface without specific approval of Engineer. Carefully perform cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces to original condition.

3.02 ANCHORING, BRACING, AND MOUNTING

- A. Equipment anchoring and mounting shall be in accordance with manufacturer's requirements for Project design criteria provided in Section 01 61 00, Common Product Requirements, to meet the requirements of Section 01 88 15, Anchorage and Bracing.

3.03 COMBINING CIRCUITS INTO COMMON RACEWAY

- A. Drawings show each homerun circuit to be provided. Do not combine power or control circuits into common raceways without authorization of Engineer.

3.04 NAMEPLATES, SIGNS, AND LABELS

- A. Arc Flash Protection Warning Signs:
 - 1. Field mark panelboards to warn qualified persons of potential arc-flash hazards. Locate marking so to be clearly visible to persons before working on energized equipment.
 - 2. Use arc flash hazard boundary, energy level, PPE level and description, shock hazard, bolted fault current, and equipment name from study required in Section 26 05 70, Electrical Systems Analysis as basis for warning signs.

B. Available Fault Current Signs:

1. Install label on service equipment to indicate the maximum available fault current at the equipment. Labels shall be of sufficient durability for the environment in which the equipment is installed. Labels shall include the following information:
 - a. Equipment name or identification.
 - b. Available fault current at the equipment.
 - c. Date the fault current calculations were performed.
2. Use bolted fault current and equipment name from study required in Section 26 05 70, Electrical Systems Analysis, as basis for the label.
3. Where existing electrical systems are modified, completely remove existing fault current labels if present, and install new labels in accordance with the above requirements.

C. Equipment Nameplates:

1. Provide a nameplate to label electrical equipment including switchgear, switchboards, motor control centers, panelboards, motor starters, transformers, terminal junction boxes, disconnect switches, switches and control stations.
2. Switchgear, motor control center, transformer, and terminal junction box nameplates shall include equipment designation.
3. Disconnect switch, starter, and control station nameplates shall include name and number of equipment powered or controlled by that device.
4. Switchboard and panelboard nameplates shall include equipment designation, service voltage, and phases.

3.05 LOAD BALANCE

- A. Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.
- B. Balance electrical load between phases as nearly as possible on switchboards, panelboards, motor control centers, and other equipment where balancing is required.
- C. When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made, and provide circuit directory that lists final circuit arrangement.

ANTIOCH ELEVATED STORAGE TANK

3.06 CLEANING AND TOUCHUP PAINTING

- A. Cleaning: Throughout the Work, clean interior and exterior of devices and equipment by removing debris and vacuuming.
- B. Touchup Paint:
 - 1. Touchup scratches, scrapes and chips on exterior and interior surfaces of devices and equipment with finish matching type, color, and consistency and type of surface of original finish.
 - 2. If extensive damage is done to equipment paint surfaces, refinish entire equipment in a manner that provides a finish equal to or better than factory finish, that meets requirements of Specification, and is acceptable to Engineer.

3.07 PROTECTION FOLLOWING INSTALLATION

- A. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation and contact surfaces.
- B. When equipment intended for indoor installation is installed at Contractor's convenience in areas where subject to dampness, moisture, dirt or other adverse atmosphere until completion of construction, ensure adequate protection from these atmospheres is provided and acceptable to Engineer.

3.08 SUPPLEMENTS

- A. The supplement listed below, following "End of Section," is part of this Specification.
 - 1. Supplement 1, Panhandle Alarm Cost Proposal.

END OF SECTION



CUSTOMER: CITY CRESTIVEW
ADDRESS: NEW ELEVATED TANK
CITY/STATE/ZIP:
ATTN:GREG YARBERRY

WE PROPOSE THE FOLLOWING: ELEVATED TANK CONTROL SYSTEMS

- 3--HOT SHOT LONG RANGE RADIO CONTROLLER MODEL TR 1000
- 4 PL259 HT-75 ANTENNA SWITCH
- 4 -DUMMY LOAD 50 OHM
- 1-ANDREW/DECIBEL ANTENNA SIDE MOUNT KIT 224 222304 (DB5001)
- 1 28 INCH OFFSET (RHON)
- 1-LOW BAND ANTENNA TOWER MOUNT DB360
- 500'22/4 STR
- 200 FEET RG8U LOW LOSS CABLE

TOTAL SYSTEM.....\$16,386.00 plus tax

NOTE 1: PRICE INCLUDES CHANGING OUT WELL 9 TRANCEIVER TO WORK WITH NEW WELL TANK LEVEL CONTROLS ALLOWING THE OPPERATOR TO SECECT WHICH TANK LEVEL THEY WANT TO USE:

NOTE 2: THE NEW TANK WILL HAVE TWO TRANCEIVERS AT THAT LOCATION AND WE WILL BE ADDING A SECOND ONE TO THE OTHER ELEVATED TANK AND REPROGRAM THE OTHER 5 WELLS PUMPS TO RESPOND TO EACH OF THE TANKS CONTROLS.

NOTE 3: PANHANDLE WILL SUPPLY THE ANTENNA MOUNT TO CONTRACTOR TO MOUNT AT A HEIGHT OF 30 FEET OR GREATER AND SUPPLY CABLE RACEWAY TO RADIO TRANSCEIVERS

NOTE 4: ALL ELECTRIAL TO RADIO CONTROLLERS TO BE SUPPLIED BY ELECTRICAL CONTRACTOR

Small Business

State of Incorporation: Florida
Federal Tax ID: 59-1892092
CAGE code: 0YBX4 **DUNS:** 05-252-3511
General Excise Tax Number: 27-00-024796-58-1
State License: FL - EF0000698 AL - 074

DATE PROPOSED FOR ACCEPTANCE BY HOWARD JOHNSON,

ACCEPTANCE OF PROPOSAL: I hereby state that I have read and understand the front and back pages of this Agreement and I will perform all duties, on my part, stated in this Agreement. In addition, I acknowledge receipt of a true copy of this Agreement. Furthermore, this Agreement contains the entire Agreement between myself and Panhandle Alarm & Telephone Co., Inc. and may not be changed, modified, terminated, or discharged except in writing. "Customer agrees that transaction is subject to a right of cancellation under the Federal Truth-In-Lending Act, Panhandle Alarm & Telephone Co., Inc. shall not be required to commence performance until after the rescission period has expired and is reasonably satisfied that the Customer has not exercised the right of rescission."

PANHANDLE ALARM & TELEPHONE CO., INC.
10 Industrial Blvd.
Pensacola FL 32503

1. PANHANDLE ALARM AND TELEPHONE CO., INC. IS NOT AN INSURER. PANHANDLE ALARM AND TELEPHONE CO., INC. does not guarantee or warrant that your system will prevent burglary, fire or other occurrences. PANHANDLE ALARM AND TELEPHONE CO., INC. will not insure or reimburse you (Owner) or any other person for losses due to any of the occurrences which the system is designated to monitor. You (Owner) must carry your own insurance.

2. NO LIABILITY FOR CERTAIN OCCURRENCES. Owner agrees that PANHANDLE ALARM AND TELEPHONE CO., INC. will have no liability for loss or damage to property or for personal injury or death or otherwise due to (A) a failure in the transmission of an alarm or (B) interruptions of service due to any of the following reasons: (1) any failure of your alarm; (2) any defective or damaged equipment, device, telephone or connecting circuit; or (3) any strike of our employees or employees of others, riot, flood, fire, acts of God, or any other cause beyond our reasonable control.

3. LIMITATION ON LIABILITY; REIMBURSEMENT. If PANHANDLE ALARM AND TELEPHONE CO., INC. should nevertheless be found liable for loss or damage to persons or property, you (Owner) agree that our liability will be limited to \$250.00. This limitation will apply no matter why PANHANDLE ALARM AND TELEPHONE CO., INC. is found liable, including, for example, (1) breach of this Agreement, (2) any equipment failure, (3) any act on our part, of our agents, assigns, and employees, whether or not constituting active or passive negligence. Owner acknowledges that his limitation on our liability is based on the following factors: (a) our charges are calculated based on our limited liability, as described above, and are not related to the value of your property or the property of others located on your premises; (b) the extent of the damage which may result from the occurrences which the system is designed to monitor is uncertain; (c) the possibility of human error or failure by our employees; (d) the response times of the police or fire department, if dispatched, are uncertain; (e) that it is not possible to determine with any degree of certainty what portion, if any, of loss was directly caused by any action or inaction on your part. You agree to reimburse us, our agents, employees, and assigns and hold us, our agents, employees, or assigns harmless for any reason whatsoever relating to (1) this Agreement; (2) your premises; or (3) the system. Such reimbursement will apply whether these claims or lawsuits are based on the performance or nonperformance of any obligation under this Agreement, alleged intentional conduct, active or passive negligence, or strict or product liability, on our part, of our agents, employees, or assigns. That in the event the Owner desires the company to assume greater liability for the performance of its services hereunder, a choice is hereby given of obtaining full or limited liability of paying an additional amount proportioned to the responsibility, and an additional rider shall be attached to this Agreement setting forth the additional liability of PANHANDLE ALARM AND TELEPHONE CO., INC. and the additional charge that the rider and additional obligation shall in no way be interpreted to hold the company as an insured.

4) DEFAULT. In the event (A) Owner shall default in payment of any fee or in making any other payment hereunder when due, (B) Owner shall default in the performance of any other covenant contained and such default shall continue for a ten day period after written notice from PANHANDLE ALARM AND TELEPHONE CO., INC., (C) Owner becomes insolvent, ceases doing business as a going concern or makes an assignment for the benefit of creditors, (D) Owner applies for or consents to the appointment of a receiver, trustee, or liquidator of Owner or of all or a substantial part of the assets of Owner, or if a receiver, trustee, or liquidator is appointed without the application or consent of Owner, or (E) a petition is filed by or against Owner under the Bankruptcy Act or any amendment hereto (including, without limitation, a petition for reorganization, arrangement, or extension) or any other insolvency law or law providing for the relief of debtors then in each such event, if and to the extent remedies: (1) to declare due and payable the entire amount of unpaid total fees for the balance of the term of this Agreement, whereupon the same shall become immediately due and payable; and (2) to pursue any other remedies provided by law. Owner shall nevertheless remain liable for the unpaid total fee for the balance of the term of this Agreement, together with the expenses of retaking, storing, repairing, and releasing the Equipment and reasonable attorney's fees incurred by PANHANDLE ALARM AND TELEPHONE CO., INC. incidental thereto.

5. THIS AGREEMENT CONTAINS NO WARRANTIES. Owner agrees that, except as set forth herein, PANHANDLE ALARM AND TELEPHONE CO., INC. has made no representation or warranty of any kind (including any warranty of merchantability or warranty of fitness for a particular purpose), nature or description, express or implied, with respect to the Equipment. No oral agreement, guarantee, promise, condition, or representations relating hereto and/or to said Equipment are integrated herein.

6. PANHANDLE ALARM AND TELEPHONE CO., INC. reserves the right to employ outside monitoring or response facilities. Owner acknowledges that this Agreement and particularly those paragraphs relating to disclaimers or warranties, liquidated damages and indemnification, inure to the benefit of and are applicable to any outside facilities employed by PANHANDLE ALARM AND TELEPHONE CO., INC. as well as PANHANDLE ALARM AND TELEPHONE CO., INC. and that they bind Owner with respect to such facilities in the same manner and with the same force and effect as they bind Owner to PANHANDLE ALARM AND TELEPHONE CO., INC.

HOT SHOT

TR1000

IRRIGATION MANUAL

Pg.

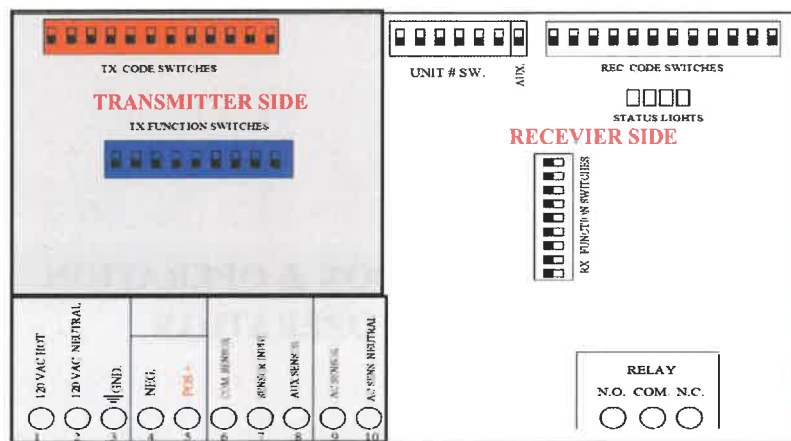
2	HOW IT WORKS & MOUNTING
3	INDICATOR LIGHTS
3	CODE SWITCH SETTINGS
4	TRANSMIT - TX FUNCTIONS
4	OPERATING THE TEST BEACON
5	BASIC PIVOT PANEL INSTALLATION & OPERATION
5	LAST PIVOT STANDING MODE & OPERATION
6	REINKE PIVOTS
7	T-L ELECTRIC PANEL
8	VALLEY 4000, 6000, AND PANELS WITH 3 SEC DELAY PCB.
9	VALLEY 8000, PRO PANEL, SELECT PANEL AND SIMILAR
10	ZIMMATIC PIVOT 10 WIRE SYSTEM
11	ZIMMATIC PIVOT 11 WIRE SYSTEM
12	ENGINE DRIVEN PIVOT AND T-L ENGINE PIVOT (ISUZU PANEL)
13	OUTPUT RELAY RX - FUNCTIONS
13	ENGINE STARTUP MODE
13	SUPERVISION FEATURE
13	FAILSAFE OPERATION
14	ENGINE PUMP WIRING & OPERATION
15	ELECTRICAL PUMP WIRING & OPERATION
16	PROPER GROUNDING
17	WARRANTY

ATTENTION: All Hot Shot units have a designated GROUND Terminal. Hot Shot units must have the ground terminal connected to a proper ground or grounding system as per the NEC (*National Electrical Code*) and or your local and state electrical code guidelines.

ATTENTION: Depending upon the style of system that your are going to control with the Hot Shot Wireless Controller you may need to supply additional parts. Such as relays, step-down transformers, Murphy switches etc. These items are suggested in the wiring guides that follow in this manual.

HOW IT WORKS

The TR-1000 is a TRANSCEIVER. Transceivers can transmit and receive communications. This allows a TR-1000 to be installed at a pivot or at a pump. To simplify things in this irrigation manual we will call the TR-1000 that is installed at the pivot the TRANSMITTER (*a transmitter sends out commands. In this application it will send out pump on and off commands*) and the TR-1000 at the pump will be called a RECEIVER (*receivers, receive commands from the transmitter to activate or deactivate something. In this manual it will be used to turn on and off a pump*). The left side of the TR-1000's circuit board is the transmitter and the right side is the receiver.



BASIC OPERATION

Think of a Hot Shot control system as a wireless switch. When the transmitter's sensor is activated the relay output on a receiver will be activated and turn on a device such as pump, motor or a light. When the sensor is deactivated on the transmitter it will deactivate the relay on the receiver turning of the device it is connected to.

MOUNTING

Cabinets are a weatherproof UV protected NEMA 4X cabinet with mounting ears on top and bottom. The Hot Shot control boxes can be mounted on the side of a control panel, pole or any other surface as long as the antenna does not have metal running within 12" of the antenna whip. If longer range is needed, an external long range antenna can be used. Do not mount the HOT SHOT to the well engine or cover because the strong vibrations can be harmful to the unit.

If installing these on a Variable Frequency Drive do not mount the Hot Shot unit to the VFD because of the potentially strong magnetic field interference that can be produced by these drives. The further away it is mounted the better it is for the Hot Shot's ability to transmit and receive.

BATTERY BACKUP

During a power outage, a gel cell rechargeable battery supplies power to a Hot Shot for approximately 24 hours. This allows a pivots Hot Shot to send a shutdown signal to the pump when the pivot has lost power. The Hot Shot comes with a battery save feature that will turn off the Hot Shot if the voltage drops from 12vdc to 10vdc. This function will add years of life to the gel cell battery.

Important... When the battery has discharged, it will take approximately 2 to 3 hours for the battery to charge enough to operate the Hot Shot in case of another power failure. The battery should be replaced every year for the best reliability during power outages.

Hot Shot Sys

TR-1000 / TRANSCEIVER - SINGLE I/O

11-00001 11-0001101

PRODUCTS

[RADIO CONTROLLERS](#)

[ACCESSORIES](#)

INSTALLATION MANUALS

[RADIO CONTROLLER MANUALS](#)

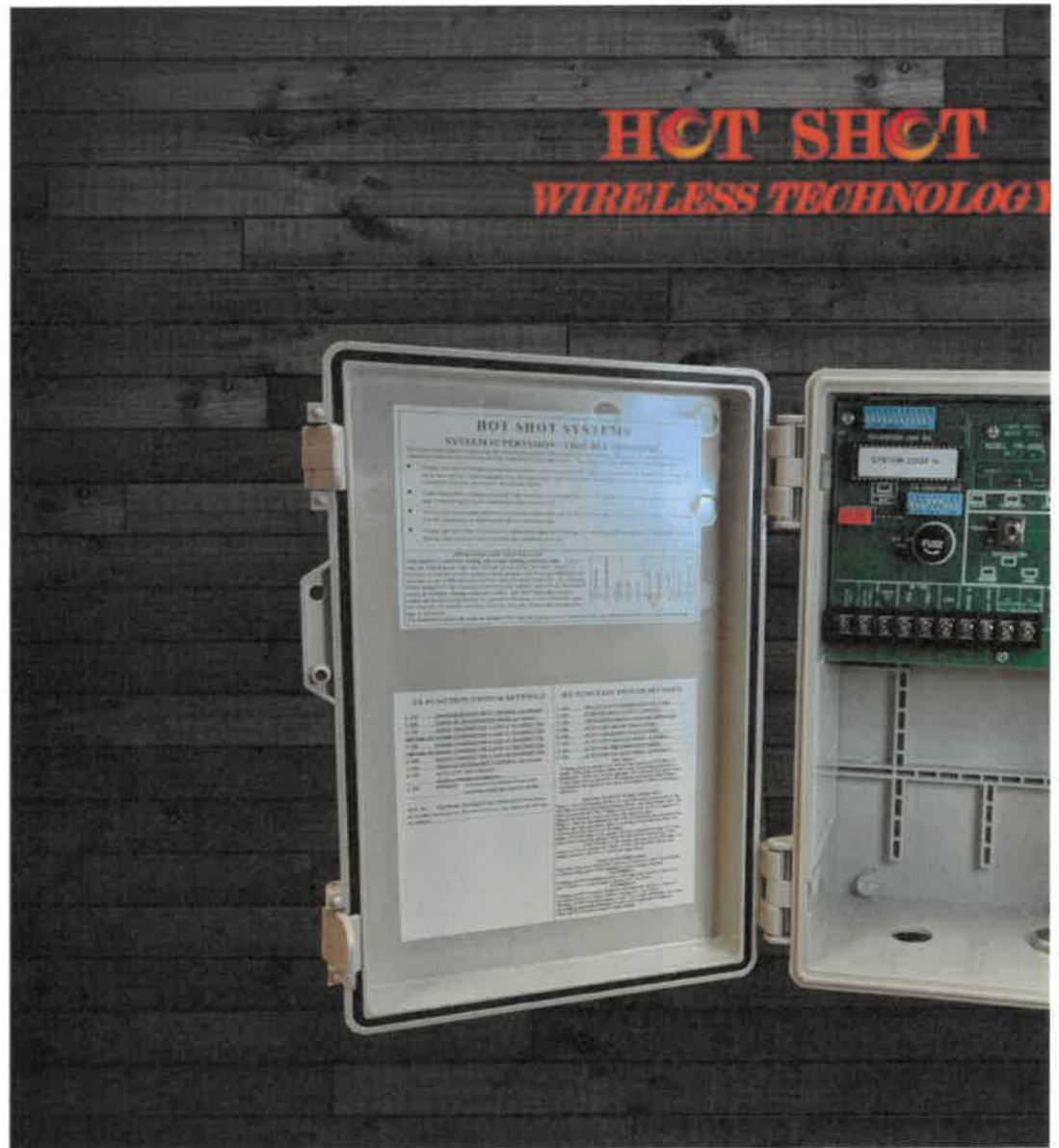
[OLDER RADIO CONTROLLER MANUALS](#)

HOT SHOT SYSTEMS

[BECOME A HOT SHOT DEALER](#)

[HOW TO VIDEOS FOR RADIO CONTROLLERS](#)

[RADIO CONTROLLER SPECS & WARRANTY](#)



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COMPANY INFORMATION

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MY ACCOUNT

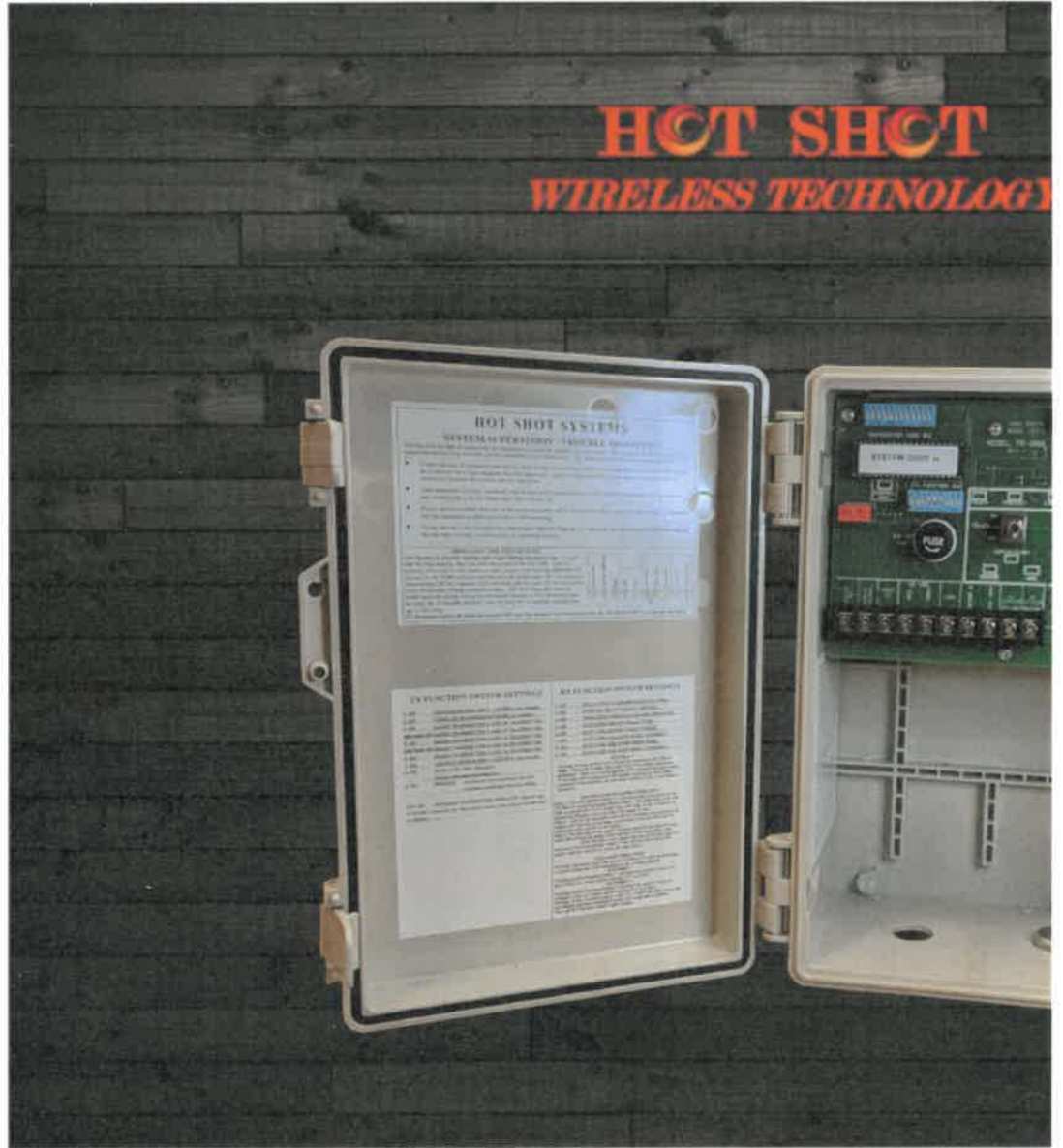
- [Login/Register](#)
- [Orders](#)
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CUSTOMER SERVICE

- [FAQs](#)
- [Returns](#)
- [Contact Us](#)

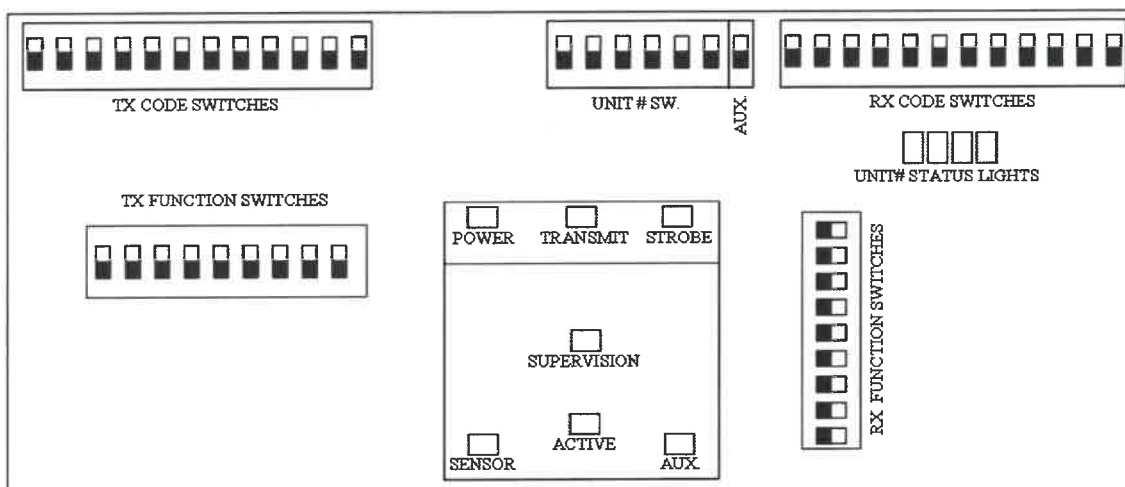
store.hotshotsystems.com/Transceiver-control-transmitter-receiver-p/tr-1000.htm

TR-1000 / TRANSCEIVER - SINGLE I/O



INDICATOR LIGHTS

POWER	Signals that the Hot Shot has power and is ready operate.
STROBE	Used for troubleshooting, this LED flashes once for each of the four correct digits of the code received. The LED will stay on steady for one second if an incorrect digit of the code is received. <i>Example: If the LED flashes two times and then goes on steady it is indicating that the third digit doesn't match. If the LED flashes one time and goes on steady it is indicating that the second digit doesn't match. If the LED comes on steady right away it is indicating that the first digit doesn't match.</i>
UNIT# STATUS 1 2 3 4	When these LED's are on it indicates that its corresponding transmitter has activated the relay and the receiver is in Last Transmitter Standing Mode (<i>Unit# switch and (Aux 7)</i>) See description on pg 5.
SUPERVISION	When this LED is flashing it indicates that it has not received its correct code from the transmitter in the past 3hrs. Sliding function switch #8 to its OFF position will turn off this indicator light.
TRANSMIT	Indicates when the Hot Shot is transmitting.
SENSOR	When these LED's are on it indicates that the terminal below it is connected to the COMMON terminal.



CODE SWITCH SETTINGS

All Hot Shots are shipped from the factory with a preprogrammed 4 digit system code. This ensures that your neighbor will not duplicate the same system code as your units. Your Hot Shot's system codes should already match, so you do not need to program any codes. If a new secure system code is needed for your installation please call 785-623-1500 to be issued a secure system code for your area that the Hot Shots will be operating in.

If you ever need to replace a unit due to servicing, the field code can be programmed to match the existing or new add on units. FOLLOW THE EXAMPLE BELOW...

EXAMPLE: CODE 6789

KEY

3	4	5	6
7	8	9	0

Use the # KEY to the left to make each digit of the code. It takes three of the switches to make one number of the code.

Use switches 1,2,3 for the first # in the code. Switches 4,5,6 for the second #. Switches 7,8,9 for the third #. Switches 10,11,12 for the fourth #.

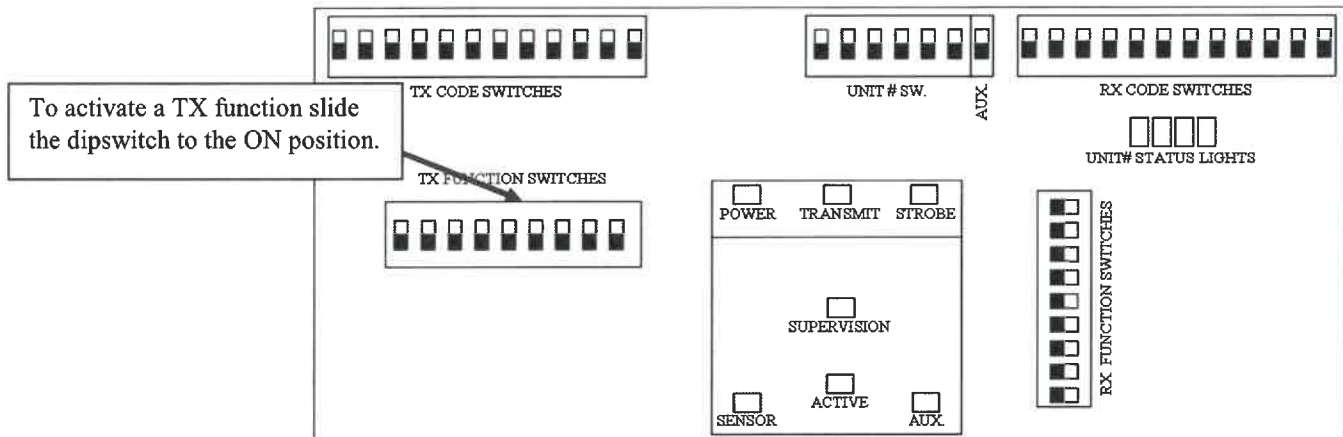
To watch a "How To" video on this feature click on the link below:

["CODE SWITCH SETTINGS"](#)

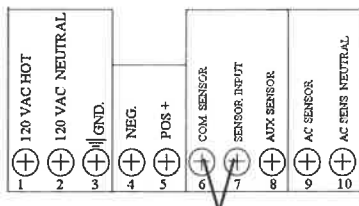
TRANSMIT - TX FUNCTIONS

SWITCH#

3	ON	ACTIVATES TRANSPONDER OPERATION: <i>When ever a command is received, that same command will then be automatically retransmitted. Sensor inputs are disabled when in Transponder Operation.</i>
4	ON	MAKES IT A UNIT #2 TRANSMITTER
4&5 both	ON	MAKES IT A UNIT #3 TRANSMITTER
5	ON	MAKES IT A UNIT #4 TRANSMITTER
5&6 both	ON	MAKES IT A UNIT #5 TRANSMITTER
6	ON	MAKES IT A UNIT #6 TRANSMITTER
4,5,6 all	ON	DISABLES ALL TRANSMISSIONS (<i>used when Hot Shot is receive only</i>) <i>(For more details see Unit# - Function Switches 4,5,6 on pg 5.)</i>
8	ON	ACTIVATES THE TEST BEACON Used for testing and range finding only. When activated the Hot Shot will send a code every 10sec cycling a receiving Hot Shot's output relay. To activate this feature put a jumper wire from the Input Sensor to COM terminal. DO NOT have the receiving Hot Shot wired to the pump during this test. This function must be turned off for normal operation. (For more details see <u>Operating The Test Beacon below.</u>)
	OFF	NORMAL OPERATION MODE
9	ON	REFRESH (This function will retransmit the state of the Sensor Inputs once every 45 minutes.)
	OFF	NO REFRESH (Transmits the code only when there is a change of state on the Sensor Inputs.)



OPERATING THE TEST BEACON



The Test Beacon function is turned on and off by using FUCNTION SWITCH #8 (see above). **This feature is used for testing and range finding purposes only.** To activate the Test Beacon first turn OFF the power to the Hot Shot. Turn function switch #8 on and connect a small jumper wire from the **SENSOR INPUT** terminal to the **COM** terminal and then turn the power back ON. *See diagram.* When turned ON the Transmitting LED will blink and the code will be transmitted every 10 seconds cycling a receiving Hot Shot's relay. **DO NOT have the receiving Hot Shot wired up to the pump during this procedure** because it will continually open the relay for 10 seconds and then close the relay for 10 seconds causing damage to the pump.

Function switch #8 must be turned OFF, the jumper wire removed and then turn off the power of the Hot Shot to take it out of Beacon Mode.

To watch a "How To" video on this feature click on the link below:

["OPERATING THE TEST BEACON"](#)

TRANSMIT# - FUNCTION SWITCHES(4,5,6)

Using unit #'s on the Hot Shot can create a more precision controlled system. When needing to use multiple transmitters that control a single receiver, assigning unit #'s to each transmitter on the system will help the receiver to differentiate between the transmitters controlling it. This operation is often referred to as a Last Pivot Standing scenario. All Hot Shots come from the factory set in the default mode as a #1 transmitter. Meaning they will only control the relay output #1 on a 810-R Plus receiver, a receiver set as a Unit #1 receiver or channel 1 of a receiver operating in Last Pivot Standing mode. Turning on function switch #4 will make a transmitter a Unit #2 transmitter that will control the relay output #2 on a 810-R Plus receiver, a receiver set as a Unit #2 receiver or channel 2 of a receiver operating in Last Pivot Standing mode. The results are the same for each corresponding Unit # that a transmitter is set to.

UNIT# SWITCHES(1,2,3,4,5,6,) AND (AUX #7)

When a Hot Shot (810-R or TR1000) is going to be used with A Hot Shot (810-T or TR1000) transmitter using it's #1,2,3,4,5 and 6 SENSOR control, the Hot Shot going to be controlled will need to be assigned to the sensor on the transmitter that will control it. All Hot Shots come factory set in the default mode as a UNIT #1. Meaning they are only controlled by a Hot Shot that is transmitting as a Unit #1. When using the SENSOR INPUT #2 or higher on a transmitter you will need to use the **UNIT# DIP SWITCHES** located to the left of the 12-digit RX CODE SWITCHES to program the Hot Shot so it can be controlled by it's corresponding transmitter. You can make it a #2 receiver (*which is controlled by a #2 transmitter*) by only turning on the #2 dipswitch. *See picture.* You can make it a #3 receiver (*which is controlled by a #3 transmitter*) by only turning on the #3 dipswitch. This makes it capable for the pivot to control and share multiple wells. Also see Multi Pivot Operation in the transmitter section.

Last Pivot Standing Mode & Operation (Unit# switches and (Aux 7))

This mode is used when 2 or more (*up to 6*) different pivots are sharing the same pump and the pump can stay running until all the pivots are done and have transmitted the relay OFF command. Each UNIT# STATUS LED on the pumps' Hot Shot will light up when its corresponding pivot's Hot Shot has sent the relay ON command. When a pivots' Hot Shot sends its relay OFF command to the pump's Hot Shot the corresponding UNIT# LED will turn off. For the pump to include each pivot in the control sequence the corresponding UNIT# switch on the pumps' Hot Shot must be turned on for each pivot that is controlling it.

NOTE - all pivots that transmitted in a relay ON command must transmit the relay OFF command or the pump will never stop.

To watch a "How To" video on this feature click on the link below:

["LAST PIVOT STANDING MODE"](#)

BASIC PIVOT PANEL INSTALLATION AND OPERATION

Most pivot installations will use this basic method because they only have a single throw pump control relay in their panel. (*Single throw relays only have a COMMON and NORMALLY OPEN contact.*) The pivots well control relay will be connected to the **ON-OFF INPUT** and the **COM** terminal on the pivot's Hot Shot. When there is contact made between **SENSOR INPUT** and **COM** (*when requesting water*) the Hot Shot will send out the ON code to the pump's Hot Shot activating it's relay and starting the pump. When contact is opened between **SENSOR INPUT** and **COM** (*such as when the pivot is finished or stop water*) the pivot's Hot Shot will send out the OFF code to the pump's Hot Shot de-activating it's relay and stopping the pump. Brand specific wiring instructions are shown later in this manual.

To watch a video on this click on the link below:

["BASIC PIVOT PUMP CONTROL"](#)

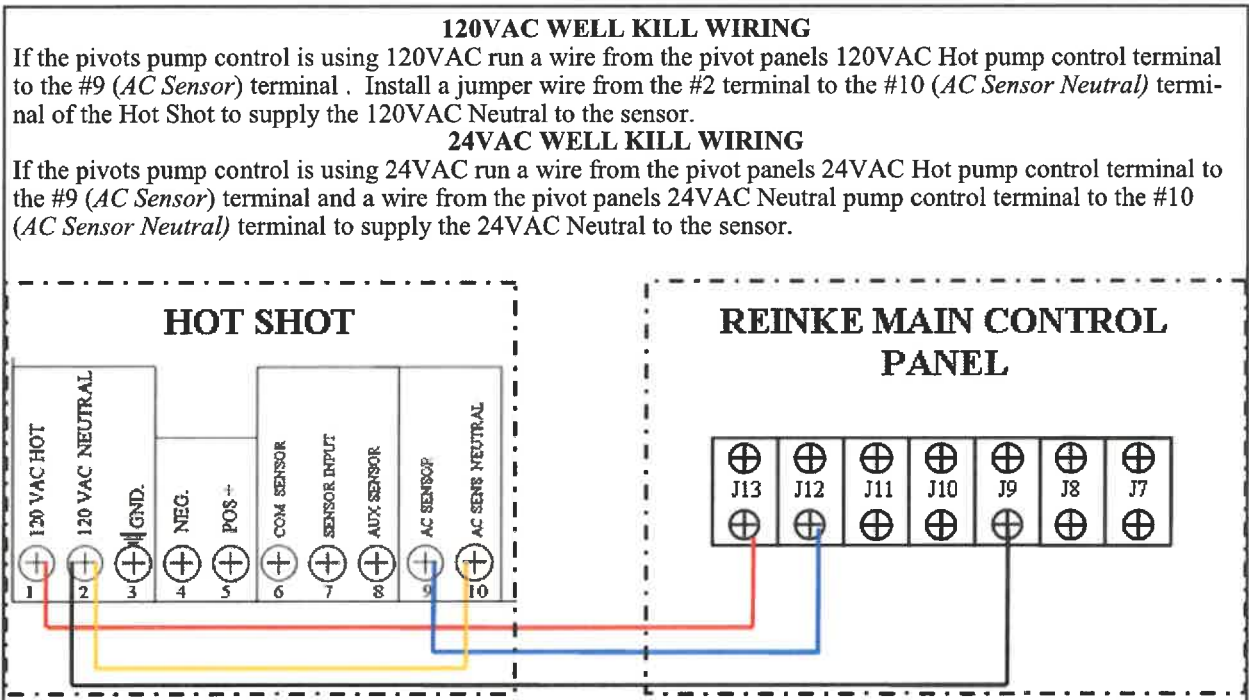
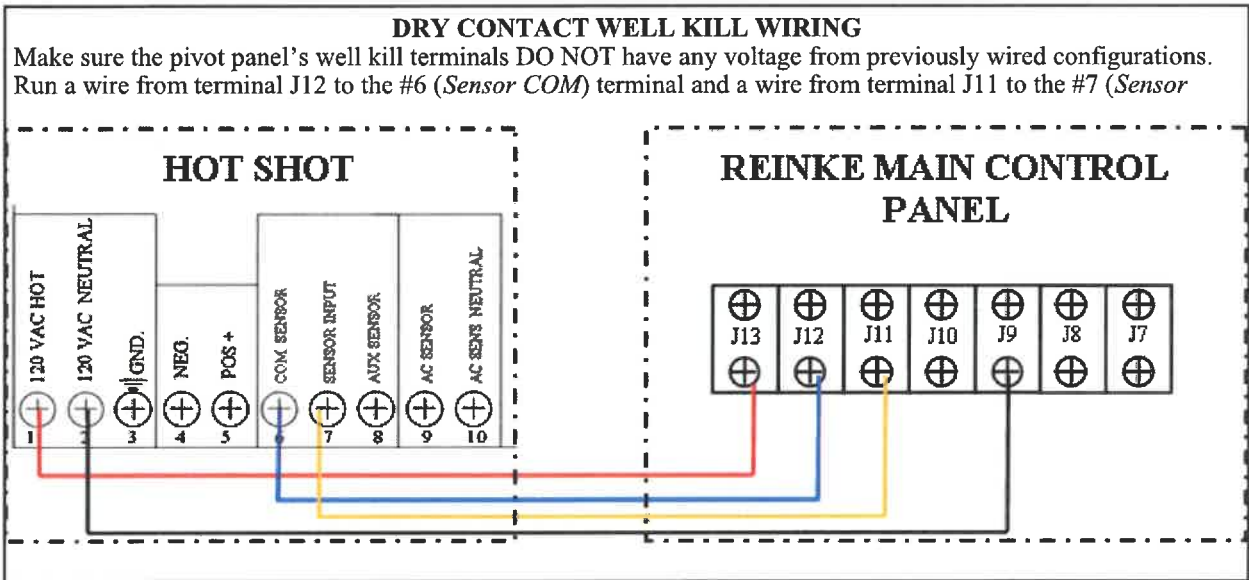
REINKE PIVOT

WIRING INSTRUCTIONS FOR BASIC OPERATION

Typically all functions switches are off unless advanced features are needed. See function switch setting on page 3 for details.

Attention: THE BACKUP BATTERY MUST BE INSTALLED FOR TRANSMITTER OPERATION.

To supply the 120vac needed for the Hot Shot TR1000 to operate, run a wire from the pivot panel's J13 terminal to the #1 terminal (120vac Hot Terminal). Run another wire from the pivot panel's neutral terminal J9 to the #2 terminal (120vac Neutral Terminal). Connect a wire from the Lighting Ground terminal of the Hot Shot to an NEC approved ground rod. If your pivot panel has NO voltage on the pump control terminals then use the DRY CONTACT WELL KILL WIRING option below. If your pivot panel has AC voltage on the pump control terminals then use the 120VAC or 24VAC WELL KILL WIRING option below.



T-L ELECTRIC PANEL (ALLEN BRADLEY)

WIRING INSTRUCTIONS FOR BASIC OPERATION

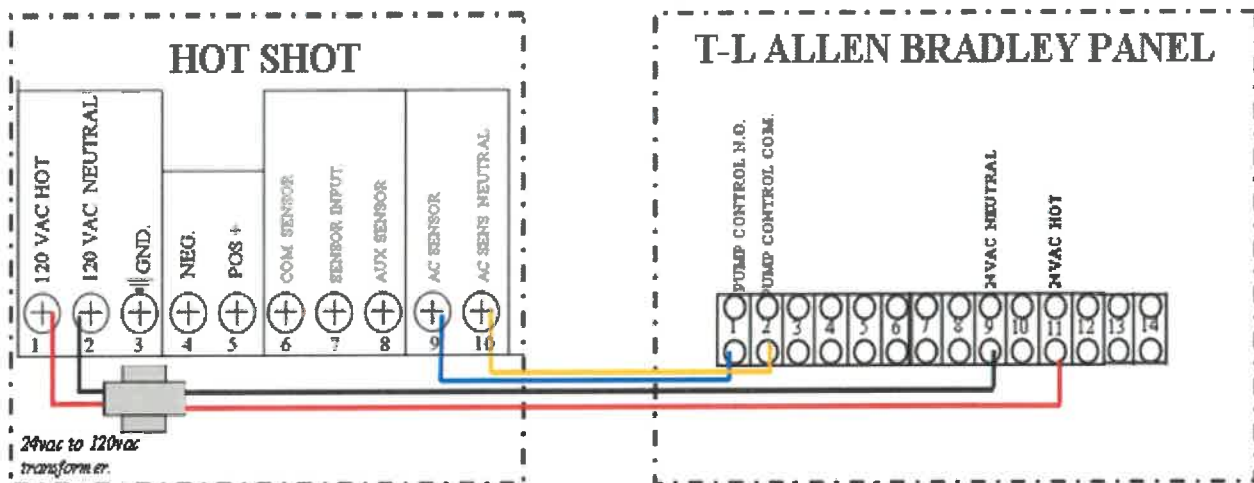
Typically all functions switches are off unless advanced features are needed. See function switch setting on page 3 for details.

Attention: THE BACKUP BATTERY MUST BE INSTALLED FOR TRANSMITTER OPERATION.

Attention: This install requires a 24vac to 120vac transformer.

To supply the 120vac needed for the Hot Shot Transmitter to operate, install a 24VAC to 120VAC step up transformer. These are available to purchase from Hot Shot Systems. Run two wires from the 24 VAC input on the transformer to terminal #9 and #11 in the T-L Allen Bradley Panel. Then take the 2 wires from the 120VAC output side and connect them to terminals #1 (120vac Hot Terminal) and #2 (120vac Neutral Terminal) of the Hot Shot. Connect a wire from the Lighting Ground terminal of the Hot Shot to an NEC approved ground rod.

For pump control run a wire from the Allen Bradley panels #1 terminal to the #9 (AC Sensor) terminal and another wire from the Allen Bradley panels #2 terminal to the #10 (AC Sensor Neutral) terminal of the Hot Shot.



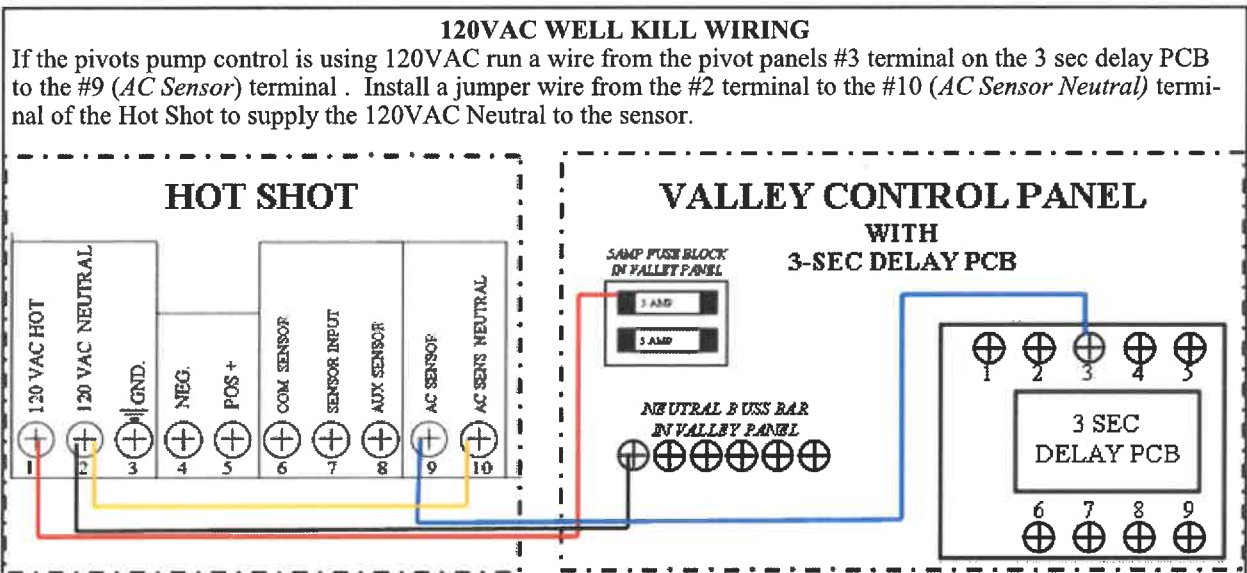
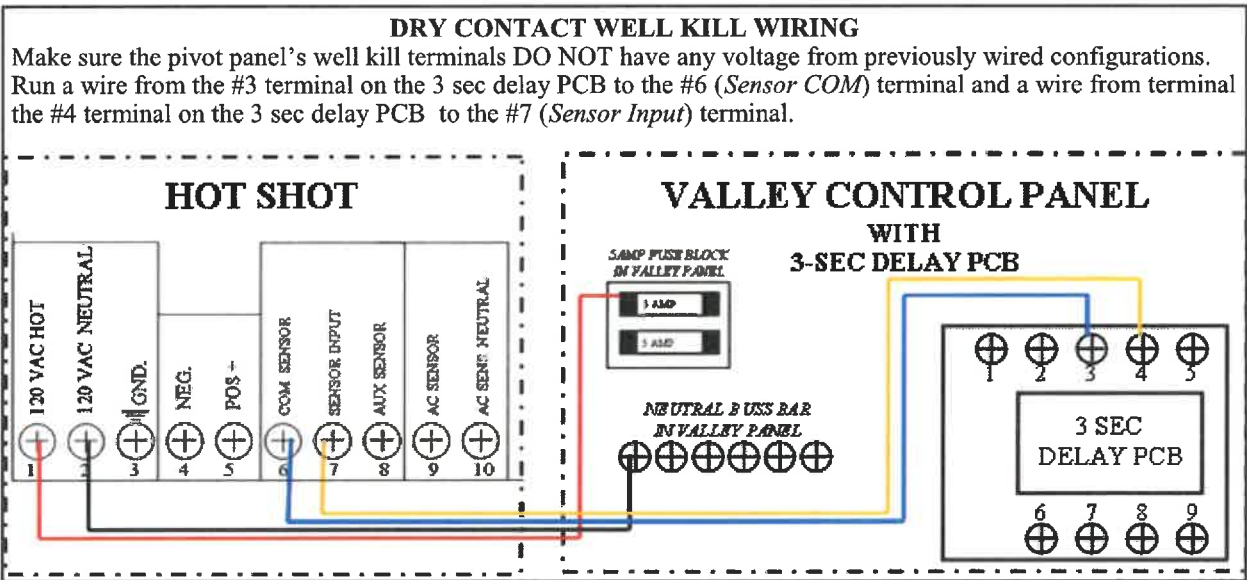
VALLEY MODELS 4000, 6000, & PANELS WITH 3 SEC DELAY PCB.

WIRING INSTRUCTIONS FOR BASIC OPERATION

Typically all functions switches are off unless advanced features are needed. See function switch setting on page 3 for details.

Attention: THE BACKUP BATTERY MUST BE INSTALLED FOR TRANSMITTER OPERATION.

To supply the 120vac needed for the Hot Shot TR1000 to operate, run a wire from the pivot panel's 120vac hot terminal on the fuse block to the #1 (120vac Hot Terminal) terminal and another wire from the pivot panel's neutral terminal to the #2 (120vac Neutral Terminal) terminal. Connect a wire from the Lighting Ground terminal of the Hot Shot to an NEC approved ground rod. If your pivot panel has **NO** voltage on the pump control terminals then use the DRY CONTACT WELL KILL WIRING option below. If your pivot panel has AC voltage on the pump control terminals then use the 120VAC WELL KILL WIRING option below.

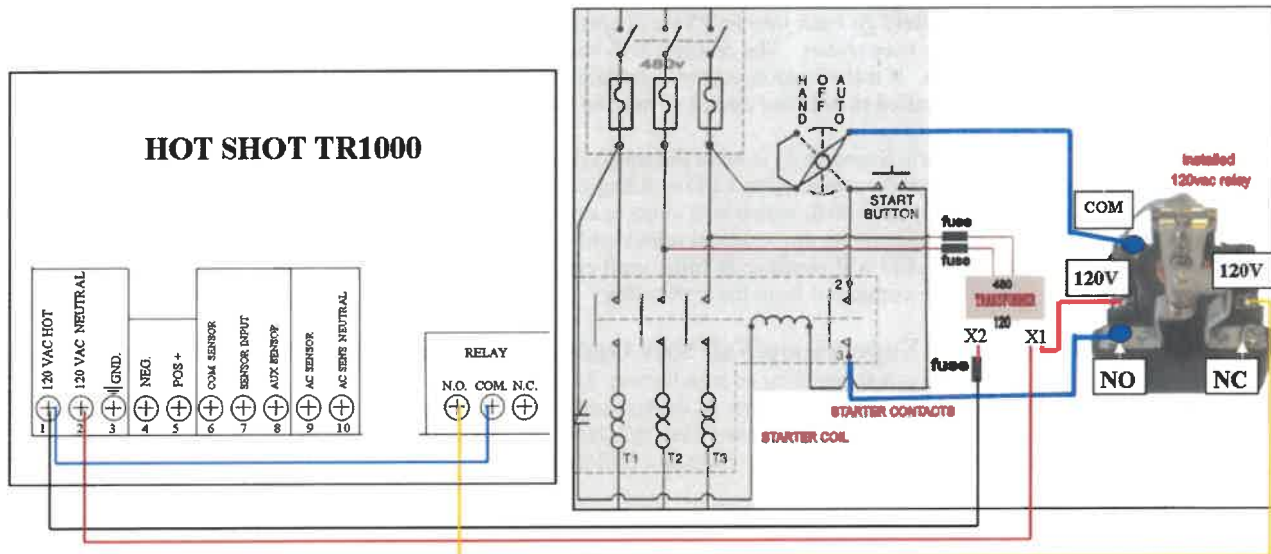


ELECTRIC PUMP WIRING

CAUTION: Never switch any voltage greater than 120v with the Hot Shot's internal relays. This will ruin the relay and void all manufacturer warranties. Use an externally mounted 120v coil relay to switch all voltages greater than 120v. *See diagram below.*

HOT SHOTS AT THE PUMP NEED TO BE TURNED ON BEFORE THE HOT SHOTS AT THE PIVOT ARE TURNED ON. HOT SHOTS ONLY TRANSMIT FOR 1 MINUTE. IF THE HOT SHOT AT THE PUMP IS TURNED ON AFTER THE ONE AT THE PIVOT IT WILL NOT OPERATE CORRECTLY UNTIL THE HOT SHOT AT THE PIVOT IS SET TO TRANSMIT AGAIN.

To supply power to the Hot Shot mount a 480v-120v step-down transformer in the pump panel. A Hot Shot only requires 1 watt of power to operate. *Hot Shot Systems suggest using a minimum of a single phase 60 hertz 0.050kVA transformer. They are available for purchase through Hot Shot Systems, just request when ordering.* Mount a 3 terminal fuse block and a 120vac relay in the pump panel. *Hot Shot Systems suggest using a 115V AC coil relay.* Wire two, 480v conductors through the first two fuses (2 amp each) to the primary side of the step-down transformer. Wire the 120v X2 terminal of the step-down transformer through the remaining fuse (2 amp) and then to terminal #1 (120vac hot input of the Hot Shot). Wire the 120v X1 terminal of the step-down transformer to the terminal #2 (120vac neutral input of the Hot Shot). Terminals may be different according to the transformer installed. Add a jumper from terminal #1 of the Hot Shot to it's COM terminal. Wire the NO terminal on the Hot Shot to one side of the 120v relay's coil. Connect the other side of the relay's coil to the X1 terminal of the step-down transformer. Connect a wire from the ground terminal of the Hot Shot to a central grounding system or an NEC approved ground rod.



PUMP START: WHEN THE HOT SHOT AT THE PIVOT'S SENSOR INPUT TO SENSOR COM IS CLOSED IT SENDS OUT THE RELAY ON COMMAND TO THE HOT SHOT AT THE PUMP. WHEN A RELAY ON COMMAND IS RECEIVED THE HOT SHOT WILL CLOSE ITS N.O. TO COM CONTACTS AND LIGHT UP THE RELAY LED. THIS WILL ENERGIZE THE 120VAC RELAY TO CLOSE THE 480V PUMP CONTACTOR STATRTING THE PUMP.

PUMP STOP: WHEN THE HOT SHOT AT THE PIVOT'S SENSOR INPUT TO SENSOR COM IS OPENED IT SENDS OUT THE RELAY OFF COMMAND TO THE HOT SHOT AT THE PUMP. WHEN A RELAY OFF COMMAND IS RECEIVED THE HOT SHOT WILL OPEN ITS N.O. TO COM CONTACTS AND TURN OFF THE RELAY LED. THIS WILL DE-ENERGIZE THE 120VAC RELAY TO OPEN THE 480V PUMP CONTACTOR STOPING THE PUMP.

APPENDIX

SUPERVISION FEATURE

The Supervision Feature is a great way for checking at a glance the integrity of communications between the transmitter and receivers. The supervision feature is designed to work with only one transmitter per system as the supervision feature's timer can operate on multiple receivers at the same time. When function 9 (Refresh) is turned on in the transmitter, it will send out a check-in signal (*technically it's a command telling each receiver on the system to reset it's supervision timer, i.e. system is working properly*) every 45 minutes. If the check-in signal is not heard by the receiver before the internal supervision timer expires, due to transmitter or receiver issues, the receiver will then look at its function switches (7, 8 or 9) and take the selected course of supervision action. See below.

Receiver's Supervision/Fail Safe action:

If **Function 8** is on in the receiver and the supervision timer does not get reset by the transmitter's check-in signal the supervision LED will begin to blink continuously. No action will be performed by the receivers relay. The supervision LED will continue to blink until either the receiver receives the transmitter's check-in signal or the receiver is reset by pressing the reset button, if equipped, or by cycling the power to the receiver.

If **Function 7** (Fail Safe Scenario 1) is on in the receiver and the supervision timer does not get reset by the transmitter's check-in signal the supervision LED will begin to blink continuously. This will also activate the receivers relay which will close or open your contacts, (*N.C. / N.O.*) possibly triggering an alarm, call out system, deactivate an external relays coil or trip a tattletale circuit to stop the device it is controlling. The supervision LED will continue to blink and the receivers relay will stay activated until either the receiver receives the transmitter's check-in signal, a relay reset command from the transmitter or the receiver is reset by pressing the reset button, if equipped, or by cycling or losing power to the receiver.

Operational Note: When using Fail Safe Scenario 1, the receiver's relay is energized and if power is lost while the receiver is in Fail Safe operation, the receiver's relay will de-energize. When power is restored, the receivers relay will not immediately go back into Fail Safe operation. The receivers relay will remain de-energized and the device it is controlling may restart. The receiver will not go into Fail Safe operation again until it's supervision timer has expired again. If this situation occurs, a tattletale device that does not recycle when the power comes back on, should be installed to hold the circuit as needed for your situation.

If **Function 9** (Fail Safe Scenario 2) is on in the receiver and the supervision timer does not get reset by the transmitter's check-in signal the supervision LED will begin to blink continuously. This will also deactivate the receiver's relay, if currently activated, which will close or open your contacts, (*N.C. / N.O.*) possibly triggering an alarm, call out system, deactivate any external relays coil or trip a tattletale circuit to stop the device it is controlling. The supervision LED will continue to blink until either the receiver receives the transmitter's check-in signal or a relay ON or OFF command from the transmitter.

Transmitter Setting for Supervision/Fail Safe Operation at the Receiver:

Function 9 (*Refresh - sends checking in signal every 45 min.*)

This function must be turned on in the transmitter so the transmitter will send out the signal to make the receiver(s) supervision timer reset. IF the transmitter does not have this function turned on the absence of the refresh/check in signal will cause the receiver(s) to go into Supervision or a Fail Safe action.

Testing Supervision/Fail Safe Operation:

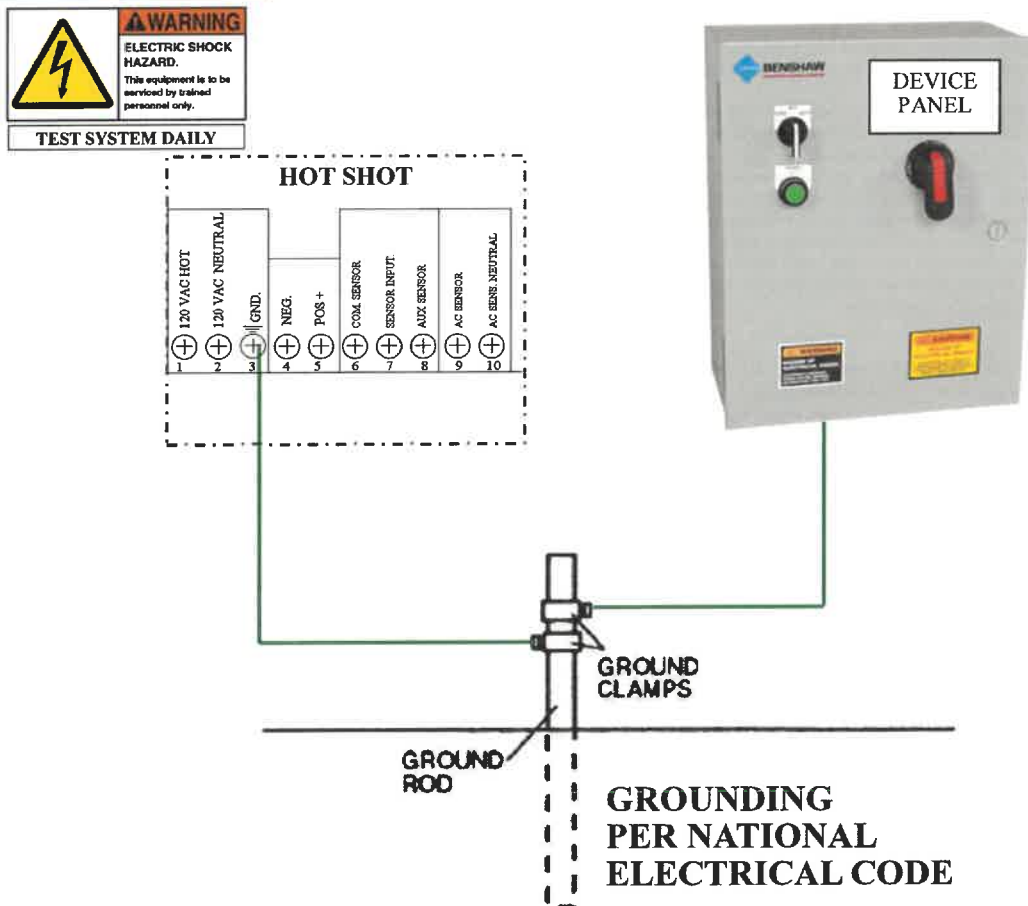
A good way to test the Supervision/ Fail Safe Operation is to turn off function switch 9 on the transmitter, so it will no longer send the refresh/check-in signal. Once the receiver's supervision timer has expired, (*may take up to 3 hrs depending on the version of software the receiver is operating*) the Supervision LED will begin to blink and depending upon the Fail Safe scenario you have chosen, the receivers relay will activate or de-active.

HOT SHOT GROUNDING FOR SAFETY AND PEAK PERFORMANCE

Hot Shot wireless systems are equipped with a GROUND terminal that needs to be connected to an NEC approved ground rod. A Hot Shot has various lightning and static protection devices incorporated on the circuit board that require proper grounding to operate. Any equipment or device panels operating with or near the Hot Shot should also be connected to the grounding system. A good ground will enhance the transmit and receive range of the Hot Shot System.

To watch a "How To" video on this feature click on the link below:

["PROPER GROUNDING"](#)



Warranty

The warranty below constitutes the only warranty in connection with any sale from Hot Shot Systems Inc. and is in lieu of all other warranties, express or implied, written or oral. THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE THAT APPLY TO ANY SALE FROM HOT SHOT SYSTEMS INC.

Hot Shot Systems Inc., warrants to You that Products (Products meaning any item purchased from Hot Shot Systems) will be free from defects in materials and workmanship under normal use and service for one (1) year from the purchase date. A product issue under this Limited Warranty must be presented during the Limited Warranty period and within thirty (30) days after any covered condition has occurred. A claim under this Limited Warranty shall be satisfied by either, in Hot Shot Systems sole discretion, repairing or replacing the Product. Replacement Products may be new or reconditioned.

To make a claim under this Limited Warranty, Hot Shot Systems must first issue You a Returned Material Authorization (RMA) number. This number can be obtained by calling Hot Shot Systems and a RMA number will be provided over the phone. A copy of the RMA number must be included with any materials shipped to Hot Shot Systems. The entirety of Products must be sent back to Hot Shot Systems and properly packaged to ensure against damage during shipping. If Hot Shot Systems determines that the claim is covered by this Limited Warranty, Hot Shot Systems will either, in its sole discretion, repair or replace the Products and/or part. Any damages not covered under this Limited Warranty will not be repaired until a purchase order is received.

The Limited Warranty period shall not be extended by the replacement or repair of Products or parts under this Limited Warranty but the remaining Limited Warranty period shall continue in effect and be applicable to the replaced or repaired Products or parts under conditions of the Limited Warranty.

The term "Long Range Wireless Control" is not a guarantee of proper radio operation everywhere in all conditions. Radio operation is subject to transmission and receive limitations, customer equipment, weather, topography and other environmental and electrical considerations associated with radio technology also affect radio operation and radio operation may vary significantly within buildings. The radio operation range of Products is not guaranteed, and Hot Shot Systems cannot and does not guarantee or represent that the radio operation will operate correctly in all conditions. It is Your responsibility to determine daily if radio operation is operating correctly and to monitor the Products to determine the communication between Products. You should contact Hot Shot Systems for assistance if needed. As such, Hot Shot Systems is not liable for any causes of action, pollution, incurred costs, losses of any kind or damages of any kind whatsoever arising out of mistakes, omissions, interruptions, errors, customer equipment or defects in the radio operation and or Products.

Intended Use. Products are intended for non pollutant, non hazardous and non critical use only. Products are to be used and installed per the installation guide and any other instructions provided by Hot Shot Systems (collectively, the "Seller's Guidelines"). Any use beyond the intended non pollutant, non-hazardous and non critical use or against the Seller's Guidelines ("Unintended use") are at the End-User's own risk, and Hot Shot Systems does not warrant or make any representations whatsoever regarding the use of Products for any unintended use. Hot Shot Systems' Products are convenience items and are not intended to be a substitute for normal maintenance, monitoring, control and proper upkeep of equipment or property that Products are monitoring or controlling. Hot Shot Systems' Products are convenience items and are not intended to monitor equipment, control equipment, liquids, chemicals or other items which are pollutants, vital, hazardous, necessary, and/or have life-or-death consequences. The End-User should take care to determine prior to use whether Products are suitable, adequate or safe for the use intended. Since individual applications are subject to great variation, Hot Shot Systems makes no representation or warranty as to suitability or fitness of Products for any specific application.

Upon expiration of the Limited Warranty period, all liability of Hot Shot Systems shall be terminated. This Limited Warranty will also be terminated immediately due to any of the following cases: failure to follow installation and operating instructions, misuse or "Unintended use", alteration, abuse, accident or tampering, and repair by anyone other than Hot Shot Systems. THIS LIMITED WARRANTY IS EXCLUSIVE AND EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, OBLIGATIONS OR LIABILITIES, WHETHER WRITTEN, ORAL, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, OR OTHERWISE. IN NO CASE SHALL HOT SHOT SYSTEMS BE LIABLE TO ANYONE FOR ANY CONSEQUENTIAL OR INCIDENTAL DAMAGES FOR BREACH OF THIS WARRANTY OR ANY OTHER WARRANTIES WHATSOEVER. This Limited Warranty gives specific legal rights.

No employee, agent, dealer or other person is authorized to give any warranties on behalf of Hot Shot Systems Inc., nor to assume for it any other liability in connection with any of its products, except an officer of Hot Shot Systems Inc., in a signed writing.

LIABILITY

Hot Shot Systems Inc. and its directors, officers, employees, subsidiaries and affiliates shall not be liable for pollution, pollution clean up, personal injury, property damage, hazardous conditions created, fluid spill cleanup, loss of product, loss of profit, or any other loss or expenses based on a claim the product(s) failed to operate properly. Test product daily to see if any malfunctions are present. If using this product in a situation where it is extremely critical to control your device to prevent damage of any kind, you must also use a call out system to notify a person in control of this situation. If this warranty and statement of liability is unacceptable, then do not purchase these products.

Hot Shot Systems makes no representation that Products and Services will reduce any risk of property loss, product loss, loss of profit, pollution or personal injury or prolong the life of any equipment or other property; or that Products and Services will in all cases provide adequate warning and protection. You understand that Products if properly installed and maintained may only reduce the risk of property loss or other loss but Products and Services are not an insurance or a guarantee that there will be no property loss, product loss, loss of profit, pollution or personal injury or other loss as a result. CONSEQUENTLY, HOT SHOT SYSTEMS SHALL HAVE NO LIABILITY FOR ANY POLLUTION, PRODUCT LOSS, LOSS OF PROFIT, PROPERTY DAMAGE, PERSONAL INJURY OR OTHER LOSS OR EXPENSES INCURRED BASED ON A CLAIM THE PRODUCTS AND SERVICES FAILED TO GIVE WARNING.

HS-1 ASSEMBLY



Remove set screw.



Thread coax cable through antenna base.



Screw coax connector onto base of antenna.



Thread in the three ground radials and secure with locking nuts.



DB5001

VHF Side Mounting Kit for 3 in (76.2 mm) OD round members. Includes top sway brace.

General Specifications

Mount Type	Side mounts
Application	Outdoor
Includes	Brackets Clamps Hardware Sway brace
Package Quantity	2

Mechanical Specifications

Color	Silver
Material Type	Galvanized steel

Dimensions

Compatible Diameter, maximum	76.2 mm 3.0 in
Compatible Diameter, minimum	31.8 mm 1.3 in
Net Weight	9.5 kg 21.0 lb

Regulatory Compliance/Certifications

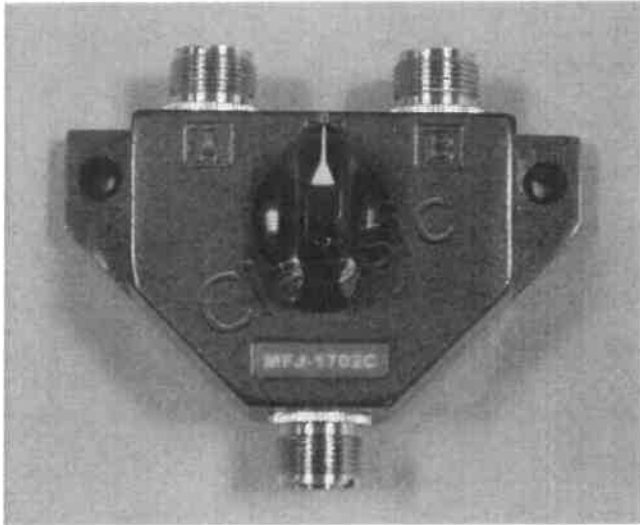
Agency	Classification
RoHS 2011/65/EU	Compliant by Exemption
China RoHS SJ/T 11364-2006	Above Maximum Concentration Value (MCV)
ISO 9001:2008	Designed, manufactured and/or distributed under this quality management system





MFJ 1702C

**COAX SWITCH 2-WAY
SO 239**



Coaxial switch 2-way with center ground position. Center position is automatically grounding if unused. Incl. lightning protection.

Specifications

Frequency range : DC-600 MHz

Max. power : 1 kW CW

Impedance : 50 Ohm

Connectors : SO 239

Insertion loss : < 0,2 dB

Isolation : > 60 dB op 300 MHz | > 50 dB op 450 MHz

Housing : metal

Dimensions : W 70 x D 50 x H 50 mm

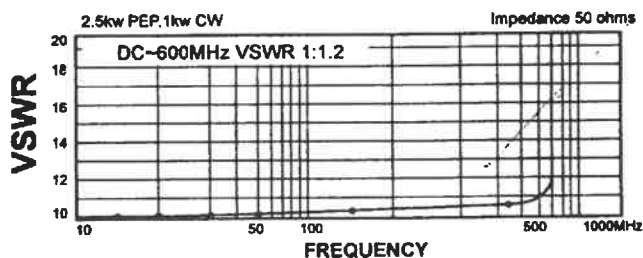
Note ! Do never operate switch when transmitting. This will damage contacts.

MFJ-1702C



■ Features:

- Built-in Lightning Surge Protection
- Has an exclusive center ground position
- Unused terminal is automatically grounded for static and RF protection
- Handles 2.5 kW PEP (1 kW CW)
- 50 ohm Impedance
- Has better than 60 dB isolation at 300 MHz and better than 50dB at 450 MHz
- Less than 0.2dB insertion loss and SWR below 1.2:1
- VSWR less than 1.2:1 (DC-600 MHz)
- Heavy cavity type construction
- 1 Year *No Matter What*™ limited Warranty



■ CAUTION

Do not change position with power on the transmission line.
MFJ-1702C does not protect against a direct lightning strike..

MFJ Enterprises, Inc.

...the world leader in ham radio accessories

300 Industrial Park Road
Starkville, MS 39759 USA

Phone: 601-323-5869; Fax 601-323-6551

<http://www.mfjenterprises.com>

made in Taiwan

SECTION 26 05 04
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. ASTM International (ASTM):
 - a. A1011/A1011M, Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low Alloy Formability.
 - b. E814, Method of Fire Tests of Through-Penetration Fire Stops.
 2. Canadian Standards Association (CSA).
 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE): 18, Standard for Shunt Power Capacitors.
 4. International Society of Automation (ISA): RP12.06.01, Wiring Practices for Hazardous (Classified) Locations Instrumentation–Part 1: Intrinsic Safety.
 5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. C12.1, Code for Electricity Metering.
 - c. C12.6, Phase-Shifting Devices Used in Metering, Marking and Arrangement of Terminals.
 - d. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
 - e. ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
 - f. KS 1, Enclosed and Miscellaneous Distribution Switches (600 Volts Maximum).
 6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 7. Underwriters Laboratories, Inc. (UL):
 - a. 98, Standard for Enclosed and Dead-Front Switches.
 - b. 248, Standard for Low Voltage Fuses.
 - c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
 - d. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
 - e. 508, Standard for Industrial Control Equipment.

ANTIOCH ELEVATED STORAGE TANK

- f. 810, Standard for Capacitors.
- g. 943, Standard for Ground-Fault Circuit-Interrupters.
- h. 1059, Standard for Terminal Blocks.
- i. 1479, Fire Tests of Through-Penetration Fire Stops.

1.02 SUBMITTALS

A. Action Submittals:

- 1. Provide manufacturers' data for the following:
 - a. Control devices.
 - b. Control relays.
 - c. Circuit breakers.
 - d. Enclosures: Include enclosure data for products having enclosures.
- 2. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals: Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

PART 2 PRODUCTS

2.01 MOLDED CASE CIRCUIT BREAKER THERMAL MAGNETIC, LOW VOLTAGE

A. General:

- 1. Type: Molded case.
- 2. Trip Ratings: 15 amps to 800 amps.
- 3. Voltage Ratings: 120, 240, 277, 480, and 600V ac.
- 4. Suitable for mounting and operating in any position.
- 5. UL 489.

B. Operating Mechanism:

- 1. Overcenter, trip-free, toggle type handle.
- 2. Quick-make, quick-break action.
- 3. Locking provisions for padlocking breaker in OPEN position.
- 4. ON/OFF and TRIPPED indicating positions of operating handle.
- 5. Operating handle to assume a CENTER position when tripped.

- C. Trip Mechanism:
1. Individual permanent thermal and magnetic trip elements in each pole.
 2. Variable magnetic trip elements with a single continuous adjustment 3X to 10X for frames greater than 100 amps.
 3. Two and three pole, common trip.
 4. Automatically opens all poles when overcurrent occurs on one pole.
 5. Test button on cover.
 6. Calibrated for 40 degrees C ambient, unless shown otherwise.
 7. Do not provide single-pole circuit breakers with handle ties where multi-pole circuit breakers are shown.
- D. Short Circuit Interrupting Ratings:
1. 22,000A for all 240/120V equipment.
 2. Series Connected Ratings: Do not apply series connected short circuit ratings.
- E. Ground Fault Circuit Interrupter (GFCI): Where indicated, equip breaker as specified above with ground fault sensor and rated to trip on 5-mA ground fault within 0.025 second (UL 943, Class A sensitivity, for protection of personnel).
1. Ground fault sensor shall be rated same as circuit breaker.
 2. Push-to-test button.
- F. Equipment Ground Fault Interrupter (EGFI): Where indicated, equip breaker specified above with ground fault sensor and rated to trip on 30-mA ground fault (UL-listed for equipment ground fault protection).
- G. Accessories: Shunt trip, auxiliary switches, handle lock ON devices, mechanical interlocks, key interlocks, unit mounting bases, double lugs as shown or otherwise required. Shunt trip operators shall be continuous duty rated or have coil-clearing contacts.
- H. Connections:
1. Supply (line side) at either end.
 2. Mechanical wire lugs, except crimp compression lugs where shown.
 3. Lugs removable/replaceable for breaker frames greater than 100 amperes.
 4. Suitable for 75 degrees C rated conductors without derating breaker or conductor ampacity.
 5. Use bolted bus connections, except where bolt-on is not compatible with existing breaker provisions.

ANTIOCH ELEVATED STORAGE TANK

- I. Enclosures for Independent Mounting:
 1. See Article Enclosures.
 2. Service Entrance Use: Breakers in required enclosure and required accessories shall be UL 489 listed.
 3. Interlock: Enclosure and switch shall interlock to prevent opening cover with switch in the ON position. Provide bypass feature for use by qualified personnel.

2.02 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

- A. Contact Rating: 7,200VA make, 720VA break, at 600V, NEMA ICS 5 Designation A600.
- B. Selector Switch Operating Lever: Standard.
- C. Indicating Light: Push-to-test.
- D. Pushbutton Color:
 1. ON or START: Black.
 2. OFF or STOP: Red.
- E. Pushbutton and selector switch lockable in OFF position where indicated.
- F. Legend Plate:
 1. Material: Aluminum.
 2. Engraving: Enamel filled in high contrasting color.
 3. Text Arrangement: 11-character/spaces on one line, 14-character/spaces on each of two lines, as required, indicating specific function.
 4. Letter Height: 7/64 inch.
- G. Manufacturers and Products:
 1. Heavy-Duty, Oil-Tight Type:
 - a. General Electric Co.; Type CR 104P.
 - b. Square D Co.; Type T.
 - c. Eaton/Cutler-Hammer; Type 10250T.
 2. Heavy-Duty, Watertight, and Corrosion-Resistant Type:
 - a. Square D Co.; Type SK.
 - b. General Electric Co.; Type CR 104P.
 - c. Eaton/Cutler-Hammer; Type E34.
 - d. Crouse-Hinds; Type NCS.

2.03 TERMINAL BLOCK, 600 VOLTS

- A. UL 486E and UL 1059.
- B. Size components to allow insertion of necessary wire sizes.
- C. Capable of termination of control circuits entering or leaving equipment, panels, or boxes.
- D. Screw clamp compression, dead front barrier type, with current bar providing direct contact with wire between compression screw and yoke.
- E. Yoke, current bar, and clamping screw of high strength and high conductivity metal.
- F. Yoke shall guide all strands of wire into terminal.
- G. Current bar shall ensure vibration-proof connection.
- H. Terminals:
 - 1. Capable of wire connections without special preparation other than stripping.
 - 2. Capable of jumper installation with no loss of terminal or rail space.
 - 3. Individual, rail mounted.
- I. Marking system, allowing use of preprinted or field-marked tags.
- J. Manufacturers:
 - 1. Weidmuller, Inc.
 - 2. Ideal.
 - 3. Electrovert USA Corp.

2.04 MAGNETIC CONTROL RELAY

- A. Industrial control with field convertible contacts rated 10 amps continuous, 7,200VA make, 720VA break.
- B. NEMA ICS 2, Designation: A600 (600 volts).
- C. Time Delay Relay Attachment:
 - 1. Pneumatic type, timer adjustable as shown.
 - 2. Field convertible from ON delay to OFF delay and vice versa.

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- D. Latching Attachment: Mechanical latch, having unlatching coil and coil clearing contacts.
- E. Manufacturers and Products:
 - 1. Eaton/Cutler-Hammer; D26 Type M.
 - 2. General Electric Co.; Type CR120B.
 - 3. Square D; Type X.

2.05 TIME DELAY RELAY

- A. Industrial relay with contacts rated 5 amps continuous, 3,600VA make, 360VA break.
- B. NEMA ICS 2 Designation: B150 (150 volts).
- C. Solid-state electronic, field convertible ON/OFF delay.
- D. One normally open and one normally closed contact (minimum).
- E. Repeat accuracy plus or minus 2 percent.
- F. Timer adjustment from 1 second to 60 seconds, unless otherwise indicated on Drawings.
- G. Manufacturers and Products:
 - 1. Square D Co.; Type XO.
 - 2. Eaton/Cutler-Hammer; Type D26MR.
 - 3. General Electric Co.; Type CR120.

2.06 RESET TIMER

- A. Drive: Synchronous motor, solenoid-operated clutch.
- B. Mounting: Semiflush panel.
- C. Contacts: 10 amps, 120 volts.
- D. Manufacturers and Products:
 - 1. Eagle Signal Controls; Bulletin 125.
 - 2. Automatic Timing and Controls; Bulletin 305.

2.07 ELAPSED TIME METER

- A. Drive: Synchronous motor.
- B. Range: 0 hour to 99,999.9 hours, nonreset type.
- C. Mounting: Semiflush panel.
- D. Manufacturers and Products:
 - 1. General Electric Co.; Type 240, 2-1/2-inch Big Look.
 - 2. Eagle Signal Controls; Bulletin 705.

2.08 PHASE MONITOR RELAY

- A. Features:
 - 1. Voltage and phase monitor relay shall drop out on low voltage, voltage unbalance, loss of phase, or phase reversal.
 - 2. Contacts: Single-pole, double-throw, 10 amperes, 120/240V ac. Where additional contacts are shown or required, provide magnetic control relays.
 - 3. Adjustable trip and time delay settings.
 - 4. Transient Protection: 1,000V ac.
 - 5. Mounting: Multipin plug-in socket base.
- B. Manufacturer and Product: Automatic Timing and Controls; SLD Series.

2.09 SUPPORT AND FRAMING CHANNELS

- A. Carbon Steel Framing Channel:
 - 1. Material: Rolled, mild strip steel, 12-gauge minimum, ASTM A1011/A1011M, Grade 33.
 - 2. Finish: Hot-dip galvanized after fabrication.
- B. Paint Coated Framing Channel: Carbon steel framing channel with electro-deposited rust inhibiting acrylic or epoxy paint.
- C. PVC-Coated Framing Channel: Carbon steel framing channel with 40-mil polyvinyl chloride coating.
- D. Stainless Steel Framing Channel: Rolled, Type 316 stainless steel, 12-gauge minimum.

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E. Extruded Aluminum Framing Channel:

1. Material: Extruded from Type 6063-T6 aluminum alloy.
2. Fittings fabricated from Alloy 5052-H32.

F. Nonmetallic Framing Channel:

1. Material: Fire retardant, fiber reinforced vinyl ester resin.
2. Channel fitting of same material as channel.
3. Nuts and bolts of long glass fiber reinforced polyurethane.

G. Manufacturers:

1. B-Line Systems, Inc.
2. Unistrut Corp.
3. Aickinstrut.

2.10 FIRESTOPS

A. General:

1. Provide UL 1479 classified hourly fire rating equal to, or greater than, the assembly penetrated.
2. Prevent the passage of cold smoke, toxic fumes, and water before and after exposure to flame.
3. Sealants and accessories shall have fire-resistance ratings as established by testing identical assemblies in accordance with ASTM E814, by Underwriters Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

2.11 ENCLOSURES

- A. Finish: Sheet metal structural and enclosure parts shall be completely painted using an electrodeposition process so interior and exterior surfaces as well as bolted structural joints have a complete finish coat on and between them.
- B. Color: Manufacturer's standard color (gray) baked-on enamel, unless otherwise shown.
- C. Barriers: Provide metal barriers within enclosures to separate wiring of different systems and voltage.

D. Enclosure Selections:

1. Except as shown otherwise, provide electrical enclosures according to the following table:

Enclosures			
Location	Finish	Environment	NEMA 250 Type
Indoor	Finished	Dry	1
Indoor	Unfinished	Dry	1
Indoor	Unfinished	Industrial Use	12
Indoor and Outdoor	Any	Wet	4
Indoor and Outdoor	Any	Denoted "WP"	3R
Indoor and Outdoor	Any	Wet and Corrosive	4X 316 Stainless Steel
Indoor and Outdoor	Any	Wet, Dust or Oil	13
Indoor and Outdoor	Any	Hazardous Gas	7
Indoor and Outdoor	Any	Hazardous Dust	9

PART 3 EXECUTION

3.01 GENERAL

- A. Install equipment in accordance with manufacturer's recommendations.

3.02 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

- A. Install heavy-duty, oil-tight type in nonhazardous, indoor, dry locations, including motor control centers, control panels, and individual stations, unless otherwise shown.
- B. Install heavy-duty, watertight and corrosion-resistant type in nonhazardous, outdoor, or normally wet areas, unless otherwise shown.

3.03 SUPPORT AND FRAMING CHANNEL

- A. Install where required for mounting and supporting electrical equipment, raceway, and cable tray systems.
- B. Channel Type:
 1. Interior, Wet or Dry (Noncorrosive) Locations:
 - a. Aluminum Raceway: Extruded aluminum or carbon steel with neoprene material isolators.

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- b. PVC-Coated Conduit: PVC coated.
- c. Steel Raceway and Other Systems Not Covered: Carbon steel or paint coated.
2. Interior, Corrosive (Wet or Dry) Locations:
 - a. Aluminum Raceway: Extruded aluminum.
 - b. PVC Conduit: Type 316 stainless steel or nonmetallic.
 - c. PVC-Coated Steel Conduit and Other Systems Not Covered: Type 316 stainless steel, nonmetallic, or PVC-coated steel.
3. Outdoor, Noncorrosive Locations:
 - a. Steel Raceway: Carbon steel or paint coated framing channel, except where mounted on aluminum handrail, then use aluminum framing channel.
 - b. Aluminum Raceway and Other Systems Not Covered: Aluminum framing channel or carbon steel with neoprene material isolators.
4. Outdoor Corrosive Locations:
 - a. PVC Conduit: Type 316 stainless steel or nonmetallic.
 - b. Aluminum Raceway: Aluminum or carbon steel with neoprene material isolators.
 - c. PVC-Coated Steel Conduit and Other Systems Not Covered: Type 316 stainless steel, nonmetallic, or PVC-coated steel.
5. Aluminum Railings: Devices mounted on aluminum railing shall use aluminum framing channel.

C. Paint cut ends prior to installation with the following:

1. Carbon Steel Channel: Zinc-rich primer.
2. Painted Channel: Rust-inhibiting epoxy or acrylic paint.
3. Nonmetallic Channel: Epoxy resin sealer.
4. PVC-Coated Channel: PVC patch.

3.04 FIRESTOPS

- A. Install in strict conformance with manufacturer's instructions. Comply with installation requirements established by testing and inspecting agency.
- B. Sealant: Install sealant including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide firestops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs.

END OF SECTION

**SECTION 26 05 05
CONDUCTORS****PART 1 GENERAL**

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. Association of Edison Illuminating Companies (AEIC): CS 8, Specification for Extruded Dielectric Shielded Power Cables Rated 5 kV through 46 kV.
 2. ASTM International (ASTM):
 - a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - b. B3, Standard Specification for Soft or Annealed Copper Wire.
 - c. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - d. B496, Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors.
 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV Through 500 kV.
 - b. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
 - c. 404, Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500000 V.
 4. Insulated Cable Engineer's Association, Inc. (ICEA):
 - a. S-58-679, Standard for Control Cable Conductor Identification.
 - b. S-73-532, Standard for Control Thermocouple Extensions and Instrumentation Cables.
 - c. T-29-520, Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input of 210,000 Btu/hour.
 5. National Electrical Manufacturers' Association (NEMA):
 - a. CC 1, Electric Power Connectors for Substations.
 - b. WC 57, Standard for Control, Thermocouple Extension, and Instrumentation Cables.
 - c. WC 70, Standard for Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.

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- d. WC 71, Standard for Nonshielded Cables Rated 2001-5000 Volts for Use in the Distribution of Electric Energy.
- e. WC 74, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
- 6. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- 7. Telecommunications Industry Association (TIA): TIA-568-C, Commercial Building Telecommunications Cabling Standard.
- 8. Underwriters Laboratories Inc. (UL):
 - a. 13, Standard for Safety for Power-Limited Circuit Cables.
 - b. 44, Standard for Safety for Thermoset-Insulated Wires and Cables.
 - c. 62, Standard for Safety for Flexible Cord and Cables.
 - d. 486A-486B, Standard for Safety for Wire Connectors.
 - e. 486C, Standard for Safety for Splicing Wire Connectors.
 - f. 510, Standard for Safety for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
 - g. 854, Standard for Safety for Service-Entrance Cables.
 - h. 1072, Standard for Safety for Medium-Voltage Power Cables.
 - i. 1277, Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
 - j. 1569, Standard for Safety for Metal-Clad Cables.
 - k. 1581, Standard for Safety for Reference Standard for Electrical Wires, Cables, and Flexible Cords.

1.02 SUBMITTALS

A. Action Submittals:

- 1. Product Data:
 - a. Wire and cable.
 - b. Wire and cable accessories.
- 2. Cable Pulling Calculations:
 - a. Ensure submitted and reviewed before cable installation.
 - b. Provide for the following cable installations:
 - 1) Medium voltage cable runs that cannot be hand pulled.
 - 2) Multiconductor 600-volt cable sizes larger than 2 AWG that cannot be hand pulled.
 - 3) Power and control conductor, and control and instrumentation cable installations in ductbanks.
 - 4) Feeder circuits; single conductors #4/0 and larger.

B. Informational Submittals:

1. Journeyman lineman or electrician splicing credentials.
2. Certified Factory Test Report for conductors 600 volts and below.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70. Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories Inc. shall conform to those standards and shall have an applied UL listing mark.

PART 2 PRODUCTS

2.01 CONDUCTORS 600 VOLTS AND BELOW

A. Conform to applicable requirements of NEMA WC 70.

B. Conductor Type:

1. 120-Volt and 277-Volt Lighting, 10 AWG and Smaller: Solid copper.
2. 120-Volt Receptacle Circuits, 10 AWG and Smaller: Solid copper.
3. All Other Circuits: Stranded copper.

C. Insulation: Type THHN/THWN-2, except for sizes No. 6 and larger, with XHHW-2 insulation.

D. Direct Burial and Aerial Conductors and Cables:

1. Type USE/RHH/RHW insulation, UL 854 listed, or Type RHW-2/USE-2.
2. Conform to physical and minimum thickness requirements of NEMA WC 70.

E. Flexible Cords and Cables:

1. Type SOW-A/50 with ethylene propylene rubber insulation in accordance with UL 62.
2. Conform to physical and minimum thickness requirements of NEMA WC 70.

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2.02 600-VOLT RATED CABLE

A. General:

1. Type TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 70,000 Btu per hour, and NFPA 70, Article 340, or UL 13 meeting requirements of NFPA 70, Article 725.
2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
3. Suitable for installation in open air, in cable trays, or conduit.
4. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
5. Overall Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

B. Type 1, Multiconductor Control Cable:

1. Conductors:
 - a. 14 AWG, seven-strand copper.
 - b. Insulation: 15-mil PVC with 4-mil nylon.
 - c. UL 1581 listed as Type THHN/THWN rated VW-1.
 - d. Conductor group bound with spiral wrap of barrier tape.
 - e. Color Code: In accordance with ICEA S-58-679, Method 1, Table 2.
2. Cable: Passes the ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.
3. Cable Sizes:

No. of Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
3	0.41	45
5	0.48	45
7	0.52	45
12	0.72	60
19	0.83	60
25	1.00	60
37	1.15	80

4. Manufacturers:
 - a. Okonite Co.
 - b. Southwire.

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C. Type 2, Multiconductor Power Cable:

1. General:
 - a. Meet or exceed UL 1581 for cable tray use.
 - b. Meet or exceed UL 1277 for direct burial and sunlight-resistance.
 - c. Overall Jacket: PVC.
2. Conductors:
 - a. Class B stranded, coated copper.
 - b. Insulation: Chemically cross-linked ethylene-propylene or cross-linked polyethylene.
 - c. UL rated VW-1 or listed Type XHHW-2.
 - d. Color Code:
 - 1) Conductors, size 8 AWG and smaller, colored conductors, ICEA S-58-679, Method 1, Table 1.
 - 2) Conductors, size 6 AWG and larger, ICEA S-73-532, Method 4.
3. Cable shall pass ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.
4. Cable Sizes:

Conductor Size	Minimum Ground Wire Size	No. of Current Carrying Conductors	Max. Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
12	12	2	0.42	45
		3	0.45	
		4	0.49	
10	10	2	0.54	60
		3	0.58	
		4	0.63	
8	10	3	0.66	60
		4	0.75	
6	8	3	0.74	60
		4	0.88	
4	6	3	0.88	60
		4	1.04	
2	6	3	1.01	80
		4	1.16	
1	6	3	1.10	80
		4	1.25	

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Conductor Size	Minimum Ground Wire Size	No. of Current Carrying Conductors	Max. Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
1/0	6	3	1.22	80
		4	1.35	
2/0	4	3	1.32	80
		4	1.53	
3/0	4	3	1.40	80
		4	1.60	
4/0	4	3	1.56	80
		4	1.78	

5. Manufacturers:
 - a. Okonite Co.
 - b. Southwire.

D. Type 3, 16 AWG, Twisted, Shielded Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57 requirements.

1. Outer Jacket: 45-mil nominal thickness.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
3. Dimension: 0.31-inch nominal OD.
4. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
 - b. 20 AWG, seven-strand tinned copper drain wire.
 - c. Insulation: 15-mil nominal PVC.
 - d. Jacket: 4-mil nominal nylon.
 - e. Color Code: Pair conductors, black and red.
5. Manufacturers:
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Belden.

2.03 SPECIAL CABLES

A. Type 30, Unshielded Twisted Pair (UTP) Telephone and Data Cable, 300V:

1. Category 6 UTP, UL listed, and third party verified to comply with TIA/EIA 568-C Category 6 requirements.

2. Suitable for high speed network applications including gigabit ethernet and video. Cable shall be interoperable with other standards compliant products and shall be backward compatible with Category 5 and Category 5e.
3. Provide four each individually twisted pair, 23 AWG conductors, with FEP insulation and blue PVC jacket.
4. NFPA 70 Plenum (CMP) rated; comply with flammability plenum requirements of NFPA 70 and NFPA 262.
5. Cable shall withstand a bend radius of 1-inch minimum at a temperature of minus 20 degrees C maximum without jacket or insulation cracking.
6. Manufacturer and Product: Belden; 7852A.

2.04 GROUNDING CONDUCTORS

- A. Equipment: Stranded copper with green, Type USE/RHH/RHW-XLPE or THHN/THWN, insulation.
- B. Direct Buried: Bare stranded copper.

2.05 ACCESSORIES FOR CONDUCTORS 600 VOLTS AND BELOW

- A. Tape:
 1. General Purpose, Flame Retardant: 7-mil, vinyl plastic, Scotch Brand 33+, rated for 90 degrees C minimum, meeting requirements of UL 510.
 2. Flame Retardant, Cold and Weather Resistant: 8.5-mil, vinyl plastic, Scotch Brand 88.
 3. Arc and Fireproofing:
 - a. 30-mil, elastomer.
 - b. Manufacturers and Products:
 - 1) 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tapebinder.
 - 2) Plymouth; 53 Plyarc, with 77 Plyglas glass cloth tapebinder.
- B. Identification Devices:
 1. Sleeve:
 - a. Permanent, PVC, yellow or white, with legible machine-printed black markings.
 - b. Manufacturers and Products:
 - 1) Raychem; Type D-SCE or ZH-SCE.
 - 2) Brady, Type 3PS.

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2. Heat Bond Marker:
 - a. Transparent thermoplastic heat bonding film with acrylic pressure sensitive adhesive.
 - b. Self-laminating protective shield over text.
 - c. Machine printed black text.
 - d. Manufacturer and Product: 3M Co.; Type SCS-HB.
3. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
4. Tie-On Cable Marker Tags:
 - a. Chemical-resistant white tag.
 - b. Size: 1/2 inch by 2 inches.
 - c. Manufacturer and Product: Raychem; Type CM-SCE.
5. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.

C. Connectors and Terminations:

1. Nylon, Self-Insulated Crimp Connectors:
 - a. Manufacturers and Products:
 - 1) Thomas & Betts; Sta-Kon.
 - 2) Burndy; Insulug.
 - 3) ILSCO.
2. Nylon, Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator:
 - a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - b. Seamless.
 - c. Manufacturers and Products:
 - 1) Thomas & Betts; Sta-Kon.
 - 2) Burndy; Insulink.
 - 3) ILSCO; ILSCONS.
3. Self-Insulated, Freespring Wire Connector (Wire Nuts):
 - a. UL 486C.
 - b. Plated steel, square wire springs.
 - c. Manufacturers and Products:
 - 1) Thomas & Betts.
 - 2) Ideal; Twister.
4. Self-Insulated, Set Screw Wire Connector:
 - a. Two piece compression type with set screw in brass barrel.
 - b. Insulated by insulator cap screwed over brass barrel.
 - c. Manufacturers:
 - 1) 3M Co.
 - 2) Thomas & Betts.
 - 3) Marrette.

D. Cable Lugs:

1. In accordance with NEMA CC 1.
2. Rated 600 volts of same material as conductor metal.
3. Uninsulated Crimp Connectors and Terminators:
 - a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - b. Manufacturers and Products:
 - 1) Thomas & Betts; Color-Keyed.
 - 2) Burndy; Hydent.
 - 3) ILSCO.
4. Uninsulated, Bolted, Two-Way Connectors and Terminators:
 - a. Manufacturers and Products:
 - 1) Thomas & Betts; Locktite.
 - 2) Burndy; Quiklug.
 - 3) ILSCO.

E. Cable Ties:

1. Nylon, adjustable, self-locking, and reusable.
2. Manufacturer and Product: Thomas & Betts; TY-RAP.

F. Heat Shrinkable Insulation:

1. Thermally stabilized cross-linked polyolefin.
2. Single wall for insulation and strain relief.
3. Dual Wall, adhesive sealant lined, for sealing and corrosion resistance.
4. Manufacturers and Products:
 - a. Thomas & Betts; SHRINK-KON.
 - b. Raychem; RNF-100 and ES-2000.

2.06 PULLING COMPOUND

- A. Nontoxic, noncorrosive, noncombustible, nonflammable, water-based lubricant; UL listed.
- B. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable.
- C. Approved for intended use by cable manufacturer.
- D. Suitable for zinc-coated steel, aluminum, PVC, bituminized fiber, and fiberglass raceways.

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E. Manufacturers:

1. Ideal Co.
2. Polywater, Inc.
3. Cable Grip Co.

2.07 WARNING TAPE

- A. As specified in Section 26 05 33, Raceway and Boxes.

2.08 SOURCE QUALITY CONTROL

- A. Conductors 600 Volts and Below: Test in accordance with UL 44 and UL 854.

PART 3 EXECUTION

3.01 GENERAL

- A. Conductor installation shall be in accordance with manufacturer's recommendations.
- B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.
- C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.
- D. Terminate conductors and cables, unless otherwise indicated.
- E. Tighten screws and terminal bolts in accordance with UL 486A-486B for copper conductors.
- F. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-center spacing as required by equipment terminals.
- G. Bundling: Where single conductors and cables in manholes, handholes, vaults, cable trays, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 12 inches on center.
- H. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.
- I. Concrete-Encased Raceway Installation: Prior to installation of conductors, pull through each raceway a mandrel approximately 1/4 inch smaller than raceway inside diameter.

3.02 POWER CONDUCTOR COLOR CODING

A. Conductors 600 Volts and Below:

1. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering area 1-1/2 inches to 2 inches wide.
2. 8 AWG and Smaller: Provide colored conductors.
3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
240/120 Volts, Single-Phase, Three-Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red
208Y/120 Volts, Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Black Red Blue
240/120 Volts, Three-Phase, Four-Wire, Delta, Center Tap, Ground on Single-Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue
480Y/277 Volts, Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Brown Orange Yellow
Note: Phase A, B, C implies direction of positive phase rotation.		

4. Tracer: Outer covering of white with identifiable colored strip, other than green, in accordance with NFPA 70.

3.03 CIRCUIT IDENTIFICATION

- A. Identify power, instrumentation, and control conductor circuits at each termination, and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.
- B. Circuits Appearing in Circuit Schedules: Identify using circuit schedule designations.

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C. Circuits Not Appearing in Circuit Schedules:

1. Assign circuit name based on device or equipment at load end of circuit.
2. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.

D. Method:

1. Conductors 3 AWG and Smaller: Identify with sleeves or heat bond markers.
2. Cables and Conductors 2 AWG and Larger:
 - a. Identify with marker plates or tie-on cable marker tags.
 - b. Attach with nylon tie cord.
3. Taped-on markers or tags relying on adhesives not permitted.

3.04 CONDUCTORS 600 VOLTS AND BELOW

A. Install 10 AWG or 12 AWG conductors for branch circuit power wiring in lighting and receptacle circuits.

B. Do not splice incoming service conductors and branch power distribution conductors 6 AWG and larger, unless specifically indicated or approved by Engineer.

C. Connections and Terminations:

1. Install wire nuts only on solid conductors. Wire nuts are not allowed on stranded conductors.
2. Install nylon self-insulated crimp connectors and terminators for instrumentation and control, circuit conductors.
3. Install self-insulated, set screw wire connectors for two-way connection of power circuit conductors 12 AWG and smaller.
4. Install uninsulated crimp connectors and terminators for instrumentation, control, and power circuit conductors 4 AWG through 2/0 AWG.
5. Install uninsulated, bolted, two-way connectors and terminators for power circuit conductors 3/0 AWG and larger.
6. Install uninsulated terminators bolted together on motor circuit conductors 10 AWG and larger.
7. Place no more than one conductor in any single-barrel pressure connection.
8. Install crimp connectors with tools approved by connector manufacturer.

9. Install terminals and connectors acceptable for type of material used.
 10. Compression Lugs:
 - a. Attach with a tool specifically designed for purpose. Tool shall provide complete, controlled crimp and shall not release until crimp is complete.
 - b. Do not use plier type crimpers.
- D. Do not use soldered mechanical joints.
- E. Splices and Terminations:
1. Insulate uninsulated connections.
 2. Indoors: Use general purpose, flame retardant tape or single wall heat shrink.
 3. Outdoors, Dry Locations: Use flame retardant, cold- and weather-resistant tape or single wall heat shrink.
 4. Below Grade and Wet or Damp Locations: Use dual wall heat shrink.
- F. Cap spare conductors with UL listed end caps.
- G. Cabinets, and Control Panels:
1. Remove surplus wire, bridle and secure.
 2. Where conductors pass through openings or over edges in sheet metal, remove burrs, chamfer edges, and install bushings and protective strips of insulating material to protect the conductors.
- H. Control and Instrumentation Wiring:
1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-fork compression lugs.
 2. Terminate with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions.
 3. Locate splices in readily accessible cabinets or junction boxes using terminal strips.
 4. Cable Protection:
 - a. Under Infinite Access Floors: May install without bundling.
 - b. All Other Areas: Install individual wires, pairs, or triads in flex conduit under floor or grouped into bundles at least 1/2 inch in diameter.
 - c. Maintain integrity of shielding of instrumentation cables.
 - d. Ensure grounds do not occur because of damage to jacket over shield.

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- I. Extra Conductor Length: For conductors to be connected by others, install minimum 6 feet of extra conductor in freestanding panels and minimum 2 feet in other assemblies.

3.05 UNDERGROUND DIRECT BURIAL CABLE

- A. Install in trench as specified in Section 31 23 23.15, Trench Backfill.
- B. Warning Tape: Install approximately 6 inches above cable, aligned parallel to, and within 12 inches of centerline of the run.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. Institute of Electrical and Electronics Engineers (IEEE): C2, National Electrical Safety Code (NESC).
 2. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC).

1.02 SUBMITTALS

- A. Action Submittals:
1. Shop Drawings:
 - a. Product data for the following:
 - 1) Exothermic weld connectors.
 - 2) Mechanical connectors.
 - 3) Compression connectors.
 - 4) Specialty tools.

1.03 QUALITY ASSURANCE

- A. Authority Having Jurisdiction (AHJ):
1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, provide material and equipment labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ to provide a basis for approval under NEC.
 2. Materials and equipment manufactured within the scope of standards published by UL:
 - a. Confirm conformance with UL standards.
 - b. Supply with an applied UL listing mark.

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PART 2 PRODUCTS

2.01 GROUND ROD

- A. Material: Copper-clad.
- B. Diameter: Minimum 3/4 inch.
- C. Length: 10 feet long and segmented to add additional lengths of ground rod if required.

2.02 GROUND CONDUCTORS

- A. As specified in Section 26 05 05, Conductors.

2.03 CONNECTORS

- A. Exothermic Weld Type:
 - 1. Outdoor Weld: Suitable for exposure to elements or direct burial.
 - 2. Indoor Weld: Use low-smoke, low-emission process.
 - 3. Manufacturers:
 - a. Erico Products, Inc.; Cadweld and Cadweld Exolon.
 - b. Thermoweld.
- B. Compression Type:
 - 1. Compress-deforming type; wrought copper extrusion material.
 - 2. Single indentation for conductors 6 AWG and smaller.
 - 3. Double indentation with extended barrel for conductors 4 AWG and larger.
 - 4. Barrels prefilled with oxide-inhibiting and antiseizing compound and sealed.
 - 5. Manufacturers:
 - a. Burndy Corp.; Hyground Irreversible Compression.
 - b. Thomas and Betts Co.
 - c. ILSCO.
- C. Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.
 - 1. Manufacturers:
 - a. Burndy Corp.
 - b. Thomas and Betts Co.

2.04 GROUNDING WELLS

- A. Ground rod box complete with cast-iron riser ring and traffic cover marked "GROUND ROD".
- B. Manufacturers and Products:
 - 1. Christy Co.; No. G5.
 - 2. Lightning and Grounding Systems, Inc.; I-R Series.

PART 3 EXECUTION

3.01 GENERAL

- A. Grounding: In compliance with NFPA 70 and IEEE C2.
- B. Ground electrical service neutral at service entrance equipment with grounding electrode conductor to grounding electrode system.
- C. Ground each separately derived system neutral with common grounding electrode conductor to grounding electrode system.
- D. Bond together all grounding electrodes that are present at each building or structure served to form one common grounding electrode system.
- E. Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.
- F. Shielded Power Cables: Ground shields at each splice or termination in accordance with recommendations of splice or termination manufacturer.
- G. Shielded Instrumentation Cables:
 - 1. Ground shield to ground bus at power supply for analog signal.
 - 2. Expose shield minimum 1 inch at termination to field instrument and apply heat shrink tube.
 - 3. Do not ground instrumentation cable shield at more than one point.

3.02 WIRE CONNECTIONS

- A. Ground Conductors: Install in conduit containing power conductors and control circuits above 50 volts.
- B. Nonmetallic Raceways and Flexible Tubing: Install equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.

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- C. Connect ground conductors to raceway grounding bushings.
- D. Extend and connect ground conductors to ground bus in all equipment containing a ground bus.
- E. Connect enclosure of equipment containing ground bus to that bus.
- F. Bolt connections to equipment ground bus.
- G. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.
- H. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.
- I. Metallic Equipment Enclosures: Use furnished ground lug; if none furnished, tap equipment housing and install solderless terminal connected to box with machine screw. For circuits greater than 20 amps use minimum 5/16-inch diameter bolt.

3.03 MOTOR GROUNDING

- A. Extend equipment ground bus via grounding conductor installed in motor feeder raceway; connect to motor frame.
- B. Nonmetallic Raceways and Flexible Tubing: Install an equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.
- C. Motors Less Than 10 hp: Use furnished ground lug in motor connection box. If none furnished, provide compression, spade-type terminal connected to conduit box mounting screw.
- D. Motors 10 hp and Above: Use furnished ground lug in motor connection box. If none furnished, tap motor frame or equipment housing; furnish compression, one-hole, lug type terminal connected with minimum 5/16-inch brass threaded stud with bolt and washer.
- E. Circuits 20 Amps or Above: Tap motor frame or equipment housing. Install solderless terminal with minimum 5/16-inch diameter bolt.

3.04 GROUND RODS

- A. Install full length with conductor connection at upper end.
- B. Install with connection point below finished grade, unless otherwise shown.

- C. Space multiple ground rods by one rod length.
- D. Install to 8 feet below local frost depth.

3.05 GROUNDING WELLS

- A. Install for ground rods located inside buildings, asphalt and paved areas, and where shown on Drawings.
- B. Install riser ring and cover flush with surface.
- C. Place 6 inches of crushed rock in bottom of each well.

3.06 CONNECTIONS

- A. General:
 - 1. Abovegrade Connections: Install exothermic weld, mechanical, or compression-type connectors; or brazing.
 - 2. Belowgrade Connections: Install exothermic weld or compression type connectors.
 - 3. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.
 - 4. Notify Engineer and Owner prior to backfilling ground connections.
- B. Exothermic Weld Type:
 - 1. Wire brush or file contact point to bare metal surface.
 - 2. Use welding cartridges and molds in accordance with manufacturer's recommendations.
 - 3. Avoid using badly worn molds.
 - 4. Mold to be completely filled with metal when making welds.
 - 5. After completed welds have cooled, brush slag from weld area and thoroughly clean joint.
- C. Compression Type:
 - 1. Install in accordance with connector manufacturer's recommendations.
 - 2. Install connectors of proper size for grounding conductors and ground rods specified.
 - 3. Install using connector manufacturer's compression tool having proper sized dies and operate per manufacturer's instructions.

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D. Mechanical Type:

1. Apply homogeneous blend of colloidal copper and rust and corrosion inhibitor before making connection.
2. Install in accordance with connector manufacturer's recommendations.
3. Do not conceal mechanical connections.

3.07 METAL STRUCTURE GROUNDING

- A. Bond metal sheathing and exposed metal vertical structural elements to grounding system.
- B. Bond electrical equipment supported by metal platforms to the platforms.
- C. Provide electrical contact between metal frames and railings supporting pushbutton stations, receptacles, and instrument cabinets, and raceways carrying circuits to these devices.

3.08 LIGHTNING PROTECTION SYSTEMS

- A. Bond lightning protection system ground terminals to building or structure grounding electrode system.

3.09 SURGE PROTECTION EQUIPMENT GROUNDING

- A. Connect surge arrestor ground terminals to equipment ground bus.

END OF SECTION

**SECTION 26 05 33
RACEWAY AND BOXES**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Association of State Highway and Transportation Officials (AASHTO): HB, Standard Specifications for Highway Bridges.
 2. ASTM International (ASTM):
 - a. A123/123M, Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
 - b. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - c. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - d. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
 - e. D149, Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
 3. Telecommunications Industry Association (TIA): 569B, Commercial Building Standard for Telecommunications Pathways and Spaces.
 4. National Electrical Contractor's Association, Inc. (NECA): Installation standards.
 5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. C80.1, Electrical Rigid Steel Conduit (ERSC).
 - c. C80.3, Steel Electrical Metallic Tubing (EMT).
 - d. C80.5, Electrical Rigid Aluminum Conduit (ERAC).
 - e. C80.6, Electrical Intermediate Metal Conduit (EIMC).
 - f. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - g. TC 2, Electrical Polyvinyl Chloride (PVC) Conduit.
 - h. TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
 - i. TC 6, Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation.

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- j. TC 14, Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
- k. VE 1, Metallic Cable Tray Systems.
- 6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
- 7. Underwriters Laboratories Inc. (UL):
 - a. 1, Standard for Safety for Flexible Metal Conduit.
 - b. 5, Standard for Safety for Surface Metal Raceways and Fittings.
 - c. 6, Standard for Safety for Electrical Rigid Metal Conduit – Steel.
 - d. 6A, Standard for Safety for Electrical Rigid Metal Conduit – Aluminum, Red Brass and Stainless.
 - e. 360, Standard for Safety for Liquid-Tight Flexible Steel Conduit.
 - f. 514B, Standard for Safety for Conduit, Tubing, and Cable Fittings.
 - g. 651, Standard for Safety for Schedule 40 and 80 Rigid PVC Conduit and Fittings.
 - h. 651A, Standard for Safety for Type EB and A Rigid PVC Conduit and HDPE Conduit.
 - i. 797, Standard for Safety for Electrical Metallic Tubing – Steel.
 - j. 870, Standard for Safety for Wireways, Auxiliary Gutters, and Associated Fittings.
 - k. 1242, Standard for Safety for Electrical Intermediate Metal Conduit – Steel.
 - l. 1660, Standard for Safety for Liquid-Tight Flexible Nonmetallic Conduit.
 - m. 1684, Standard for Safety for Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
 - n. 2024, Standard for Safety for Optical Fiber and Communication Cable Raceway.

1.02 SUBMITTALS

A. Action Submittals:

- 1. Manufacturer's Literature:
 - a. Rigid galvanized steel conduit.
 - b. PVC Schedule 40 conduit.
 - c. PVC-coated rigid galvanized steel conduit.
 - d. Flexible metal, liquid-tight conduit.
 - e. Flexible, nonmetallic, liquid-tight conduit.
 - f. Flexible metal, nonliquid-tight conduit.
 - g. Conduit fittings.
 - h. Junction and pull boxes used at or below grade.

2. Equipment and machinery proposed for bending metal conduit.
3. Method for bending PVC conduit less than 30 degrees.
4. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.
5. Conduit Layout:
 - a. Provide drawings for under ground and concealed conduits including, but not limited to ductbanks, under floor slabs, concealed in floor slabs, and concealed in walls.
 - b. Provide plan and section showing arrangement and location of conduit and duct bank required for:
 - 1) Low voltage feeder and branch circuits.
 - 2) Instrumentation and control systems.
 - 3) Communications systems.
 - 4) Empty conduit for future use.
 - c. Electronic CAD; scale not greater than 1 inch equals 20 feet.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer's certification of training for PVC-coated rigid galvanized steel conduit installer.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

B. PVC-Coated, Rigid Galvanized Steel Conduit Installer: Certified by conduit manufacturer as having received minimum 2 hours of training on installation procedures.

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PART 2 PRODUCTS

2.01 CONDUIT AND TUBING

- A. Rigid Galvanized Steel Conduit (RGS):
 - 1. Meet requirements of NEMA C80.1 and UL 6.
 - 2. Material: Hot-dip galvanized with chromated protective layer.
- B. Electric Metallic Tubing (EMT):
 - 1. Meet requirements of NEMA C80.3 and UL 797.
 - 2. Material: Hot-dip galvanized with chromated and lacquered protective layer.
- C. PVC Schedule 40 Conduit:
 - 1. Meet requirements of NEMA TC 2 and UL 651.
 - 2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.
- D. PVC-Coated Rigid Galvanized Steel Conduit:
 - 1. Meet requirements of NEMA RN 1.
 - 2. Material:
 - a. Meet requirements of NEMA C80.1 and UL 6.
 - b. Exterior Finish: PVC coating, 40-mil nominal thickness; bond to metal shall have tensile strength greater than PVC.
 - c. Interior finish: Urethane coating, 2-mil nominal thickness.
 - 3. Threads: Hot-dipped galvanized and factory coated with urethane.
 - 4. Bendable without damage to interior or exterior coating.
- E. Flexible Metal, Liquid-Tight Conduit:
 - 1. UL 360 listed for 105 degrees C insulated conductors.
 - 2. Material: Galvanized steel with extruded PVC jacket.
- F. Flexible Metal, Nonliquid-Tight Conduit:
 - 1. Meet requirements of UL 1.
 - 2. Material: Galvanized steel.

G. Flexible, Nonmetallic, Liquid-Tight Conduit:

1. Material: PVC core with fused flexible PVC jacket.
2. UL 1660 listed for:
 - a. Dry Conditions: 80 degrees C insulated conductors.
 - b. Wet Conditions: 60 degrees C insulated conductors.
3. Manufacturers and Products:
 - a. Carlon; Carflex or X-Flex.
 - b. T & B; Xtraflex LTC or EFC.

2.02 FITTINGS

A. Rigid Galvanized Steel Conduit:

1. General:
 - a. Meet requirements of UL 514B.
 - b. Type: Threaded, galvanized. Set screw and threadless compression fittings not permitted.
2. Bushing:
 - a. Material: Malleable iron with integral insulated throat, rated for 150 degrees C.
 - b. Manufacturers and Products:
 - 1) Appleton; Series BU-I.
 - 2) O-Z/Gedney; Type HB.
3. Grounding Bushing:
 - a. Material: Malleable iron with integral insulated throat rated for 150 degrees C, with solderless lugs.
 - b. Manufacturers and Products:
 - 1) Appleton; Series GIB.
 - 2) O-Z/Gedney; Type HBLG.
4. Conduit Hub:
 - a. Material: Malleable iron with insulated throat with bonding screw.
 - b. UL listed for use in wet locations.
 - c. Manufacturers and Products:
 - 1) Appleton, Series HUB-B.
 - 2) O-Z/Gedney; Series CH.
 - 3) Meyers; ST Series.
5. Conduit Bodies:
 - a. Sized as required by NFPA 70.
 - b. Manufacturers and Products (For Normal Conditions):
 - 1) Appleton; Form 35 threaded unilets.
 - 2) Crouse-Hinds; Form 7 or Form 8 threaded condulets.
 - 3) Killark; Series O electrolets.
 - 4) Thomas & Betts; Form 7 or Form 8.

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- c. Manufacturers (For Hazardous Locations):
 - 1) Appleton.
 - 2) Crouse-Hinds.
 - 3) Killark.
- 6. Couplings: As supplied by conduit manufacturer.
- 7. Unions:
 - a. Concrete tight, hot-dip galvanized malleable iron.
 - b. Manufacturers and Products:
 - 1) Appleton; Series SCC bolt-on coupling or Series EC three-piece union.
 - 2) O-Z/Gedney; Type SSP split coupling or Type 4 Series, three-piece coupling.
- 8. Conduit Sealing Fitting:
 - a. Manufacturers and Products:
 - 1) Appleton; Type EYF, EYM, or ESU.
 - 2) Crouse-Hinds; Type EYS or EZS.
 - 3) Killark; Type EY or Type EYS.
- 9. Drain Seal:
 - a. Manufacturers and Products:
 - 1) Appleton; Type EYD.
 - 2) Crouse-Hinds; Type EYD or Type EZD.
- 10. Drain/Breather Fitting:
 - a. Manufacturers and Products:
 - 1) Appleton; Type ECDB.
 - 2) Crouse-Hinds; ECD.
- 11. Expansion Fitting:
 - a. Manufacturers and Products:
 - 1) Deflection/Expansion Movement:
 - a) Appleton; Type DF.
 - b) Crouse-Hinds; Type XD.
 - 2) Expansion Movement Only:
 - a) Appleton; Type XJ.
 - b) Crouse-Hinds; Type XJ.
 - c) Thomas & Betts; XJG-TP.
- 12. Cable Sealing Fitting:
 - a. To form watertight nonslip cord or cable connection to conduit.
 - b. For Conductors with OD of 1/2 inch or Less: Neoprene bushing at connector entry.
 - c. Manufacturers and Products:
 - 1) Appleton; CG-S.
 - 2) Crouse-Hinds; CGBS.

B. Electric Metallic Tubing:

1. Meet requirements of UL 514B.
2. Type: Steel body and locknuts with steel or malleable iron compression nuts. Set screw and drive-on fittings not permitted.
3. Electro zinc-plated inside and out.
4. Raintight.
5. Coupling Manufacturers and Products:
 - a. Appleton; Type 95T.
 - b. Crouse-Hinds.
 - c. Thomas & Betts.
6. Connector Manufacturers and Products:
 - a. Appleton; Type ETP.
 - b. Crouse-Hinds.
 - c. Thomas & Betts.

C. PVC Conduit and Tubing:

1. Meet requirements of NEMA TC 3.
2. Type: PVC, slip-on.

D. PVC-Coated Rigid Galvanized Steel Conduit:

1. Meet requirements of UL 514B.
2. Fittings: Rigid galvanized steel type, PVC coated by conduit manufacturer.
3. Conduit Bodies: Cast metal hot-dipped galvanized or urethane finish. Cover shall be of same material as conduit body. PVC coated by conduit manufacturer.
4. Finish: 40-mil PVC exterior, 2-mil urethane interior.
5. Overlapping pressure-sealing sleeves.
6. Conduit Hangers, Attachments, and Accessories: PVC-coated.
7. Manufacturers:
 - a. Robroy Industries.
 - b. Ocal.
8. Expansion Fitting:
 - a. Manufacturer and Product: Ocal; OCAL-BLUE XJG.

E. Flexible Metal, Liquid-Tight Conduit:

1. Metal insulated throat connectors with integral nylon or plastic bushing rated for 105 degrees C.
2. Insulated throat and sealing O-rings.
3. Manufacturers and Products:
 - a. Thomas & Betts; Series 5331.
 - b. O-Z/Gedney; Series 4Q.

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- F. Flexible Metal, Nonliquid-Tight Conduit:
 - 1. Meet requirements of UL 514B.
 - 2. Body: Galvanized steel.
 - 3. Throat: Nylon insulated.
 - 4. 1-1/4-Inch Conduit and Smaller: One screw body.
 - 5. 1-1/2-Inch Conduit and Larger: Two screw body.
 - 6. Manufacturer and Product: Appleton; Series 7400.

- G. Flexible, Nonmetallic, Liquid-Tight Conduit:
 - 1. Meet requirements of UL 514B.
 - 2. Type: High strength plastic body, complete with lock nut, O-ring, threaded ferrule, sealing ring, and compression nut.
 - 3. Body/compression nut (gland) design to ensure high mechanical pullout strength and watertight seal.
 - 4. Manufacturers and Products:
 - a. Carlon; Type LT.
 - b. O-Z/Gedney; Type 4Q-P.
 - c. Thomas & Betts; Series 6300.

- H. Watertight Entrance Seal Device:
 - 1. New Construction:
 - a. Material: Oversized sleeve, malleable iron body with sealing ring, pressure ring, grommet seal, and pressure clamp.
 - b. Manufacturer and Product: O-Z/Gedney; Type FSK or Type WSK, as required.
 - 2. Cored-Hole Application:
 - a. Material: Assembled dual pressure disks, neoprene sealing ring, and membrane clamp.
 - b. Manufacturer and Product: O-Z/Gedney; Series CSM.

2.03 OUTLET AND DEVICE BOXES

- A. Sheet Steel: One-piece drawn type, zinc-plated or cadmium-plated.

- B. Cast Metal:
 - 1. Box: Malleable iron or cast ferrous metal.
 - 2. Cover: Gasketed, weatherproof, malleable iron, or cast ferrous metal, with stainless steel screws.
 - 3. Hubs: Threaded.
 - 4. Lugs: Cast Mounting.

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5. Manufacturers and Products, Nonhazardous Locations:
 - a. Crouse-Hinds; Type FS or Type FD.
 - b. Appleton; Type FS or Type FD.
 - c. Killark.
 6. Manufacturers and Products, Hazardous Locations:
 - a. Crouse-Hinds; Type GUA or Type EAJ.
 - b. Appleton; Type GR.
- C. Cast Aluminum:
1. Material:
 - a. Box: Cast, copper-free aluminum.
 - b. Cover: Gasketed, weatherproof, cast copper-free aluminum with stainless steel screws.
 2. Hubs: Threaded.
 3. Lugs: Cast mounting.
 4. Manufacturers and Products, Nonhazardous Locations:
 - a. Crouse-Hinds; Type FS-SA or Type FD-SA.
 - b. Appleton; Type FS or Type FD.
 - c. Killark.
 5. Manufacturers and Products, Hazardous Locations:
 - a. Crouse-Hinds; Type GUA-SA.
 - b. Appleton; Type GR.
- D. PVC-Coated Cast Metal:
1. Type: One-piece.
 2. Material: Malleable iron, cast ferrous metal, or cast aluminum.
 3. Coating:
 - a. Exterior Surfaces: 40-mil PVC.
 - b. Interior Surfaces: 2-mil urethane.
 4. Manufacturers:
 - a. Robroy Industries.
 - b. Ocal.
- E. Nonmetallic:
1. Box: PVC.
 2. Cover: PVC, weatherproof, with stainless steel screws.
 3. Manufacturer and Product: Carlon; Type FS or Type FD, with Type E98 or Type E96 covers.

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2.04 JUNCTION AND PULL BOXES

- A. Outlet Box Used as Junction or Pull Box: As specified under Article Outlet and Device Boxes.
- B. Conduit Bodies Used as Junction Boxes: As specified under Article Fittings.

2.05 ACCESSORIES

- A. Duct Bank Spacers:
 - 1. Modular Type:
 - a. Nonmetallic, interlocking, for multiple conduit sizes.
 - b. Suitable for all types of conduit.
 - c. Manufacturers:
 - 1) Underground Device, Inc.
 - 2) Carlon.
 - 2. Template Type:
 - a. Nonmetallic, custom made one-piece spacers.
 - b. Suitable for all types of conduit.
 - c. Material: HDPE or polypropylene, 1/2-inch minimum thickness.
 - d. Conduit openings cut 1 inch larger than conduit outside diameter.
 - e. Additional openings for stake-down, rebar, and concrete flow through as required.
 - f. Manufacturer and Product: SP Products; Quik Duct.
- B. Identification Devices:
 - 1. Raceway Tags:
 - a. Material: Permanent, nonferrous metal.
 - b. Shape: Round.
 - c. Raceway Designation: Pressure stamped, embossed, or engraved.
 - d. Tags relying on adhesives or taped-on markers not permitted.
 - 2. Warning Tape:
 - a. Material: Polyethylene, 4-mil gauge with detectable strip.
 - b. Color: Red.
 - c. Width: Minimum 3 inches.
 - d. Designation: Warning on tape that electric circuit is located below tape.
 - e. Identifying Letters: Minimum 1-inch-high permanent black lettering imprinted continuously over entire length.
 - f. Manufacturers and Products:
 - 1) Panduit; Type HTDU.
 - 2) Reef Industries; Terra Tape.

3. Buried Raceway Marker:
 - a. Material: Sheet bronze, consisting of double-ended arrows, straight for straight runs and bent at locations where runs change direction.
 - b. Designation: Engrave to depth of 3/32 inch; ELECTRIC CABLES, in letters 1/4-inch high.
 - c. Minimum Dimension: 1/4 inch thick, 10 inches long, and 3/4 inch wide.
- C. Heat Shrinkable Tubing:
 1. Material: Heat-shrinkable, cross-linked polyolefin.
 2. Semi-flexible with meltable adhesive inner liner.
 3. Color: Black.
 4. Manufacturers:
 - a. Raychem.
 - b. 3M.
- D. Wraparound Duct Band:
 1. Material: Heat-shrinkable, cross-linked polyolefin, precoated with hot-melt adhesive.
 2. Width: 50 mm minimum.
 3. Manufacturer and Product: Raychem; Type TWDB.

PART 3 EXECUTION

3.01 GENERAL

- A. Conduit and tubing sizes shown are based on use of copper conductors.
- B. Comply with NECA Installation Standards.
- C. Crushed or deformed raceways not permitted.
- D. Maintain raceway entirely free of obstructions and moisture.
- E. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.
- F. Sealing Fittings: Provide drain seal in vertical raceways where condensate may collect above sealing fitting.
- G. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.

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- H. Group raceways installed in same area.
- I. Proximity to Heated Piping: Install raceways minimum 12 inches from parallel runs.
- J. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.
- K. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.
- L. Block Walls: Do not install raceways in same horizontal course or vertical cell with reinforcing steel.
- M. Install watertight fittings in outdoor, underground, or wet locations.
- N. Paint threads and cut ends, before assembly of fittings, galvanized conduit, PVC-coated galvanized conduit, or IMC installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound.
- O. Metal conduit shall be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.
- P. Do not install raceways in concrete equipment pads, foundations, or beams without Engineer approval.
- Q. Horizontal raceways installed under floor slabs shall lie completely under slab, with no part embedded within slab.
- R. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.
- S. Install conduits for fiber optic cables, telephone cables, and Category 6 data cables in strict conformance with the requirements of TIA 569B.

3.02 INSTALLATION IN CAST-IN-PLACE STRUCTURAL CONCRETE

- A. Minimum Cover: 2 inches, including fittings.
- B. Conduit placement shall not require changes in reinforcing steel location or configuration.
- C. Provide nonmetallic support during placement of concrete to ensure raceways remain in position.
- D. Conduit larger than 1 inch shall not be embedded in concrete slabs, walls, foundations, columns, or beams unless approved by Engineer.

E. Slabs and Walls (Requires Engineer Approval):

1. Trade size of conduit not to exceed one-fourth of slab or wall thickness.
2. Install within middle two-fourths of slab or wall.
3. Separate conduit less than 2-inch trade size by a minimum ten times conduit trade size, center-to-center, unless otherwise shown.
4. Separate conduit 2-inch and greater trade size by a minimum eight times conduit trade size, center-to-center, unless otherwise shown.
5. Cross conduit at an angle greater than 45 degrees, with minimum separation of 1 inch.
6. Separate conduit by a minimum six times the outside dimension of expansion/deflection fittings at expansion joints.
7. Conduit shall not be installed below the maximum water surface elevation in walls of water holding structures.

F. Columns and Beams (Requires Engineer Approval):

1. Trade size of conduit not to exceed one-fourth of beam thickness.
2. Conduit cross-sectional area not to exceed 4 percent of beam or column cross section.

3.03 CONDUIT APPLICATION

A. Diameter: Minimum 3/4 inch.

B. Exterior, Exposed: PVC-coated rigid galvanized steel.

C. Interior, Exposed:

1. Rigid galvanized steel.
2. Electric metallic tubing for ceiling portion of lighting circuits.

D. Interior, Concealed (Not Embedded in Concrete): Rigid galvanized steel.

E. Aboveground, Embedded in Concrete Walls, Ceilings, or Floors:

1. PVC Schedule 40.
2. Electric metallic tubing, for lighting and receptacle circuits only.

F. Direct Earth Burial: PVC-coated rigid galvanized steel.

G. Concrete-Encased Ductbank:

1. PVC Schedule 40 for ac circuits, PVC-Coated Rigid Galvanized Steel for dc circuits.

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- H. Under Slabs-On-Grade: PVC Schedule 40 for ac circuits, PVC-Coated Rigid Galvanized Steel for dc circuits.
- I. Transition from Underground or Concrete Embedded to Exposed: PVC-coated rigid steel conduit.
- J. Under Equipment Mounting Pads: PVC-coated rigid steel conduit.
- K. Exterior Light Pole Foundations: PVC-coated rigid steel conduit.

3.04 FLEXIBLE CONNECTIONS

- A. For motors, wall or ceiling mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other locations approved by Engineer where flexible connection is required to minimize vibration:
 - 1. Conduit Size 4 Inches or Less: Flexible, liquid-tight conduit.
 - 2. Conduit Size Over 4 Inches: Nonflexible.
 - 3. Wet or Corrosive Areas: Flexible, nonmetallic or flexible metal liquid tight.
 - 4. Dry Areas: Flexible, metallic liquid-tight.
 - 5. Hazardous Areas: Flexible coupling suitable for Class I, Division 1 and 2 areas.
- B. Suspended Lighting Fixtures in Dry Areas: Flexible steel, nonliquid-tight conduit.
- C. Outdoor Areas, Process Areas Exposed to Moisture, and Areas Required to be Oiltight and Dust-Tight: Flexible metal, liquid-tight conduit.
- D. Flexible Conduit Length: 18 inches minimum, 60 inches maximum; sufficient to allow movement or adjustment of equipment.

3.05 PENETRATIONS

- A. Make at right angles, unless otherwise shown.
- B. Notching or penetration of structural members, including footings and beams, not permitted.
- C. Fire-Rated Walls, Floors, or Ceilings: Firestop openings around penetrations to maintain fire-resistance rating.
- D. Apply heat shrinkable tubing or single layer of wraparound duct band to metallic conduit protruding through concrete floor slabs to a point 2 inches above and 2 inches below concrete surface.

- E. Concrete Walls, Floors, or Ceilings (Aboveground): Provide nonshrink grout dry-pack, or use watertight seal device.
- F. Entering Structures:
 - 1. General: Seal raceway at first box or outlet with oakum or expandable plastic compound to prevent entrance of gases or liquids from one area to another.
 - 2. Concrete Roof or Membrane Waterproofed Wall or Floor:
 - a. Provide a watertight seal.
 - b. Without Concrete Encasement: Install watertight entrance seal device on each side.
 - c. With Concrete Encasement: Install watertight entrance seal device on accessible side.
 - d. Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.
 - e. Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.
 - 3. Existing or Precast Wall (Underground): Core drill wall and install watertight entrance seal device.
 - 4. Nonwaterproofed Wall or Floor (Underground, without Concrete Encasement):
 - a. Provide Schedule 40 galvanized pipe sleeve, or watertight entrance seal device.
 - b. Fill space between raceway and sleeve with expandable plastic compound or oakum and lead joint, on each side.

3.06 SUPPORT

- A. Support from structural members only, at intervals not exceeding NFPA 70 requirements. Do not exceed 8 feet in any application. Do not support from piping, pipe supports, or other raceways.
- B. Multiple Adjacent Raceways: Provide ceiling trapeze. Application/Type of Conduit Strap:
 - 1. Rigid Steel or EMT Conduit: Zinc coated steel, pregalvanized steel or malleable iron.
 - 2. PVC-Coated Rigid Steel Conduit: PVC-coated metal.
 - 3. Nonmetallic Conduit: Nonmetallic or PVC-coated metal.
- C. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:
 - 1. Wood: Wood screws.
 - 2. Hollow Masonry Units: Toggle bolts.

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3. Concrete or Brick: Expansion shields, or threaded studs driven in by powder charge, with lock washers and nuts.
 4. Steelwork: Machine screws.
 5. Location/Type of Hardware:
 - a. Dry, Noncorrosive Areas: Galvanized.
 - b. Wet, Noncorrosive Areas: Stainless steel.
 - c. Corrosive Areas: Stainless steel.
- D. Nails or wooden plugs inserted in concrete or masonry for attaching raceway not permitted. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.

3.07 BENDS

- A. Install concealed raceways with a minimum of bends in the shortest practical distance.
- B. Make bends and offsets of longest practical radius. Bends in conduits and ducts being installed for fiber optic cables shall be not less than 20 times cable diameter, 15 inches minimum.
- C. Install with symmetrical bends or cast metal fittings.
- D. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.
- E. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.
- F. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run, and raceways are same size.
- G. PVC Conduit:
 1. Bends 30 Degrees and Larger: Provide factory-made elbows.
 2. 90-Degree Bends: Provide rigid steel elbows, PVC-coated where direct buried.
 3. Use manufacturer's recommended method for forming smaller bends.
- H. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

3.08 PVC CONDUIT

- A. Solvent Welding:
 - 1. Apply manufacturer recommended solvent to joints.
 - 2. Install in order that joint is watertight.
- B. Adapters:
 - 1. PVC to Metallic Fittings: PVC terminal type.
 - 2. PVC to Rigid Metal Conduit or IMC: PVC female adapter.
- C. Belled-End Conduit: Bevel unbelled end of joint prior to joining.

3.09 PVC-COATED RIGID STEEL CONDUIT

- A. Install in accordance with manufacturer's instructions.
- B. Tools and equipment used in cutting, bending, threading and installation of PVC-coated rigid conduit shall be designed to limit damage to PVC coating.
- C. Provide PVC boot to cover exposed threading.

3.10 TERMINATION AT ENCLOSURES

- A. Cast Metal Enclosure: Install manufacturer's premolded insulating sleeve inside metallic conduit terminating in threaded hubs.
- B. Nonmetallic, Cabinets, and Enclosures:
 - 1. Terminate conduit in threaded conduit hubs, maintaining enclosure integrity.
 - 2. Metallic Conduit: Provide ground terminal for connection to maintain continuity of ground system.
- C. Sheet Metal Boxes, Cabinets, and Enclosures:
 - 1. General:
 - a. Install insulated bushing on ends of conduit where grounding is not required.
 - b. Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.
 - c. Utilize sealing locknuts or threaded hubs on sides and bottom of NEMA 3R and NEMA 12 enclosures.

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- d. Terminate conduits at threaded hubs at the tops of NEMA 3R and NEMA 12 boxes and enclosures.
 - e. Terminate conduits at threaded conduit hubs at NEMA 4 and NEMA 4X boxes and enclosures.
2. Rigid Galvanized Conduit:
 - a. Provide one lock nut each on inside and outside of enclosure.
 - b. Install grounding bushing at source enclosure.
 - c. Provide bonding jumper from grounding bushing to equipment ground bus or ground pad.
 3. Electric Metallic Tubing: Provide gland compression, insulated connectors.
 4. Flexible Metal Conduit: Provide two screw type, insulated, malleable iron connectors.
 5. Flexible, Nonmetallic Conduit: Provide nonmetallic, liquid-tight strain relief connectors.
 6. PVC-Coated Rigid Galvanized Steel Conduit: Provide PVC-coated, liquid-tight, metallic connector.
 7. PVC Schedule 40 Conduit: Provide PVC terminal adapter with lock nut, except where threaded hubs required above.
- D. Free-Standing Enclosures:
1. Terminate metal conduit entering bottom with grounding bushing; provide grounding jumper extending to equipment ground bus or grounding pad.
 2. Terminate PVC conduit entering bottom with bell end fittings.

3.11 UNDERGROUND RACEWAYS

- A. Grade: Maintain minimum grade of 4 inches in 100 feet, either from one manhole, handhole, or pull box to the next, or from a high point between them, depending on surface contour.
- B. Cover: Maintain minimum 2-foot cover above conduit and concrete encasement, unless otherwise shown.
- C. Make routing changes as necessary to avoid obstructions or conflicts.
- D. Couplings: In multiple conduit runs, stagger so couplings in adjacent runs are not in same transverse line.
- E. Union type fittings not permitted.

- F. Spacers:
 - 1. Provide preformed, nonmetallic spacers designed for such purpose, to secure and separate parallel conduit runs in a trench or concrete encasement.
 - 2. Install at intervals not greater than that specified in NFPA 70 for support of the type conduit used, but in no case greater than 10 feet.
- G. Support conduit so as to prevent bending or displacement during backfilling or concrete placement.
- H. Transition from Underground to Exposed: PVC-coated rigid steel conduit.
- I. Installation with Other Piping Systems:
 - 1. Crossings: Maintain minimum 12-inch vertical separation.
 - 2. Parallel Runs: Maintain minimum 12-inch separation.
 - 3. Installation over valves or couplings not permitted.
- J. Metallic Raceway Coating: At couplings and joints, apply wraparound duct band with one-half tape width overlap to obtain two complete layers.
- K. Concrete Encasement:
 - 1. As specified in Section 03 30 00, Cast-in-Place Concrete.
 - 2. Concrete Color: Red.
- L. Backfill:
 - 1. As specified in Section 31 23 23.15, Trench Backfill.
 - 2. Do not backfill until inspected by Engineer.

3.12 UNDER SLAB RACEWAYS

- A. Make routing changes as necessary to avoid obstructions or conflicts.
- B. Support raceways so as to prevent bending or displacement during backfilling or concrete placement.
- C. Install raceways with no part embedded within slab and with no interference with slab on grade construction.
- D. Raceway spacing, in a single layer or multiple layers:
 - 1. 3 inches clear between adjacent 2-inch or larger raceway.
 - 2. 2 inches clear between adjacent 1-1/2-inch or smaller raceway.

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- E. Multiple Layers of Raceways: Install under slab on grade in trench below backfill zone, as specified in Section 31 23 23.15, Trench Backfill.
- F. Individual Raceways and Single Layer Multiple Raceways: Install at lowest elevation of backfill zone with spacing as specified herein. Where conduits cross at perpendicular orientation, installation of conduits shall not interfere with placement of under slab fill that meets compaction and void limitations of earthwork specifications.
- G. Under slab raceways that emerge from below slab to top of slab as exposed, shall be located to avoid conflicts with structural slab rebar. Coordinate raceway stub ups with location of structural rebar.
- H. Fittings:
 - 1. Union type fittings are not permitted.
 - 2. Provide expansion/deflection fittings in raceway runs that exit building or structure below slab. Locate fittings 18 inches, maximum, beyond exterior wall. Raceway type between building exterior wall to fitting shall be PVC-coated rigid steel.
 - 3. Couplings: In multiple raceway runs, stagger so couplings in adjacent runs are not in same traverse line.

3.13 OUTLET AND DEVICE BOXES

- A. General:
 - 1. Install plumb and level.
 - 2. Install suitable for conditions encountered at each outlet or device in wiring or raceway system, sized to meet NFPA 70 requirements.
 - 3. Open no more knockouts in sheet steel device boxes than are required; seal unused openings.
 - 4. Install galvanized mounting hardware in industrial areas.
- B. Size:
 - 1. Depth: Minimum 2 inches, unless otherwise required by structural conditions. Box extensions not permitted.
 - a. Hollow Masonry Construction: Install with sufficient depth such that conduit knockouts or hubs are in masonry void space.
 - 2. Ceiling Outlet: Minimum 4-inch octagonal device box, unless otherwise required for installed fixture.
 - 3. Switch and Receptacle: Minimum 2-inch by 4-inch device box.

C. Locations:

1. Drawing locations are approximate.
2. To avoid interference with mechanical equipment or structural features, relocate outlets as directed by Engineer.
3. Light Fixture: Install in symmetrical pattern according to room layout, unless otherwise shown.

D. Mounting Height:

1. General:
 - a. Dimensions given to centerline of box.
 - b. Where specified heights do not suit building construction or finish, adjust up or down to avoid interference.
 - c. Do not straddle CMU block or other construction joints.
2. Light Switch:
 - a. 48 inches above floor.
 - b. When located next to door, install on lock side of door.
3. Convenience Receptacle:
 - a. General Interior Areas: 15 inches above floor.
 - b. General Interior Areas (Counter Tops): Install device plate bottom or side flush with top of backsplash, or 6 inches above counter tops without backsplash.
 - c. Industrial Areas, Workshops: 48 inches above floor.
 - d. Outdoor Areas: 24 inches above finished grade.

E. Flush Mounted:

1. Install with concealed conduit.
2. Install proper type extension rings or plaster covers to make edges of boxes flush with finished surface.
3. Holes in surrounding surface shall be no larger than required to receive box.

F. Supports:

1. Support boxes independently of conduit by attachment to building structure or structural member.
2. Install bar hangers in frame construction or fasten boxes directly as follows:
 - a. Wood: Wood screws.
 - b. Concrete or Brick: Bolts and expansion shields.
 - c. Hollow Masonry Units: Toggle bolts.
 - d. Steelwork: Machine screws.

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3. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
 4. Provide plaster rings where necessary.
 5. Boxes embedded in concrete or masonry need not be additionally supported.
- G. Install separate junction boxes for flush or recessed lighting fixtures where required by fixture terminal temperature.
- H. Boxes Supporting Fixtures: Provide means of attachment with adequate strength to support fixture.

3.14 JUNCTION AND PULL BOXES

A. General:

1. Install plumb and level.
2. Installed boxes shall be accessible.
3. Do not install on finished surfaces.
4. Use outlet boxes as junction and pull boxes wherever possible and allowed by applicable codes.
5. Use conduit bodies as junction and pull boxes where no splices are required and allowed by applicable codes.
6. Install pull boxes where necessary in raceway system to facilitate conductor installation.
7. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.
8. Install in conduit runs at least every 150 feet or after the equivalent of three right-angle bends.

B. Flush Mounted:

1. Install with concealed conduit.
2. Holes in surrounding surface shall be no larger than required to receive box.
3. Make edges of boxes flush with final surface.

C. Mounting Hardware:

1. Noncorrosive Dry Areas: Galvanized.
2. Noncorrosive Wet Areas: Stainless steel.
3. Corrosive Areas: Stainless steel.

D. Supports:

1. Support boxes independently of conduit by attachment to building structure or structural member.
2. Install bar hangers in frame construction or fasten boxes directly as follows:
 - a. Wood: Wood screws.
 - b. Concrete or Brick: Bolts and expansion shields.
 - c. Hollow Masonry Units: Toggle bolts.
 - d. Steelwork: Machine screws.
3. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
4. Boxes embedded in concrete or masonry need not be additionally supported.

E. At or Below Grade:

1. Install boxes for below grade conduit flush with finished grade in locations outside of paved areas, roadways, or walkways.
2. If adjacent structure is available, box may be mounted on structure surface just above finished grade in accessible but unobtrusive location.
3. Obtain Engineer's written acceptance prior to installation in paved areas, roadways, or walkways.
4. Use boxes and covers suitable to support anticipated weights.

3.15 EMPTY RACEWAYS

- A. Provide permanent, removable cap over each end.
- B. Provide PVC plug with pull tab for underground raceways with end bells.
- C. Provide nylon pull cord.
- D. Identify, as specified in Article Identification Devices, with waterproof tags attached to pull cord at each end, and at intermediate pull point.

3.16 IDENTIFICATION DEVICES

A. Raceway Tags:

1. Identify origin and destination.
2. For exposed raceways, install tags at each terminus, near midpoint, and at minimum intervals of every 50 feet, whether in ceiling space or surface mounted.
3. Install tags at each terminus for concealed raceways.
4. Provide noncorrosive wire for attachment.

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- B. Warning Tape: Install approximately 18 inches above underground or concrete-encased raceways. Align parallel to, and within 12 inches of, centerline of run.
- C. Buried Raceway Marker:
 - 1. Install at grade to indicate direction of underground raceway.
 - 2. Install at bends and at intervals not exceeding 100 feet in straight runs.
 - 3. Embed and secure to top of concrete base, sized 14 inches long, 6 inches wide, and 8 inches deep; top set flush with finished grade.

3.17 PROTECTION OF INSTALLED WORK

- A. Protect products from effects of moisture, corrosion, and physical damage during construction.
- B. Provide and maintain manufactured watertight and dust-tight seals over conduit openings during construction.
- C. Touch up painted conduit threads after assembly to cover nicks or scars.
- D. Touch up coating damage to PVC-coated conduit with patching compound approved by manufacturer. Compound shall be kept refrigerated according to manufacturers' instructions until time of use.

END OF SECTION

SECTION 26 05 70
ELECTRICAL SYSTEMS ANALYSIS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American National Standards Institute (ANSI).
 2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C57.12.00, Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
 - b. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - c. 399, Recommended Practice for Industrial and Commercial Power System Analysis.
 - d. 1584, Guide for Performing Arc Flash Hazard Calculations.
 3. National Electrical Manufacturers Association (NEMA): Z535.4, Product Safety Signs and Labels.
 4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 70E, Standard for Electrical Safety in the Workplace.
 5. Occupational Safety and Health Standards (OSHA): 29 CFR, Part 1910 Subpart S, Electrical.

1.02 SUBMITTALS

- A. Action Submittals:
1. Short circuit study.
 2. Protective Device Coordination Study: Submit within 30 days after approval of short circuit study.
 3. Arc Flash Study: Submit initial study with protective Device Coordination Study. Submit final study prior to equipment energization.
 4. Arc flash warning labels; submit sample with initial study.
 5. Electronic files on thumb drive of final studies including all engineering software input files, output reports, and libraries.

1.03 QUALITY ASSURANCE

- A. Short circuit, protective device coordination, and arc flash studies shall be prepared by a professional electrical engineer registered in the State of Florida.

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1.04 SEQUENCING AND SCHEDULING

- A. Initial complete short circuit study shall be submitted and reviewed before Engineer will review Shop Drawings for switchgear equipment for incoming service.
- B. Initial complete protective device coordination and arc flash studies shall be submitted within 30 days after approval of initial short circuit study.
- C. Initial complete arc flash study shall be submitted and accepted prior to energization of the electrical equipment.
- D. Revised short circuit, protective device coordination, and arc flash studies, and arc flash labels shall be submitted 10 days before energizing electrical equipment.
- E. Final short circuit, protective device coordination, and arc flash studies shall be completed prior to Project Substantial Completion. Final version of study shall include as-installed equipment, materials, and parameter data or settings entered into equipment based on study.
- F. Submit final arc flash labels described herein and in compliance with NEMA Z535.4 prior to Project Substantial Completion.

1.05 GENERAL STUDY REQUIREMENTS

- A. Equipment and component titles used in the studies shall be identical to equipment and component titles shown on Drawings.
- B. Perform studies using one of the following electrical engineering software packages:
 - 1. SKM Power Tools for Windows.
 - 2. ETAP.
 - 3. Paladin.
 - 4. Easy Power.
- C. Perform complete fault calculations for each source combination.
 - 1. Source combination may include present and future power company supply circuits, large motors, or generators.
- D. Utilize proposed load data for study obtained from Contract Documents, field investigation of system configuration, wiring information, and equipment.

- E. Existing System and Equipment:
 - 1. Extent of existing system to be included in study is limited to system elements that affect new system and equipment.
 - 2. Include impedance elements that affect new system and equipment.
 - 3. Include protective devices in series with new equipment.
- F. Device coordination time-current curves for medium and low voltage distribution system; include individual protective device time-current characteristics.

1.06 SHORT CIRCUIT STUDY

- A. General:
 - 1. Prepare in accordance with IEEE 399.
 - 2. Use cable impedances based on copper conductors, except where aluminum conductors are specified or shown.
 - 3. Use bus impedances based on copper bus bars, except where aluminum bus bars are specified or shown.
 - 4. Use cable and bus resistances calculated at 25 degrees C.
 - 5. Use medium-voltage cable reactances based on use of typical dimensions of shielded cables with 133 percent insulation levels.
 - 6. Use 600-volt cable reactances based on use of typical dimensions of THHN/THWN conductors.
 - 7. Use transformer impedances 92.5 percent of “nominal” impedance based on tolerances specified in IEEE C57.12.00.
- B. Provide:
 - 1. Calculation methods and assumptions.
 - 2. Typical calculation.
 - 3. Tabulations of calculated quantities.
 - 4. Results, conclusions, and recommendations.
 - 5. Selected base per unit quantities.
 - 6. One-line diagrams.
 - 7. Source impedance data, including electric utility system and motor fault contribution characteristics.
 - 8. Impedance diagrams.
 - 9. Zero-sequence impedance diagrams.
- C. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed three-phase bolted fault at each:
 - 1. Electric utility’s supply termination point.
 - 2. Service entrance rated panelboard.

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- D. Provide bolted line-to-ground fault current study for areas as defined for three-phase bolted fault short circuit study.
- E. Provide bolted line-to-line fault current study for areas as defined for three-phase bolted fault short circuit study.
- F. Verify:
 - 1. Equipment and protective devices are applied within their ratings.
 - 2. Adequacy of panelboard bus bars to withstand short circuit stresses.
 - 3. Cable sizes for ability to withstand short circuit heating, in addition to normal load currents.
- G. Tabulations:
 - 1. General Data:
 - a. Short circuit reactances of rotating machines.
 - b. Cable and conduit material data.
 - c. Bus data.
 - d. Transformer data.
 - e. Circuit resistance and reactance values.
 - 2. Short Circuit Data:
 - a. Fault impedances.
 - b. X to R ratios.
 - c. Asymmetry factors.
 - d. Motor contributions.
 - e. Short circuit kVA.
 - f. Symmetrical and asymmetrical fault currents.
 - 3. Equipment Evaluation:
 - a. Equipment bus bracing, equipment short circuit rating, transformer, cable, busway.
 - b. Maximum fault current available.
- H. Written Summary:
 - 1. Scope of studies performed.
 - 2. Explanation of bus and branch numbering system.
 - 3. Prevailing conditions.
 - 4. Selected equipment deficiencies.
 - 5. Results of short circuit study.
 - 6. Comments or suggestions.
- I. Suggest changes and additions to equipment rating and/or characteristics.
- J. Revise data for “as-installed” condition.

1.07 PROTECTIVE DEVICE COORDINATION STUDY

A. General:

1. Prepare in accordance with IEEE 242.
2. Proposed protective device coordination time-current curves for distribution system, graphically displayed on conventional log-log curve sheets.
 - a. Provide separate curve sheets for phase and ground fault coordination for each scenario.
 - b. Each curve sheet to have title and one-line diagram that applies to specific portion of system associated with time-current curves on that sheet. Limit number of devices shown to four to six.
 - c. Identify device associated with each curve by manufacturer type, function, and, if applicable, recommended tap, time delay, instantaneous and other settings recommended.
 - d. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
 - e. Apply motor protection methods that comply with NFPA 70.

B. Plot Characteristics on Curve Sheets:

1. Electric utility's relays.
2. Electric utility's fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
3. Low-voltage equipment circuit breaker trip devices, including manufacturers tolerance bands.
4. Pertinent transformer full-load currents at 100 percent.
5. Transformer magnetizing inrush currents.
6. Transformer damage curves; appropriate for system operation and location.
7. ANSI transformer withstand parameters.
8. Significant symmetrical and asymmetrical fault currents.

C. Primary Protective Device Settings for Delta-Wye Connected Transformer:

1. Secondary Line-to-Ground Fault Protection: Primary protective device operating band within transformer's characteristics curve, including a point equal to 58 percent of IEEE C57.12.00 withstand point.
2. Secondary Line-to-Line Faults: 16 percent current margin between primary protective device and associated secondary device characteristic curves.

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- D. Separate medium voltage relay characteristics curves from curves for other devices by at least 0.4-second time margin.
- E. Tabulate Recommended Protective Device Settings:
 - 1. Relays:
 - a. Current tap.
 - b. Time dial.
 - c. Instantaneous pickup.
 - d. Electronic settings data file.
 - 2. Circuit Breakers:
 - a. Adjustable pickups.
 - b. Adjustable time-current characteristics.
 - c. Adjustable time delays.
 - d. Adjustable instantaneous pickups.
 - e. I^2t In/Out.
 - f. Zone interlocking.
 - g. Electronic settings data file.
- F. Written Summary:
 - 1. Scope of studies performed.
 - 2. Summary of protective device coordination methodology.
 - 3. Prevailing conditions.
 - 4. Selected equipment deficiencies.
 - 5. Results of coordination study.
 - 6. Appendix of complete relay and circuit breaker electronic setting files.
 - 7. Comments or suggestions.

1.08 ARC FLASH STUDY

- A. Perform arc flash hazard study after short circuit and protective device coordination study has been completed, reviewed and accepted.
- B. Perform arc flash study in accordance with NFPA 70E, OSHA 29 CFR, Part 1910 Subpart S, and IEEE 1584.
- C. Base Calculation: For each major part of electrical power system, determine the following:
 - 1. Flash hazard protection boundary.
 - 2. Limited approach boundary.
 - 3. Restricted approach boundary.
 - 4. Incident energy level.
 - 5. Glove class required.

- D. Produce arc flash warning labels that list items in Paragraph Base Calculation and the following additional items.
1. Bus name.
 2. Bus voltage.
- E. Produce bus detail sheets that list items in Paragraph Base Calculation and the following additional items:
1. Bus name.
 2. Upstream protective device name, type, and settings.
 3. Bus line-to-line voltage.
- F. Produce arc flash evaluation summary sheet listing the following additional items:
1. Bus name.
 2. Upstream protective device name, type, settings.
 3. Bus line-to-line voltage.
 4. Bus bolted fault.
 5. Protective device bolted fault current.
 6. Arcing fault current.
 7. Protective device trip/delay time.
 8. Breaker opening time.
 9. Solidly grounded column.
 10. Equipment type.
 11. Gap.
 12. Arc flash boundary.
 13. Working distance.
 14. Incident energy.
- G. Analyze short circuit, protective device coordination, and arc flash calculations and highlight equipment that is determined to be underrated or causes incident energy values greater than 40 cal/cm^2 . Propose approaches to reduce energy levels.
- H. Prepare report summarizing arc flash study with conclusions and recommendations which may affect integrity of electric power distribution system. As a minimum, include the following:
1. Equipment manufacturer's information used to prepare study.
 2. Assumptions made during study.
 3. Reduced copy of one-line drawing; 11 inches by 17 inches maximum.

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4. Arc flash evaluations summary spreadsheet.
5. Bus detail sheets.
6. Arc flash warning labels printed in color on thermally bonded adhesive backed UV and weather-resistant labels.

PART 2 PRODUCTS

2.01 ARC FLASH WARNING LABELS

- A. Arc flash warning labels printed in color on thermally bonded adhesive backed, UV- and weather-resistant labels. An example label is located following end of section in Figure 1.

PART 3 EXECUTION

3.01 GENERAL

- A. Adjust relay and protective device settings according to values established by coordination study.
- B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Notify Engineer in writing of required major equipment modifications.
- D. Provide laminated one-line diagrams (minimum size 11 inches by 17 inches) to post on interior of electrical room doors.
- E. Provide arc flash warning labels on equipment as specified in this section.

3.02 SUPPLEMENTS

- A. The supplement listed below, following “End of Section,” is a part of this Specification:
 1. Figure 1: Example Arc Flash Label.

END OF SECTION

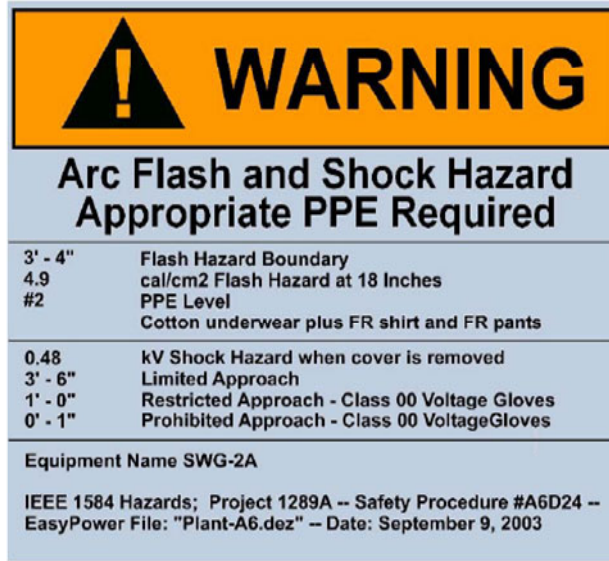


Figure 1
Example Arc Flash Label

SECTION 26 08 00
COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. ASTM International (ASTM):
 - a. D877/D877M, Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.
 - b. D923, Standard Practices for Sampling Electrical Insulating Liquids.
 - c. D924, Standard Test Method for Dissipation Factor (or Power Factor) and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids.
 - d. D971, Standard Test Method for Interfacial Tension of Oil Against Water by the Ring Method.
 - e. D974, Standard Test Method for Acid and Base Number by Color-Indicator Titration.
 - f. D1298, Standard Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.
 - g. D1500, Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale).
 - h. D1524, Standard Test Method for Visual Examination of Used Electrical Insulating Liquids in the Field.
 - i. D1533, Standard Test Method for Water in Insulating Liquids by Coulometric Karl Fischer Titration.
 - j. D1816, Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using VDE Electrodes.
 2. Institute of Electrical and Electronics Engineers (IEEE):
 - a. 43, Recommended Practice for Testing Insulation Resistance of Electric Machinery.
 - b. 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminators Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV.
 - c. 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
 - d. 95, Recommended Practice for Insulation Testing of AC Electric Machinery (2300V and Above) with High Direct Voltage.

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- e. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
 - f. 400, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems Rated 5 kV and Above.
 - g. 450, Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications.
 - h. C2, National Electrical Safety Code.
 - i. C37.20.1, Standard for Metal-Enclosed Low-Voltage (1,000 Vac and below, 3200 Vdc and below) Power Circuit Breaker Switchgear.
 - j. C37.20.2, Standard for Metal-Clad Switchgear.
 - k. C37.20.3, Standard for Metal-Enclosed Interrupter Switchgear.
 - l. C37.23, Standard for Metal-Enclosed Bus.
 - m. C62.33, Standard Test Methods and Performance Values for Metal-Oxide Varistor Surge Protective Components.
3. Insulated Cable Engineers Association (ICEA):
 - a. S-93-639, 5-46 kV Shielded Power Cables for Use in the Transmission and Distribution of Electric Energy.
 - b. S-94-649, Concentric Neutral Cables Rated 5 through 46 kV.
 - c. S-97-682, Standard for Utility Shielded Power Cables Rated 5 through 46 kV.
 4. National Electrical Manufacturers Association (NEMA):
 - a. AB 4, Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.
 - b. PB 2, Deadfront Distribution Switchboards.
 - c. WC 74, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
 5. InterNational Electrical Testing Association (NETA): ATS, Acceptance Testing Specifications for Electrical Power Equipment and Systems.
 6. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 70B, Recommended Practice for Electrical Equipment Maintenance.
 - c. 70E, Standard for Electrical Safety in the Workplace.
 - d. 101, Life Safety Code.
 7. National Institute for Certification in Engineering Technologies (NICET).
 8. Occupational Safety and Health Administration (OSHA): CFR 29, Part 1910, Occupational Safety and Health Standards.

1.02 SUBMITTALS

A. Informational Submittals:

1. Submit 30 days prior to performing inspections or tests:
 - a. Schedule for performing inspection and tests.
 - b. List of references to be used for each test.
 - c. Sample copy of equipment and materials inspection form(s).
 - d. Sample copy of individual device test form.
 - e. Sample copy of individual system test form.
2. Energization Plan: Prior to initial energization of electrical distribution equipment; include the following:
 - a. Owner's representative sign-off form for complete and accurate arc flash labeling and proper protective device settings for equipment to be energized.
 - b. Staged sequence of initial energization of electrical equipment.
 - c. Lock-Out-Tag-Out plan for each stage of the progressive energization.
 - d. Barricading, signage, and communication plan notifying personnel of newly energized equipment.
3. Submit test or inspection reports and certificates for each electrical item tested within 30 days after completion of test:
4. Operation and Maintenance Data:
 - a. In accordance with Section 01 78 23, Operation and Maintenance Data.
 - b. After test or inspection reports and certificates have been reviewed by Engineer and returned, insert a copy of each in Operation and Maintenance Manual.
5. Programmable Settings: At completion of Performance Demonstration Test, submit final hardcopy printout and electronic files on compact disc of as-left setpoints, programs, and device configuration files for:
 - a. Protective relays.
 - b. Intelligent overload relays.
 - c. Adjustable frequency drives.
 - d. Power metering devices.
 - e. Uninterruptible power supplies.
 - f. Electrical communications modules.

1.03 QUALITY ASSURANCE

A. Testing Firm Qualifications:

1. Corporately and financially independent organization functioning as an unbiased testing authority.

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2. Professionally independent of manufacturers, suppliers, and installers of electrical equipment and systems being tested.
3. Employer of engineers and technicians regularly engaged in testing and inspecting of electrical equipment, installations, and systems.
4. Supervising engineer accredited as Certified Electrical Test Technologist by NICET or NETA and having a minimum of 5 years' testing experience on similar projects.
5. Technicians certified by NICET or NETA.
6. Assistants and apprentices assigned to Project at ratio not to exceed two certified to one noncertified assistant or apprentice.
7. Registered Professional Engineer to provide comprehensive Project report outlining services performed, results of such services, recommendations, actions taken, and opinions.
8. In compliance with OSHA CFR 29, Part 1910.7 criteria for accreditation of testing laboratories or a full member company of NETA.

B. Test equipment shall have an operating accuracy equal to or greater than requirements established by NETA ATS.

C. Test Instrument Calibration: In accordance with NETA ATS.

1.04 SEQUENCING AND SCHEDULING

A. Perform inspection and electrical tests after equipment listed herein has been installed.

B. Perform tests with apparatus de-energized whenever feasible.

1. Scheduled with Engineer and Owner prior to de-energization.
2. Minimized to avoid extended period of interruption to the operating plant equipment.

C. Notify Engineer and Owner at least 24 hours prior to performing tests on energized electrical equipment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Perform tests in accordance with requirements of Section 01 91 14, Equipment Testing and Facility Startup.

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- B. Tests and inspections shall establish:
 - 1. Electrical equipment is operational within industry and manufacturer's tolerances and standards.
 - 2. Installation operates properly.
 - 3. Equipment is suitable for energization.
 - 4. Installation conforms to requirements of Contract Documents and NFPA 70, NFPA 70E, NFPA 101, and IEEE C2.
- C. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.
- D. Set, test, and calibrate protective relays, circuit breakers, fuses, and other applicable devices in accordance with values established by short circuit, coordination, and harmonics studies as specified in Section 26 05 70, Electrical Systems Analysis.
- E. Adjust mechanisms and moving parts of equipment for free mechanical movement.
- F. Adjust and set electromechanical electronic relays and sensors to correspond to operating conditions, or as recommended by manufacturer.
- G. Verify nameplate data for conformance to Contract Documents and approved Submittals.
- H. Realign equipment not properly aligned and correct unlevelness.
- I. Properly anchor electrical equipment found to be inadequately anchored.
- J. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench/screw driver to manufacturer's recommendations, or as otherwise specified in NETA ATS.
- K. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.
- L. Provide proper lubrication of applicable moving parts.
- M. Inform Engineer of working clearances not in accordance with NFPA 70.
- N. Investigate and repair or replace:
 - 1. Electrical items that fail tests.
 - 2. Active components not operating in accordance with manufacturer's instructions.
 - 3. Damaged electrical equipment.

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O. Electrical Enclosures:

1. Remove foreign material and moisture from enclosure interior.
2. Vacuum and wipe clean enclosure interior.
3. Remove corrosion found on metal surfaces.
4. Repair or replace, as determined by Engineer door and panel sections having dented surfaces.
5. Repair or replace, as determined by Engineer poor fitting doors and panel sections.
6. Repair or replace improperly operating latching, locking, or interlocking devices.
7. Replace missing or damaged hardware.
8. Finish:
 - a. Provide matching paint and touch up scratches and mars.
 - b. If required because of extensive damage, as determined by Engineer, refinish entire assembly.

- P. Replace fuses and circuit breakers that do not conform to size and type required by the Contract Documents or approved Submittals.

3.02 CHECKOUT AND STARTUP

A. Voltage Field Test:

1. Check voltage at point of termination of power company supply system to Project when installation is essentially complete and is in operation.
2. Check voltage amplitude and balance between phases for loaded and unloaded conditions.
3. Record supply voltage (all phases simultaneously on same graph) for 24 hours during normal working day.
 - a. Submit Voltage Field Test Report within 5 days of test.
4. Unbalance Corrections:
 - a. Make written request to power company to correct condition if balance (as defined by NEMA) exceeds 1 percent, or if voltage varies throughout the day and from loaded to unloaded condition more than plus or minus 4 percent of nominal.
 - b. Obtain written certification from responsible power company official that voltage variations and unbalance are within their normal standards if corrections are not made.

B. Equipment Line Current Tests:

1. Check line current in each phase for each piece of equipment.

2. Make line current check after power company has made final adjustments to supply voltage magnitude or balance.
3. If phase current for a piece of equipment is above rated nameplate current, prepare Equipment Line Phase Current Report that identifies cause of problem and corrective action taken.

3.03 PANELBOARDS

- A. Visual and Mechanical Inspection: Include the following inspections and related work:
 1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
 2. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's instruction manual.
 3. Check panelboard mounting, area clearances, and alignment and fit of components.
 4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
 5. Perform visual and mechanical inspection for overcurrent protective devices.
- B. Electrical Tests: Include the following items performed in accordance with manufacturer's instruction:
 1. Insulation Resistance Tests:
 - a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
 - b. Each phase of each bus section.
 - c. Phase-to-phase and phase-to-ground for 1 minute.
 - d. With breakers open.
 - e. With breakers closed.
 - f. Control wiring except that connected to solid state components.
 - g. Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
 2. Ground continuity test ground bus to system ground.

3.04 LOW VOLTAGE CABLES, 600 VOLTS MAXIMUM

- A. Visual and Mechanical Inspection:
 1. Inspect each individual exposed power cable No. 6 and larger for:
 - a. Physical damage.
 - b. Proper connections in accordance with single-line diagram.

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- c. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.
 - d. Color coding conformance with specification.
 - e. Proper circuit identification.
 2. Mechanical Connections for:
 - a. Proper lug type for conductor material.
 - b. Proper lug installation.
 - c. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
 3. Shielded Instrumentation Cables for:
 - a. Proper shield grounding.
 - b. Proper terminations.
 - c. Proper circuit identification.
 4. Control Cables for:
 - a. Proper termination.
 - b. Proper circuit identification.
 5. Cables Terminated Through Window Type CTs: Verify neutrals and grounds are terminated for correct operation of protective devices.
- B. Electrical Tests for Conductors No. 6 and Larger:
 1. Insulation Resistance Tests:
 - a. Utilize 1,000-volt dc megohmmeter for 600-volt insulated conductors.
 - b. Test each conductor with respect to ground and to adjacent conductors for 1 minute.
 - c. Evaluate ohmic values by comparison with conductors of same length and type.
 - d. Investigate values less than 50 megohms.
 2. Continuity test by ohmmeter method to ensure proper cable connections.
- C. Low-voltage cable tests may be performed by installer in lieu of independent testing firm.

3.05 MOLDED AND INSULATED CASE CIRCUIT BREAKERS

- A. General: Inspection and testing limited to circuit breakers rated 70 amperes and larger and to motor circuit protector breakers rated 50 amperes and larger.
- B. Visual and Mechanical Inspection:
 1. Proper mounting.
 2. Proper conductor size.
 3. Feeder designation according to nameplate and one-line diagram.
 4. Cracked casings.

5. Connection bolt torque level in accordance with NETA ATS, Table 100.12.
6. Operate breaker to verify smooth operation.
7. Compare frame size and trip setting with circuit breaker schedules or one-line diagram.
8. Verify that terminals are suitable for 75 degrees C rated insulated conductors.

C. Electrical Tests:

1. Insulation Resistance Tests:
 - a. Utilize 1,000-volt dc megohmmeter for 480-volt and 600-volt circuit breakers and 500-volt dc megohmmeter for 240-volt circuit breakers.
 - b. Pole-to-pole and pole-to-ground with breaker contacts opened for 1 minute.
 - c. Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.
 - d. Test values to comply with NETA ATS, Table 100.1.
2. Contact Resistance Tests:
 - a. Contact resistance in microhms across each pole.
 - b. Investigate deviation of 50 percent or more from adjacent poles and similar breakers.
3. Primary Current Injection Test to Verify:
 - a. Long-time minimum pickup and delay.
 - b. Short-time pickup and delay.
 - c. Ground fault pickup and delay.
 - d. Instantaneous pickup by run-up or pulse method.
 - e. Trip characteristics of adjustable trip breakers shall be within manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - f. Trip times shall be within limits established by NEMA AB 4, Table 5-3. Alternatively, use NETA ATS, Table 100.7.
 - g. Instantaneous pickup value shall be within values established by NEMA AB 4, Table 5-4. Alternatively, use NETA ATS, Table 100.8.

3.06 GROUNDING SYSTEMS

A. Visual and Mechanical Inspection:

1. Equipment and circuit grounds in panelboard assemblies for proper connection and tightness.
2. Ground bus connections in panelboard assemblies for proper termination and tightness.

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3. Effective transformer core and equipment grounding.
4. Accessible connections to grounding electrodes for proper fit and tightness.
5. Accessible exothermic-weld grounding connections to verify that molds were fully filled and proper bonding was obtained.

B. Electrical Tests:

1. Fall-of-Potential Test:
 - a. In accordance with IEEE 81, Section 8.2.1.5 for measurement of main ground system's resistance.
 - b. Main ground electrode system resistance to ground to be no greater than 5 ohm(s).

3.07 LOW VOLTAGE SURGE ARRESTORS

A. Visual and Mechanical Inspection:

1. Adequate clearances between arrestors and enclosures.
2. Ground connections to ground bus.

B. Electrical Tests:

1. Varistor Type Arrestors:
 - a. Clamping voltage test.
 - b. Rated RMS voltage test.
 - c. Rated dc voltage test.
 - d. Varistor arrestor test values in accordance with IEEE C62.33, Section 4.4 and Section 4.9.

3.08 THERMOGRAPHIC SURVEY

- A. Provide thermographic survey per NETA ATS Table 100.18 of connections associated with incoming service conductors, bus work, and branch feeder conductors No. 6 and larger at each: Panelboard.
- B. Provide thermographic survey of feeder conductors No. 6 and larger terminating at: Panelboard.
- C. Remove necessary enclosure metal panels and covers prior to performing survey.
- D. Perform with equipment energized during periods of maximum possible loading per NFPA 70B, Section 20.17.

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- E. Do not perform survey on equipment operating at less than 40 percent of rated load. If plant load is insufficient, perform test with supplemental load bank producing rated load on item being measured.
- F. Use thermographic equipment capable of:
 - 1. Detecting emitted radiation.
 - 2. Converting detected radiation to visual signal.
 - 3. Detecting 1 degree C temperature difference between subject area and reference point of 30 degrees C.
- G. Temperature Gradients:
 - 1. 3 degrees C to 7 degrees C indicates possible deficiency that warrants investigation.
 - 2. 7 degrees C to 15 degrees C indicates deficiency that is to be corrected as time permits.
 - 3. 16 degrees C and above indicates deficiency that is to be corrected immediately.
- H. Provide written report of:
 - 1. Areas surveyed and the resultant temperature gradients.
 - 2. Locations of areas having temperature gradients of 3 degrees C or greater.
 - 3. Cause of heat rise and actions taken to correct cause of heat rise.
 - 4. Detected phase unbalance.

END OF SECTION

**SECTION 26 24 16
PANELBOARDS**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. National Electrical Contractor's Association (NECA): 407, Recommended Practice for Installing and Maintaining Panelboards.
 2. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. 289, Application Guide for Ground Fault Circuit Interrupters.
 - c. KS 1, Enclosed Switches.
 - d. PB 1, Panelboards.
 - e. PB 1.1, General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
 3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 4. Underwriters Laboratories, Inc. (UL):
 - a. 67, Standard for Panelboards.
 - b. 98, Standard for Enclosed and Dead-Front Switches.
 - c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
 - d. 489, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
 - e. 508, Standard for Industrial Control Equipment.
 - f. 870, Wireways, Auxiliary Gutters and Associated Fittings.
 - g. 943, Ground-Fault Circuit-Interrupters.
 - h. 1699, Standard for Arc-Fault Circuit-Interrupters.

1.02 SUBMITTALS

- A. Action Submittals:
1. Manufacturer's data sheets for each type of panelboard, protective device, accessory item, and component.
 2. Manufacturer's shop drawings including dimensioned plan, section, and elevation for each panelboard type, enclosure, and general arrangement.
 3. Tabulation of features for each panelboard to include the following:
 - a. Protective devices with factory settings.
 - b. Provisions for future protective devices.
 - c. Space for future protective devices.

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- d. Voltage, frequency, and phase ratings.
- e. Enclosure type.
- f. Bus and terminal bar configurations and current ratings.
- g. Provisions for circuit terminations with wire range.
- h. Short circuit current rating of assembled panelboard at system voltage.
- i. Features, characteristics, ratings, and factory settings of auxiliary components.
- j. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

- 1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
- 2. Manufacturer's recommended installation instructions.

1.03 QUALITY ASSURANCE

- A. Listing and Labeling: Provide products specified in this section that are listed and labeled as defined in NEC Article 100.

1.04 EXTRA MATERIALS

- A. Extra Materials: Furnish, tag, and box for shipment and storage the following spare parts, special tools, and material:

<u>Item</u>	<u>Quantity</u>
Touch-up paint for panelboards	One half-pint container
Special tools required to maintain or dismantle	One complete set

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Materials, equipment, and accessories specified in this section shall be products of:
 - 1. Eaton/Cutler-Hammer.
 - 2. General Electric Co.
 - 3. Square D Co.
- B. No "or-equal" or substitute products will be considered.

2.02 GENERAL

- A. Provide low voltage panelboards for application at 600V or less in accordance with this section.
- B. Provide equipment in accordance with NEMA PB 1, NFPA 70, and UL 67.
- C. Wire Terminations:
 - 1. Provide panelboard assemblies, including protective devices, suitable for use with 75 degrees C or greater wire insulation systems at NFPA 70, 75 degrees C conductor ampacity, and in accordance with UL 486E.
 - 2. Lugs for termination of conductors shall comply with Section 26 05 05, Conductors.
 - 3. Lugs for termination of copper feeder phase and neutral conductors shall be replaceable, bolted mechanical or crimp compression type.
- D. Load Current Ratings:
 - 1. Unless otherwise indicated, load current ratings for panelboard assemblies, including bus and circuit breakers, are noncontinuous as defined by NEC. Continuous ratings shall be 80 percent of noncontinuous rating.
 - 2. Where indicated “continuous” or “100 percent”, selected components and protective devices shall be rated for continuous load current at value shown.
- E. Short Circuit Current Rating (SCCR): Integrated equipment short circuit rating for each panelboard assembly shall be no less than the following:
 - 1. Minimum SCCR at 208Y/120 or 120/240 volts shall be 22,000 amperes rms symmetrical.
 - 2. Minimum SCCR at 480Y/277 volts shall be 65,000 amperes rms symmetrical.
- F. Series-Connected Short Circuit Current Ratings: Panelboards shall be fully rated; application of series-connected device ratings is unacceptable.

2.03 OVERCURRENT PROTECTIVE DEVICES

- A. Overcurrent Device Mounting and Arrangement: Design panelboards to accommodate device installation and replacement without disturbing adjacent devices and without removing main bus.

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- B. Overcurrent Protective Devices: In accordance with NEMA KS 1, UL 98, and UL 489. Protective devices shall be adapted to panelboard installation.
- C. Provisions for Future Overcurrent Device:
 - 1. Provide space, mountings and bus connections such that like device may be installed without additional hardware.
 - 2. Panel openings shall be closed with individual removable cover for each provision for future device.
 - 3. Unless otherwise indicated, "spaces" in panelboards shall be fully equipped provision for future like devices.
 - 4. Provisions for future devices shall be suitable devices rated no less than 60 amperes.
- D. Branch Protective Devices:
 - 1. Provide Wire Lug Load Connections: Mechanical or crimp compression type, removable/replaceable, and suitable for 75 degrees C rated conductors without derating switch nor conductor ampacity.
 - 2. Provide a nameplate for each circuit, blanks for spares.

2.04 CIRCUIT BREAKERS

- A. General: Thermal-magnetic unless otherwise indicated, quick-make, quick-break, molded case, of indicating type showing ON/OFF and TRIPPED positions of operating handle. Circuit breakers shall comply with Section 26 05 04, Basic Electrical Materials and Methods.
- B. Bus Connection: Bolt-on circuit breakers in 480Y/277-volt, and plug-in circuit breakers in 208Y/120 and 240/120-volt panelboards.
- C. Trip Mechanism:
 - 1. Individual permanent thermal and magnetic trip elements in each pole.
 - 2. Variable magnetic trip elements with a single continuous adjustment 3X to 10X for frames greater than 100 amps.
 - 3. Two and three pole, common trip.
 - 4. Automatically opens all poles when overcurrent occurs on one pole.
 - 5. Test button on cover.
 - 6. Calibrated for 40 degrees C ambient, unless shown otherwise.
- D. Unacceptable Substitution:
 - 1. Do not substitute single-pole circuit breakers with handle ties for multi-pole breakers.
 - 2. Do not use tandem or dual circuit breakers in normal single-pole spaces.

- E. Specialty Breakers: Where indicated, provide breakers with the following features:
1. Ground Fault Circuit Interrupter (GFCI): Rated to trip on 5-mA ground fault within 0.025 second (UL 943, Class A sensitivity, for protection of personnel). Ground fault sensor shall be rated same as circuit breaker. Breaker shall include push-to-test and reset buttons.
 2. Equipment Ground Fault Interrupter (EGFI): Where indicated, equip breaker with ground fault sensor and rated to trip on 30-mA ground fault (UL listed for equipment ground fault protection).

2.05 ENCLOSURES

- A. General:
1. Provide as specified in Section 26 05 04, Basic Electrical Materials and Methods.
 2. Type 1, Type 3R, and Type 3S material code-gauge, hot-dip galvanized sheet steel with reinforced steel frame.
 3. Provide surface-mount panelboard from trim with same dimensions as box front.
- B. Finish: Rust inhibitor prime followed by manufacturer's standard gray baked enamel or lacquer.
- C. NEMA 250 Type 1 Branch Panelboard Enclosure:
1. Secure front trim to box with concealed trim clamps.
 2. Overlap flush panelboards front trims with box nominal 3/4 inch on all sides.
 3. Provide door in panelboard front trim, with concealed hinges, to access protective device operating handles.
 4. Provide multi-point latching for doors over 30 inches in height.
 5. Door Lock: Secure with flush catch and tumbler lock; all panelboards keyed alike, with two milled keys each lock.
 6. Circuit Directory: Metal frame with transparent plastic face and enclosed card, mounted inside each panel door.
- D. Multi-Section Panelboards: Where more than one section is required, provide multiple panelboard sections with separate fronts.
1. Sections shall be suitable for individual mounting to be field interconnected to form a single electrical unit.
 2. Recessed-mount sections of the same panel shall all have the same size tubs and flush covers.
 3. Surface-mount multi-section panelboards may be comprised of sections of unequal heights.

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4. Provide feed-through and main lugs in individual sections as required for field assembly of a complete multi-section panelboard. Unless otherwise indicated, provide feed-through lugs on each section but last.
5. Provide neutral and ground terminal bars in each section.

2.06 BUSSING AND TERMINAL BARS

A. Bus:

1. Material: Copper, full sized throughout length.
2. Provide for mounting of future protective devices along full length of bus regardless of number of units and spaces shown. Machine, drill, and tap as required for current and future positions.

B. Equipment Ground Terminal Bus: Copper with suitably sized provisions for termination of ground conductors, and bonded to box.

1. Provide individual mechanical termination points no less than the quantity of breaker pole positions.
2. Provide individual termination points for all other grounding conductors such as feeder, grounding electrode, etc.
3. Termination points shall be bolted crimp compression lugs for conductors 6 AWG and larger.

C. Neutral Terminal Bus: Copper with suitably sized provisions for termination of neutral conductors, and isolated from box.

1. Provide individual mechanical termination points no less than the quantity of breaker pole positions.
2. Provide individual termination points for all other neutral conductors.
3. Oversize Neutral: Provide oversized neutral terminal bus as indicated.

D. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances for future protective device ampere ratings indicated.

2.07 SPECIAL FEATURES

- A. General: Where indicated on Drawings or schedules, provide special features as specified.
- B. Service Equipment Approval: Listed for use as service equipment for panelboards having service disconnecting means.

C. Surge Arresters:

1. Comply with Section 26 43 00, Surge Protection Devices.
2. Provide protective device within panelboard as disconnecting means and short circuit protection per manufacturer's recommendation.
3. Provide factory mounting within panelboard utilizing UL-recognized mounting device.

PART 3 EXECUTION

3.01 GENERAL

- A. Install in accordance with NECA 407, NEMA PB 1.1, and manufacturers' written installation instructions.
- B. Install securely, plumb, in-line and square with walls.
- C. Install top of cabinet trim 78 inches above floor, unless otherwise shown. Install cabinet so tops of protective device operating handles are no more than 78 inches above the floor.
- D. Ground Fault Protection: Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289.
- E. Install filler plates in unused spaces.
- F. Wiring in Panel Gutters: Train conductors neatly in groups; bundle and wrap with nylon wire ties.
- G. Mount flush panels uniformly flush with wall finish.
- H. Provide typewritten circuit directory for each panelboard.
- I. Provide engraved identification for each protective device.

END OF SECTION

**SECTION 26 27 26
WIRING DEVICES**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. ASTM International (ASTM): A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 2. Federal Specifications (FS):
 - a. W-C-596G, General Specification for Connector, Electrical, Power.
 - b. W-S-896F, Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).
 3. Institute of Electrical and Electronic Engineers, Inc. (IEEE):
 - a. C62.41.2, Recommended Practice on Characterization of Surges in Low-Voltage (1,000V and less) AC Power Circuits.
 - b. C62.45, Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1,000V and less) AC Power Circuits.
 4. National Electrical Contractors Association (NECA): 1, Standard Practice of Good Workmanship in Electrical Contracting.
 5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. FB 11, Plugs, Receptacles, and Connectors of the Pin and Sleeve Type for Hazardous Locations.
 - c. WD 1, General Color Requirements for Wiring Devices.
 - d. WD 6, Wiring Devices – Dimensional Specifications.
 6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 7. UL:
 - a. 498, Standard for Safety for Attachment Plugs and Receptacles.
 - b. 508, Standard for Safety for Industrial Control Equipment.
 - c. 943, Standard for Safety for Ground-Fault Circuit-Interrupters.
 - d. 1010, Standard for Safety for Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations.
 - e. 1436, Standard for Safety for Outlet Circuit Testers and Similar Indicating Devices.
 - f. 1449, Standard for Safety for Surge Protective Devices (SPD).

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1.02 SUBMITTALS

- A. Action Submittals: Manufacturer's product data for wiring devices.

PART 2 PRODUCTS

2.01 SWITCHES

- A. Switch, General Purpose:

1. NEMA WD 1 and FS W-S-896F.
2. Totally enclosed, ac type, with quiet tumbler switch and screw terminal.
3. Rivetless one-piece brass or copper alloy contact arm with silver alloy contact.
4. Capable of controlling 100 percent tungsten filament and fluorescent lamp loads.
5. Rating: 20 amps, 120/277 volts.
6. Automatic grounding clip and integral grounding terminal on mounting strap.
7. Special Features: Provide the following features in comparable devices where indicated:
 - a. Three-way and four-way.
8. Manufacturers and Products, Industrial Grade:
 - a. Cooper Arrow Hart; AH1200 Series.
 - b. Bryant; 4801 Series.
 - c. Hubbell; 1201 Series.
 - d. Leviton; 1201 Series.

- B. Switch, Motor Rated:

1. Type: Two-pole or three-pole, manual motor starting/disconnect switch without overload protection.
2. UL 508 listed.
3. Totally enclosed snap-action switch. Quick-make, slow-break design with silver alloy contacts.
4. Minimum General Purpose Rating: 30 amperes, 600V ac.
5. Minimum Motor Ratings:
 - a. 2 horsepower for 120V ac, single-phase, two-pole.
 - b. 3 horsepower for 240V ac, single-phase, two-pole.
 - c. 15 horsepower for 480V ac, three-phase, three-pole.
6. Screw-type terminal.
7. Manufacturers and Products:
 - a. Cooper Arrow Hart.
 - b. Hubbell Bryant: HBL78 Series.
 - c. Leviton.

2.02 RECEPTACLES

A. Receptacle, General Purpose:

1. NEMA WD 1 and FS W-C-596G.
2. Duplex, two-pole, three-wire grounding type with screw type wire terminals.
3. Impact resistant nylon cover and body, with finger grooves in face, unless otherwise indicated.
4. One-piece mounting strap with integral ground contact (rivetless construction).
5. Contact Arrangement: Contact to be made on two sides of each inserted blade without detent.
6. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps, unless otherwise indicated.
7. Size: For 2-inch by 4-inch outlet box.
8. Industrial Grade Manufacturers and Products:
 - a. Cooper Arrow Hart; 5262 Series.
 - b. Hubbell Bryant; HBL5262 Series.
 - c. Leviton; 5262 Series.

B. Receptacle, Ground Fault Circuit Interrupter:

1. Meet requirements of general-purpose receptacle.
2. Listed Class A to UL 943, tripping at 5 mA.
3. Rectangular smooth face with push-to-test and reset buttons.
4. Listed weather-resistant per NEC 406.8 for installation in damp or wet locations.
5. Feed-through Capability: 20 amps.
6. Manufacturers and Products:
 - a. Hubbell Bryant; GFTR20 Series.
 - b. Cooper Arrow Hart WRVGF20 Series.
 - c. Leviton; 7899 Series.

2.03 DEVICE PLATES

A. Sectional type plate not permitted.

B. Nylon:

1. Material: Specification grade, 0.10-inch minimum thickness, noncombustible, thermosetting.
2. Color: To match associated wiring device.
3. Mounting Screw: Oval-head metal, color matched to plate.

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- C. Stainless Steel:
 - 1. Material: Specification grade, one-piece, 0.040-inch nominal thickness stainless steel.
 - 2. Finish: ASTM A167, Type 302/304, satin.
 - 3. Mounting Screw: Oval-head, finish matched to plate.

- D. Cast Metal:
 - 1. Material: Copper-free aluminum, with gaskets.
 - 2. Screw: Oval-head stainless steel.

- E. Sheet Steel:
 - 1. Finish: Zinc electroplate.
 - 2. Screws: Oval-head stainless steel.
 - 3. Manufacturers:
 - a. Appleton.
 - b. Crouse-Hinds.

- F. Weatherproof:
 - 1. Receptacle, Weatherproof Type 1:
 - a. Gasketed, cast-aluminum, with individual cap over each receptacle opening.
 - b. Mounting Screw and Cap Spring: Stainless steel.
 - c. Manufacturers and Products:
 - 1) Crouse-Hinds; Type WLRD-1.
 - 2) Appleton; Type FSK-WRD.
 - 2. Receptacle, Weatherproof Type 2:
 - a. UL listed for wet location while in use.
 - b. Die cast metal cover.
 - c. Manufacturer and Product: TayMac; Type Multi-Mac.
 - 3. Switch:
 - a. Gasketed, cast-metal or cast-aluminum, incorporating external operator for internal switch.
 - b. Mounting Screw: Stainless steel.
 - c. Manufacturers and Products:
 - 1) Crouse-Hinds; DS-181 or DS-185.
 - 2) Appleton; FSK-1VTS or FSK-1VS.

- G. Raised Sheet Steel: 1/2-inch high zinc- or cadmium-plated steel designed for one-piece drawn type sheet steel box.

2.04 FINISHES

- A. Wiring device catalog numbers specified in this section do not designate device color. Unless otherwise indicated, or required by code, provide colors as specified below.
- B. Wiring Device:
 - 1. Office Areas: Gray.
 - 2. Other Areas: Gray.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

- A. Comply with NECA 1.
- B. Coordination with Other Trades:
 - 1. Ensure device and its box are protected. Do not place wall finish materials over device box and do not cut holes for box with router that is guided by riding against outside of box.
 - 2. Keep outlet box free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate raceway system, conductors, and cables.
 - 3. Install device box in brick or block wall such that cover plate does not cross a joint, unless otherwise indicated. Where indicated or directed to cross joint, trowel joint flush with face of wall.
 - 4. Install wiring device after wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. Length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailling existing conductors is permitted provided outlet box is large enough.

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D. Device Installation:

1. Replace devices that have been in temporary use during construction or that show signs they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (150 mm) in length.
5. Use torque screwdriver when a torque is recommended or required by manufacturer.
6. When conductors larger than 12 AWG are installed on 15-amp or 20-amp circuits, splice 12 AWG pigtails for device connections.
7. Tighten unused terminal screws on device.
8. Device Plates:
 - a. Do not use oversized or extra deep plate.
 - b. Repair wall finishes and remount outlet box when standard device plate does not fit flush or does not cover rough wall opening.

3.02 SWITCH INSTALLATION

A. Switch, General Purpose:

1. Mounting Height: See Section 26 05 33, Raceway and Boxes.
2. Install with switch operation in vertical position.
3. Install single-pole, two-way switch such that toggle is in up position when switch is on.

3.03 RECEPTACLE INSTALLATION

A. Duplex Receptacle:

1. Install with grounding slot down, except where horizontal mounting is shown, in which case install with neutral slot down.
2. Ground receptacle to box with grounding wire only.
3. Weatherproof Receptacle:
 - a. Install in cast metal box.
 - b. Install such that hinge for protective cover is above receptacle opening.
4. Ground Fault Interrupter: Install feed-through model at locations where ground fault protection is specified for “downstream” conventional receptacles.
5. Special-Purpose Receptacle: Install in accordance with manufacturer’s instructions.

3.04 DEVICE PLATE INSTALLATION

- A. Securely fasten to wiring device; ensure tight fit to box.
- B. Flush Mounted: Install with all four edges in continuous contact with finished wall surface without use of mat or similar material. Plaster fillings will not be acceptable.
- C. Surface Mounted: Plate shall not extend beyond sides of box, unless plate has no sharp corners or edges.
- D. Install with alignment tolerance to box of 1/16 inch.
- E. Type (Exterior):
 - 1. Switch: Weatherproof.
 - 2. Receptacle in Damp Location: Weatherproof Type 1.
 - 3. Receptacle in Wet Location: Weatherproof Type 2.
- F. Type (Interior):
 - 1. Office Areas: Stainless steel.
 - 2. Other Areas: Stainless steel.
 - 3. Flush Mounted Box: Stainless steel.
 - 4. Surface Mounted, Metal Box:
 - a. General Purpose Areas (Dry, Non-process): Sheet Steel.
 - b. Other Areas: Cast metal.
 - 5. Surface Mounted, Aluminum Box:
 - a. General Purpose Areas: Stamped.
 - b. Other Areas: Cast metal.
 - 6. Surface Mounted, Sheet Steel Box: Raised sheet steel.
 - 7. Surface Mounted, Cast Box: Cast.
 - 8. Surface Mounted, Nonmetallic Box: Manufacturer's standard.
 - 9. Receptacle Shown as Weatherproof on Drawings: Weatherproof Type 1.

3.05 IDENTIFICATION

- A. Use tape labels for identification of individual wall switches and receptacles in dry indoor locations.
 - 1. Degrease and clean device plate surface to receive tape labels.
 - 2. Use 3/16-inch Kroy black letters on white background, unless otherwise indicated.
 - 3. Identify panelboard and circuit number from which item is served on face of plate.

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- B. Identify conductors with durable wire markers or tags inside outlet boxes where more than one circuit is present.

3.06 FIELD QUALITY CONTROL

- A. Perform tests and inspections, and prepare test reports.
- B. Test Instrument for 125-Volt 20-Amp Receptacle: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- C. Using test plug, verify device and its outlet box are securely mounted.
- D. Line Voltage Range: 105 volts to 132 volts.
- E. Percent Voltage Drop under 15-Amp Load: Less than 6 percent; 6 percent or higher is not acceptable.
- F. Ground Impedance: 2 ohms, maximum.
- G. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
- H. Tests shall be diagnostic, indicating damaged conductors, high resistance at circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION

**SECTION 26 41 00
FACILITY LIGHTNING PROTECTION**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. Lightning Protection Institute (LPI): 175, Standard of Practice.
 2. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 780, Standard for the Installation of Lightning Protection Systems.
 3. UL:
 - a. 96, Standard for Lightning Protection Components.
 - b. 96A, Standard for Installation Requirements for Lightning Protection Systems.

1.02 DESIGN REQUIREMENTS

- A. Provide lightning protection system design for the following structures:
1. Water Storage Tank.
- B. Design lightning protection system to comply with applicable provisions of LPI 175, UL 96, UL 96A, and NFPA 780.

1.03 SUBMITTALS

- A. Action Submittals:
1. CAD Drawings:
 - a. Lightning protection system layout.
 - b. Component locations.
 - c. Detailed plans.
 2. Down conductor.
 3. Connecting conductor.
 4. Bond strap.
 5. Air terminals.
 6. Fittings.
 7. Connectors.
 8. Ground rods.

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B. Informational Submittals:

1. Field test report.
2. Ground Witness Certification-Form LPI-175A.
3. Post-Installation Certification-Form LPI-175B.
4. UL 96 Master Label "C" Certification.

1.04 QUALITY ASSURANCE

- A. Designer: Lightning protection system design shall be prepared by an LPI-certified master designer. Shop drawings shall be stamped by the designer.
- B. System components shall be the product of a manufacturer regularly engaged in the manufacturing of lightning protection components in accordance with UL 96.
- C. Lightning protection system shall be installed under direct supervision of an LPI 175 Certified Master Installer.
- D. Inspection of final installation and grounding connection shall be performed by an LPI-certified inspector.
- E. Provide the Work in accordance with NFPA 70. Where required by Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
- F. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Materials, equipment, and accessories specified in this section shall be products of:
 1. Thompson Lightning.
 2. IPC Protection.
 3. Erico Eritech Lightning Protection Systems.

2.02 GENERAL

- A. Complete system shall bear UL 96 Master Label C.
- B. System Material: Copper or high copper content, heavy-duty bronze castings, unless otherwise specified.
- C. Material shall comply in weight, size, and composition for the class of structure to be protected as established by NFPA 780.

2.03 COMPONENTS

- A. Air Terminal:
 - 1. Material: Solid copper rods with tapered or blunt points as required for application.
 - 2. Diameter: 1/2 inch.
 - 3. Length: Sufficient to extend minimum 10 inches above object being protected.
 - 4. UL 96 Label B applied to each terminal.
- B. Conductors:
 - 1. Lightning System Conductors: Bare medium hard-drawn stranded copper, or stranded aluminum as required for the application.
 - 2. Main Down Conductor: Smooth twist stranding.
 - 3. Connecting Conductor: Concentric stranding.
 - 4. Bonding Conductor: Flexible strap, size to be determined by the designer.
 - 5. Main down and connecting conductors shall bear the UL 96 Label A, applied every 10 feet.
 - 6. Grounding Conductors: Stranded bare copper.
- C. Cable Fastener and Accessories: Capable of withstanding minimum pull of 100 pounds.
- D. Fittings:
 - 1. Heavy-duty.
 - 2. Bolts, Screws, and Related Hardware: Stainless steel.
- E. Ground Rods:
 - 1. Material: Copper-clad.
 - 2. Diameter: 3/4 inch.
 - 3. Length: 10 feet. The ground rods shall be segmented should additional depth be required for the ground rods.

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F. Grounding Connections:

1. Welds: Exothermic process.
2. Fasteners: Bolted clamp type, corrosion-resistant copper alloy.
3. Hardware: Silicone bronze.

G. Cable Connections and Splicers:

1. Welds: Exothermic process.
2. Fasteners: Bolted clamp type, corrosion-resistant copper alloy.
3. Through-Roof Connectors: Straight or right angle with bronze and lead seal flashing washer.

H. Conduit: Schedule 40 PVC, as specified in Section 26 05 33, Raceway and Boxes.

PART 3 EXECUTION

3.01 GENERAL

- A. Workmanship to comply with all applicable provisions of LPI 175, UL 96, UL 96A, and NFPA 780.
- B. Aluminum materials shall be used where required to meet the galvanic corrosion requirements of UL 96A.
- C. Provide pitchpockets or method compatible with roofing to waterproof roof penetrations.
- D. Install system in inconspicuous manner so components blend with building aesthetics.

3.02 EXAMINATION

- A. Verify conditions prior to installation. Actual conditions may require adjustments in air terminal and ground rod locations.

3.03 INSTALLATION

A. Air Terminals:

1. Supports: Brackets or braces.
2. Parapet Bracket Attachment: Lag or expansion bolts.
3. Secure base to roof surface with adhesive or pitch compatible with roofing bond.

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4. Provide terminal flashing at roof penetrations.
5. Perimeter Terminals:
 - a. Maximum Spacing: 20 feet.
 - b. Maximum Distance From Outside Edge of Building: 2 feet.
6. Roof Ridge Terminals: Maximum spacing 20 feet.
7. Mid-Roof Terminals: Maximum spacing 50 feet.
8. Provide blunt point air terminals for applications exposed to personnel.

B. Conductors:

1. Conceal whenever practical.
2. Provide 1-inch PVC conduit in building walls or columns for main downloads and roof risers.
3. Support: Maximum spacing for exposed conductors.
 - a. Vertical: 3 foot.
 - b. Horizontal: 4 foot.
4. Maintain horizontal and vertical conductor courses free from dips or pockets.
5. Bends: Maximum 90 degrees, with minimum 8-inch radius.
6. Install air terminal conductors on the structural roof surface before roofing composition is applied.

C. Bonding:

1. Bond to Main Conductor System:
 - a. Roof-mounted ventilators, fans, air handlers, masts, flues, cooling towers, handrails, and other sizeable metal objects.
 - b. Roof flashing, gravel stops, insulation vents, ridge vents, roof drains, soil pipe vents, and other small metal objects if located within 6 feet of main conductors or another grounded object.
2. Bond each steel column or major framing members to grounding system.
3. Bond each main down conductor to grounding system.

D. Grounding System:

1. Grounding Conductor:
 - a. Completely encircle building structure.
 - b. Bury minimum 1 foot below finished grade.
 - c. Minimum 2 feet from foundation walls.
2. Interconnect ground rods by direct-buried copper cables.
3. Maximum Resistance: 5 ohms when connected to ground rods.

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4. Connections:
 - a. Install ground cables continuous between connections.
 - b. Exothermic welded connections to ground rods, cable trays, structural steel, handrails, and buried and nonaccessible connections.
 - c. Provide bolted clamp type mechanical connectors for all exposed secondary connections.
 - d. Use bolted offset parapet bases or through-roof concealed base assemblies for air terminal connections.
 - e. Provide interconnections with electrical and telephone systems and all underground water, gas, and sewer metal pipes.
 - f. Provide electric service arrestor ground wire to building water main.

3.04 FIELD QUALITY CONTROL

A. Field Testing:

1. Isolate lightning protection system from other ground conditions while performing tests.
2. Resistance: Test ground resistance of grounding system by the fall-of-potential method.
 - a. Test Resistance to Ground: Maximum 5 ohms.
 - b. Install additional ground rods as required to obtain maximum allowable resistance.
3. Test Report:
 - a. Description of equipment tested.
 - b. Description of test.
 - c. Test results.
 - d. Conclusions and recommendations.
 - e. Appendix, including appropriate test forms.
 - f. Identification of test equipment used.
 - g. Signature of responsible test organization authority.

END OF SECTION

SECTION 26 43 00
SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American National Standards Institute (ANSI).
 2. Department of Defense: MIL-STD-220C, Test Method Standard – Method of Insertion Loss Measurement.
 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C62.41.1, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
 - b. C62.41.2, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1,000 V and less) AC Power Circuits.
 - c. C62.45, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1,000 V and less) AC Power Circuits.
 4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 5. UL:
 - a. 497A, Standard for Secondary Protectors for Communications Circuits.
 - b. 1283, Standard for Electromagnetic Interference Filters.
 - c. 1449, Standard for Surge Protective Devices.

1.02 SUBMITTALS

- A. Action Submittals:
1. Product data on each suppressor type, indicating component values, part numbers, and conductor sizes. Include dimensional drawing for each, showing mounting arrangements.
 2. Electrical single-line diagram showing location of each SPD.
 3. Manufacturer's UL certified test data and nameplate data for each surge protective device (SPD).

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1.03 QUALITY ASSURANCE

- A. UL Compliance and Labeling:
 - 1. SPDs for Power and Signal Circuits: Comply with UL 1449 and complimentary listed to UL 1283 as an electromagnetic interference filter. Provide units listed and labeled by UL.
 - 2. SPDs for Telephone Circuit Protection: Comply with UL 497A.
- B. ANSI Compliance: Use SPD devices in compliance with the recommendations of IEEE C62.41.1, IEEE C62.41.2, and IEEE C62.45.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Eaton, SPD Series.
- B. General Electric, Tranquell.
- C. Square D, Surelogic.

2.02 GENERAL

- A. Unless indicated otherwise, provide direct bus-connected and factory-installed SPDs inside distribution equipment.
- B. SPD Operating Conditions: Capable of performing at ambient temperatures between minus 40 degrees C and 60 degrees C, at relative humidity ranging from 0 percent to 95 percent, and at altitudes ranging from sea level to 12,000 feet.
- C. Connect SPDs through a fused switch or circuit breaker as selected by manufacturer. Provide overcurrent protection to allow full surge handling capabilities and afford safety protection from thermal overloads and short circuits.
- D. SPD Short Circuit Current Rating (SCCR): No less than the SCCR of distribution equipment.
- E. Design SPD devices to protect all modes (L-L, L-N, L-G, N-G) of electrical system being used.
- F. Power Filter: Include a high-frequency extended range power filter for each SPD complimentary listed to UL 1283 as an electromagnetic interference filter.

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- G. Provide SPDs with the following monitoring and diagnostics:
 - 1. LED-type indication lights to show normal and failed status of each protected phase.
 - 2. Surge event counter.
 - 3. Form C dry contact which operates when unit fails.
- H. Provide UL Type 2 SPDs.
- I. EMI/RFI Noise Suppression: -50dB attenuation at 100 kHz, tested per MIL-STD 220C.
- J. Voltage Protection Rating (VPR):

Voltage Rating	L-N	N-G	L-G	L-L
208Y/120	800	800	800	1200
480Y/277	1200	1200	1200	2000
240 Δ	--	--	1200	1200
480 Δ	--	--	2000	2000

2.03 SERVICE ENTRANCE AND DISTRIBUTION SPD

- A. Provide SPD meeting IEEE C62.41.1 and IEEE C62.41.2 Location in accordance with Category C.
- B. Surge Current Capacity:
 - 1. Service Entrance:
 - a. 200 kA per phase.
 - b. 100 kA per mode.
 - 2. Distribution:
 - a. 120 kA per phase.
 - b. 60 kA per mode.
- C. Maximum Continuous Operating Voltage (MCOV): Not less than 115 percent of nominal system voltage.
- D. Nominal Discharge Current (I_N): 20kA.

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2.04 PANELBOARD SPD

- A. Provide SPD meeting IEEE C62.41.1 and IEEE C62.41.2 Location in accordance with Category B.
- B. Surge Current Capacity:
 - 1. Distribution: 120 kA per phase; 60 kA per mode.
 - 2. Branch: 80 kA per phase; 40 kA per mode
- C. Maximum Continuous Operating Voltage (MCOV): Not less than 125 percent of the nominal system voltage.
- D. Nominal Discharge Current (I_N): 10kA.

2.05 PAIRED CABLE DATA LINE INTERIOR SUPPRESSORS

- A. Provide units meeting IEEE C62.41, Location Category A.
- B. Use bi-polar 1,500-watt silicon avalanche diodes between protected conductor and earth ground.
- C. Provide units with a maximum single impulse current rating of 80 amperes (10 by 1,000 microsecond-waveform).
- D. Breakdown voltage shall not exceed 36 volts.

2.06 PAIRED CABLE DATA LINE EXTERIOR SUPPRESSORS

- A. Provide units meeting IEEE C62.41, Location Category A.
- B. Design Requirements: A hybrid design with a minimum of three stages, using solid-state components and operating bi-directionally.
- C. Meet or exceed the following criteria:
 - 1. Maximum single impulse current rating of 10,000 amperes (8 by 20 microsecond-waveform).
 - 2. Pulse Life Rating: 3,000 amperes (8 by 20 microsecond-waveform); 2,000 occurrences.
 - 3. Maximum clamping voltage at 10,000 amperes (8 by 20 microsecond current waveform), shall not exceed the peak of normal applied signal voltage by 200 percent.

PART 3 EXECUTION

3.01 APPLICATION REQUIREMENTS

- A. Provide SPDs when indicated on Drawings or in the equipment specifications.
- B. Provide factory-installed SPDs as integral components to new switchgear, switchboards, motor control centers, panelboards and transfer switches. Externally mounted SPDs are not acceptable for new distribution equipment.
- C. Externally mounted SPDs are acceptable for SPDs added to existing equipment as described below.
- D. Electronic Equipment Paired Cable Conductors: Install data line suppressors at the low voltage input and output of each piece of equipment, including telephone cable entrance.
 - 1. Use secondary protectors on lines that do not exit the structure.
 - 2. Use primary protectors on lines that exit and enter the structure.

3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Install suppressors according to manufacturer's recommendations.
- B. Install suppressors directly to the cabinet which houses the circuit to be protected so that the suppressor leads are straight and short, with conductors laced, running directly to the point of connection within the panel, without loops or bends. If bends are unavoidable, no bend may exceed 90 degrees and bending radius may not be less than 6 inches.
- C. Provide connecting wires as short as possible with gently twisted conductors, tied together, to prevent separation.
 - 1. Maximum Length: 24 inches.
- D. Field Installed Conductors: As specified for building wire, not smaller than 8 AWG and not larger than 4 AWG. Provide device leads not longer than the maximum length recommended by manufacturer, unless specifically reviewed and approved by manufacturer.
- E. Provide dedicated disconnecting means for SPD devices installed at main service entrance location, switchgear, and motor control centers. Provide dedicated 30-60-ampere circuit breakers (size dependent upon wire size used) with number of poles as required, as disconnecting means for SPD devices. Provide circuit breakers with interrupting capacity equal to that specified for other breakers at that location.

END OF SECTION

**SECTION 31 09 18
STATIC PILE TESTING**

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM): D1143, Standard Test Method for Piles Under Static Axial Compressive Load.

1.02 DEFINITIONS

- A. Load Test: Axial witnessed by the Engineer on test piles and production piles selected by Engineer for test loading.
- B. Plunging Failure: 3 inches of movement with no increase in load.
- C. Production Piles: Piles incorporated into the Work, utilizing a uniform selection of materials and workmanship, and which are determined acceptable by Engineer based on observation and pile test results.
- D. Test Piles: Piles constructed of same equipment, materials, procedures and workmanship as production piles. Test pile can be used as production pile if approved by the Engineer, and if the pile is not damaged and is not loaded to plunging failure as defined herein.

1.03 SUBMITTALS

A. Action Submittals:

1. Load transfer assembly designed by professional engineer in the State of Florida.
2. Dimensioned sketch of the loading arrangement, including sizes of primary members.

B. Informational Submittals:

1. Qualifications: Testing agency and testing instrumentation installer.
2. Load test procedures. At minimum submit the following:
 - a. Minimum (i) test descriptions, (ii) forms, and (iii) checklists to be used to control and document each required load test.
 - b. Description of specific test to be performed.

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- c. Provide space(s) after each test description for Contractor, Engineer, and testing agency, to certify that successful testing, in accordance with referenced standards, has been completed.
3. Load System: Detailed method for providing load beam reactions for test pile including reference beam, dial setups, and telltale installation.
4. Certifications of Calibration:
 - a. Calibrate as a unit each jacking system to be used during static load tests, including gauges for measuring load, and pressure, and dial gauges for measuring deformation.
 - b. Submit at least 10 days prior to commencement of testing.
5. Load test record data.
6. Test record documents.

1.04 QUALIFICATIONS

- A. Testing Agency: Independent, certified, and with at least 5 years of experience in similar testing including installing instrumentation, performing testing, monitoring specified testing, analyzing data.
- B. Testing Instrumentation Installer: Testing Agency with at least 5 years of experience in installation of the test pile instrumentation.

1.05 INSTRUMENTATION PREINSTALLATION MEETING

- A. Discussion to include details and scheduling of instrumentation installation, test procedures, and monitoring and installing test piles, and acceptance/rejection procedures.
- B. Attended by Contractor, Engineer, Testing Agency, and pile installation personnel, before starting Work specified under this section.

1.06 TESTING SCHEDULE

- A. The load tests shall be conducted no sooner than 7 days after installation of the test piles.

1.07 TEST LOCATIONS

- A. Load test shall be conducted at 3 test pile locations selected by Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 LOAD TEST PROCEDURES

- A. Engineer's acceptance required prior to commencement of respective testing.

3.02 LOAD TEST RECORD DATA

- A. Record for each pile tested, include minimum:
 1. Installation data, as specified in Section 31 63 16, Auger Cast-in-Place Piles.
 2. Report: In accordance with referenced standard for load test performed.
 3. Schedule of loading.
 4. Method of load application.
 5. Method of measuring loads.
 6. Log-time for each load increment.
 7. Load versus settlement.
 8. Settlement versus time.
 9. Creep settlement vs. load.
 10. Load Limit: Based on Davisson criteria.

3.03 TEST RECORD DOCUMENTS

- A. Test Procedures: Engineer accepted versions of load increments and durations, certified versions, and while testing is in progress, daily updated version.
- B. List of piles to be tested.
- C. Updated versions of documentation required for testing.
- D. Certifications of calibration.
- E. Load test record data.

3.04 TEST PILE INSTALLATION

- A. Meet requirements specified in Section 31 63 16, Auger Cast-in-Place Piles, for production.

3.05 AXIAL LOAD TEST EQUIPMENT

- A. Apparatus: ASTM D1143, Section 6, capable of applying incremental static loads.

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- B. Calibrated Load Cell:
 - 1. ASTM D1143, Section 6.2.
 - 2. Calibrated Capacity: 1.2 times specified test load.
 - 3. Spherical bearing plate.
 - 4. Digital readout.
- C. Pile Movement Measuring Apparatus: ASTM D1143, Section 7.
 - 1. Precision: 0.001 inch.
 - 2. Furnish materials necessary for proper attachment and monitoring of test pile.
 - 3. Provide gauge blocks to increase dial gauge travel an additional 4 inches.
 - 4. Provide a backup system for measuring vertical movement as specified in Sections 7.2.3 or 7.2.4.
 - 5. Section 7.2.5, Other Types of Measuring Apparatus, shall not apply.
- D. Telltales: Two steel rods, extending to toe, and 20 feet up from the toe, of each pile as described in ASTM D1143, Section 7.4, Pile Compression and Strain Measurements, for measurement of pile toe movement.
- E. Load Transfer Assembly: Furnish, as shown in Figure 7 of ASTM D1143, so that telltale rod can exit through test pile top.
- F. Furnish load frame, reaction Kentledge/ballast, connections, and all other materials necessary to set up and execute the static pile load test as specified.
- G. Furnish materials for shielding load test equipment from sun, wind, and precipitation as specified in ASTM D1143.

3.06 LOAD TESTING

- A. Provide 14 days prior notice to Engineer.
- B. Install complete load system to satisfactorily perform each required pile loading test. Erect load frame for compression and tension testing.
- C. Conduct testing in presence of Engineer and only after Engineer's acceptance of load testing and reaction Kentledge and frame.
- D. Construction operations producing discernible vibrations shall not be performed within 100 feet of pile test in progress.

3.07 COMPRESSION LOAD TESTING

- A. Compression load test shall be conducted to two times of the design allowable compression capacity.
- B. Just prior to loading test pile, establish elevation of pile tops.
- C. Perform survey reads on the test pile and reference beam at least twice during each load increment as follows:
 - 1. At 2 minutes after new load is applied.
 - 2. Just prior to load increment increase.
- D. Perform in general accordance with ASTM D1143, as modified herein.
- E. Quick Load Test Method:
 - 1. Test piles in general accordance with ASTM D1143, with some modifications for reading instrumentation.
 - 2. Apply test load in approximately 5-ton increments.
 - 3. Maintain each load increment for 10 minutes.
 - 4. After final holding time, remove test load in 5-ton increments with 10 minutes between increments.
 - 5. Continue increasing testing load until plunging failure occurs or ultimate capacity is reached or Engineer elects to terminate further loading, whichever occurs first.

END OF SECTION

**SECTION 31 10 00
SITE CLEARING**

PART 1 GENERAL

1.01 DEFINITIONS

- A. Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying.
- B. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.
- C. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2-inch caliper to a depth of 12 inches below subgrade.
- D. Stripping: Removal of topsoil and sod.
- E. Scalping: Removal of upper soil layer by mechanical means in a 2 to 3 feet wide by 2 to 4 inch deep furrow.
- F. Project Limits: Areas, as shown or specified, within which Work is to be performed.

1.02 SUBMITTALS

- A. Action Submittals: Drawings clearly showing clearing, grubbing, and stripping limits.

1.03 QUALITY ASSURANCE

- A. Obtain Engineer's approval of staked clearing, grubbing, and stripping limits, prior to commencing clearing, grubbing, and stripping.

1.04 SCHEDULING AND SEQUENCING

- A. Prepare Site only after adequate erosion and sediment controls are in place. Limit areas exposed uncontrolled to erosion during installation of temporary erosion and sediment controls to maximum of 1/2 acres.

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PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Clear and grub areas needed for Site improvements within limits shown or specified. Strip areas as need for structural and foundation purposes.
- B. Do not injure or deface vegetation that is not designated for removal.

3.02 LIMITS

- A. As follows, but not to extend beyond Project limits.
 - 1. Excavation Excluding Trenches: 5 feet beyond top of cut slopes.
 - 2. Trench Excavation: 3 feet from outer edges of trench width.
 - 3. Fill:
 - a. Clearing and Grubbing: 5 feet beyond toe of permanent fill.
 - b. Stripping: 2 feet beyond toe of permanent fill.
 - 4. Structures: 10 feet outside footprint of new structures.
 - 5. Roadways: Clearing and grubbing: 5 feet from outer edges of proposed road.
 - 6. Overhead Utilities:
 - a. Clearing and Grubbing: Entire width of easements and rights-of-way.
 - Stripping and Scalping: Wherever grading is required.
 - 7. Other Areas: As shown.
- B. Remove rubbish, trash, and junk from entire area within Project limits.

3.03 CLEARING

- A. Clear areas within limits shown or specified.
- B. Fell trees so that they fall away from facilities and vegetation not designated for removal.
- C. Completely remove and dispose of tree stumps under proposed structures, yard piping, electric duck banks, pads and roadways.

- D. Stumps not under proposed facilities can remain, but must be cut to a minimum of 12 inches from ground surface.
- E. Cut off shrubs, brush, weeds, and grasses to within 3 inches of ground surface.

3.04 GRUBBING

- A. Grub areas within limits shown or specified.

3.05 STRIPPING

- A. Strip areas within limits of foundations and structures as specified.
- B. Store topsoil on site for reuse in areas approved by the Engineer.

3.06 SCALPING

- A. Scalp areas within limits shown or specified.

3.07 TREE REMOVAL

- A. Remove Within Project Limits and as specified on the Drawings:
 - 1. Dead, dying, leaning, or otherwise unsound trees that may strike and damage Project facilities in falling.
 - 2. Trees designated by Engineer.
- B. Completely remove and dispose of tree stumps under proposed structures, yard piping, electric duck banks, pads and roadways.
- C. Stumps not under proposed facilities can remain, but must be cut to a minimum of 12 inches from ground surface.

3.08 SALVAGE

- A. Saleable log timber may be sold to Contractor's benefit. Promptly remove from Project Site.

3.09 DISPOSAL

- A. Clearing, Grubbing and Stripping Debris:
 - 1. Dispose of debris offsite.
 - 2. Burning of debris onsite will not be allowed.

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3. Woody debris may be chipped. Chips may be sold to Contractor's benefit or used for landscaping onsite as mulch or uniformly mixed with topsoil, provided that resulting mix will be fertile and not support combustion. Maximum dimensions of chipped material used onsite shall be 1/4 inch by 2 inches. Dispose of chips that are unsaleable or unsuitable for landscaping or other uses with unchipped debris.
4. Limit offsite disposal of clearing and grubbing debris to locations that are approved by federal, state, and local authorities.

END OF SECTION

**SECTION 31 23 23
FILL AND BACKFILL**

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
 - a. C117, Standard Test Method for Materials Finer Than 75-Micrometers (No. 200) Sieve in Mineral Aggregates by Washing.
 - b. C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - c. D75, Standard Practice for Sampling Aggregates.
 - d. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - e. D1556, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
 - f. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - g. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - h. D4254, Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - i. D6938, Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.02 DEFINITIONS

A. Relative Compaction:

1. Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM D1557.
2. Apply corrections for oversize material to either as-compacted field dry density or maximum dry density, as determined by Engineer.

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- B. Optimum Moisture Content:
 - 1. Determined in accordance with ASTM Standard specified to determine maximum dry density for relative compaction.
 - 2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.
- C. Relative Density: Calculated in accordance with ASTM D4254 based on maximum index density determined in accordance with ASTM D4253 and minimum index density determined in accordance with ASTM D4254.
- D. Prepared Ground Surface: Ground surface after completion of required demolition, clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and subgrade preparation.
- E. Completed Course: A course or layer that is ready for next layer or next phase of Work.
- F. Lift: Loose (uncompacted) layer of material.
- G. Geosynthetics: Geotextiles, geogrids, or geomembranes.
- H. Well-Graded:
 - 1. A mixture of particle sizes with no specific concentration or lack thereof of one or more sizes.
 - 2. Does not define numerical value that must be placed on coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters.
 - 3. Used to define material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.
- I. Influence Area: Area within planes sloped downward and outward at 60-degree angle from horizontal measured from:
 - 1. 1 foot outside outermost edge at base of foundations or slabs.
 - 2. 1 foot outside outermost edge at surface of roadways or shoulder.
 - 3. 0.5 foot outside exterior at spring line of pipes or culverts.
- J. Borrow Material: Material from required excavations or from designated borrow areas on or near Site.
- K. Selected Backfill Material: Materials available onsite that Engineer determines to be suitable for specific use.

- L. Imported Material: Materials obtained from sources offsite, suitable for specified use.
- M. Structural Fill: Fill materials as required under structures, pavements, and other facilities.
- N. Embankment Material: Fill materials required to raise existing grade in areas other than under structures.

1.03 SUBMITTALS

- A. Informational Submittals: Certified test results from independent testing agency.

1.04 QUALITY ASSURANCE

- A. Notify Engineer when: Fill material appears to be deviating from Specifications.

1.05 SEQUENCING AND SCHEDULING

- A. Complete applicable Work specified in Section 31 23 16, Excavation; and Section 31 23 13, Subgrade Preparation, prior to placing fill or backfill.
- B. Obtain Engineer's acceptance of concrete work and attained strength prior to placing backfill.
- C. Backfill around water-holding structures only after completion of satisfactory leakage tests as specified in Section 03 40 00, Precast Concrete.
- D. Do not place granular base, subbase, or surfacing until after subgrade has been prepared as specified in Section 31 23 13, Subgrade Preparation.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

- A. Gradation Tests: As necessary to locate acceptable sources of imported material.

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2.02 EARTHFILL

- A. Excavated material from required excavations free from rocks larger than 3 inches, from roots and other organic matter, ashes, cinders, trash, debris, and other deleterious materials.
- B. Provide imported material of equivalent quality, if required to accomplish Work.

2.03 GRANULAR FILL

- A. 1-inch minus crushed gravel or crushed rock.
- B. Free from dirt, clay balls, and organic material.
- C. Well-graded from coarse to fine and containing sufficient fines to bind material when compacted, but with maximum 8 percent by weight passing No. 200 sieve.

2.04 SAND

- A. Free from clay, organic matter, or other deleterious material.
- B. Gradation as determined in accordance with ASTM C117 and ASTM C136:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
1/4-inch	100
No. 4	95 - 100
No. 200	0 - 8

2.05 WATER FOR MOISTURE CONDITIONING

- A. Free of hazardous or toxic contaminants, or contaminants deleterious to proper compaction.

PART 3 EXECUTION

3.01 GENERAL

- A. Keep placement surfaces free of water, debris, and foreign material during placement and compaction of fill and backfill materials.

- B. Place and spread fill and backfill materials in horizontal lifts of uniform thickness, in a manner that avoids segregation, and compact each lift to specified densities prior to placing succeeding lifts. Slope lifts only where necessary to conform to final grades or as necessary to keep placement surfaces drained of water.
- C. During filling and backfilling, keep level of fill and backfill around each structure and buried tank even.
- D. Do not place fill or backfill, if fill or backfill material is frozen, or if surface upon which fill or backfill is to be placed is frozen.
- E. If pipe, conduit, duct bank, or cable is to be laid within fill or backfill:
 - 1. Fill or backfill to an elevation 2 feet above top of item to be laid.
 - 2. Excavate trench for installation of item.
 - 3. Install bedding, if applicable, as specified in Section 31 23 23.15, Trench Backfill.
 - 4. Install item.
 - 5. Backfill envelope zone and remaining trench, as specified in Section 31 23 23.15, Trench Backfill, before resuming filling or backfilling specified in this section.
- F. Tolerances:
 - 1. Final Lines and Grades: Within a tolerance of 0.1 foot unless dimensions or grades are shown or specified otherwise.
 - 2. Grade to establish and maintain slopes and drainage as shown. Reverse slopes are not permitted.
- G. Settlement: Correct and repair any subsequent damage to structures, pavements, curbs, slabs, piping, and other facilities, caused by settlement of fill or backfill material.

3.02 BACKFILL UNDER AND AROUND STRUCTURES

- A. Under Facilities: Within influence area beneath structures, slabs, pavements, curbs, piping, conduits, duct banks, and other facilities, backfill with granular fill, unless otherwise shown. Place granular fill in lifts of 6-inch maximum thickness and compact each lift to minimum of 95 percent relative compaction as determined in accordance with ASTM D1557.
- B. Other Areas: Backfill with earthfill to lines and grades shown, with proper allowance for topsoil thickness where shown. Place in lifts of 6-inch maximum thickness and compact each lift to minimum 90 percent relative compaction as determined in accordance with ASTM D1557.

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3.03 FILL

- A. Outside Influence Areas beneath Structures, Tanks, Pavements, Curbs, Slabs, Piping, and Other Facilities: Unless otherwise shown, place earthfill as follows:
1. Allow for 6-inch thickness of topsoil where required.
 2. Maximum 8-inch thick lifts.
 3. Place and compact fill across full width of embankment.
 4. Compact to minimum 90 percent relative compaction as determined in accordance with ASTM D1557.
 5. Dress completed embankment with allowance for topsoil, crest surfacing, and slope protection, where applicable.

3.04 SITE TESTING

- A. Gradation:
1. One sample from each 100 tons of finished product or more often as determined by Engineer, if variation in gradation is occurring, or if material appears to depart from Specifications.
 2. If test results indicate material does not meet Specification requirements, terminate material placement until corrective measures are taken.
 3. Remove material placed in Work that does not meet Specification requirements.
- B. In-Place Density Tests: In accordance with ASTM D1556. During placement of materials, test as follows:
1. Granular Fill: One test per 1,000 square feet of each lift, or one test per lift, more stringent applies.

3.05 REPLACING OVEREXCAVATED MATERIAL

- A. Replace excavation carried below grade lines shown or established by Engineer as follows:
1. Beneath Footings: Granular fill.
 2. Beneath Fill or Backfill: Same material as specified for overlying fill or backfill.

END OF SECTION

**SECTION 31 23 23.15
TRENCH BACKFILL**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Public Works Association (APWA): Uniform Color Code.
 2. ASTM International (ASTM):
 - a. C33/C33M, Standard Specification for Concrete Aggregates.
 - b. C94/C94M, Standard Specification for Ready-Mixed Concrete.
 - c. C117, Standard Test Method for Materials Finer than 75 Micrometer (No. 200) Sieve in Mineral Aggregates by Washing.
 - d. C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - e. C150/C150M, Standard Specification for Portland Cement.
 - f. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 - g. C1012/C1012M, Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution.
 - h. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - i. D1140, Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75 micrometer) Sieve.
 - j. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - k. D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 - l. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - m. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - n. D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 - o. D4832, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
 3. National Electrical Manufacturers Association (NEMA): Z535.1, Safety Colors.

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1.02 DEFINITIONS

- A. Base Rock: Granular material upon which manhole bases and other structures are placed.
- B. Bedding Material: Granular material upon which pipes, conduits, cables, or duct banks are placed.
- C. Imported Material: Material obtained by Contractor from source(s) offsite.
- D. Lift: Loose (uncompacted) layer of material.
- E. Pipe Zone: Backfill zone that includes full trench width and extends from prepared trench bottom to an upper limit above top outside surface of pipe, conduit, cable or duct bank.
- F. Prepared Trench Bottom: Graded trench bottom after excavation and installation of stabilization material, if required, but before installation of bedding material.
- G. Relative Compaction: The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by ASTM D1557. Corrections for oversize material may be applied to either as-compacted field dry density or maximum dry density, as determined by Engineer.
- H. Relative Density: As defined by ASTM D4253 and ASTM D4254.
- I. Selected Backfill Material: Material available onsite that Engineer determines to be suitable for a specific use.
- J. Well-Graded: A mixture of particle sizes that has no specific concentration or lack thereof of one or more sizes producing a material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids. Satisfying both of the following requirements, as defined in ASTM D2487:
 - 1. Coefficient of Curvature: Greater than or equal to 1 and less than or equal to 3.
 - 2. Coefficient of Uniformity: Greater than or equal to 4 for materials classified as gravel, and greater than or equal to 6 for materials classified as sand.

PART 2 PRODUCTS

2.01 MARKING TAPE

A. Detectable:

1. Solid aluminum foil, visible on unprinted side, encased in protective high visibility, inert polyethylene plastic jacket.
2. Foil Thickness: Minimum 0.35 mils.
3. Laminate Thickness: Minimum 5 mils.
4. Width: 6 inches.
5. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.
6. Joining Clips: Tin or nickel-coated furnished by tape manufacturer.
7. Manufacturers and Products:
 - a. Reef Industries; Terra Tape, Sentry Line Detectable.
 - b. Mutual Industries; Detectable Tape.
 - c. Presco; Detectable Tape.

B. Color: In accordance with APWA Uniform Color Code.

Color*	Facility
Green	Sewers and drain lines
*As specified in NEMA Z535.1, Safety Color Code.	

2.02 BEDDING MATERIAL AND PIPE ZONE MATERIAL

A. Unfrozen, friable, and no clay balls, roots, or other organic material.

B. Clean or gravelly sand with less than 5percent passing No. 200 sieve, as determined in accordance with ASTM D1140, or gravel or crushed rock within maximum particle size and other requirements as follows unless otherwise specified.

1. Duct Banks: 3/4-inch maximum particle size.
2. Pipe Under 18-Inch Diameter: 3/4-inch maximum particle size, except 1/4 inch for stainless steel pipe, copper pipe, tubing, and plastic pipe under 3-inch diameter.

2.03 EARTH BACKFILL

A. Soil, loam, or other excavated material suitable for use as backfill.

B. Free from roots or organic matter, refuse, boulders and material larger than 1/2 cubic foot, or other deleterious materials.

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PART 3 EXECUTION

3.01 TRENCH PREPARATION

- A. Water Control:
 - 1. As specified in Section 31 23 19.01, Dewatering.
 - 2. Remove water in a manner that minimizes soil erosion from trench sides and bottom.
 - 3. Provide continuous water control until trench backfill is complete.
- B. Remove foreign material and backfill contaminated with foreign material that falls into trench.

3.02 TRENCH BOTTOM

- A. Firm Subgrade: Grade with hand tools, remove loose and disturbed material, and trim off high areas and ridges left by excavating bucket teeth. Allow space for bedding material if shown or specified.
- B. Soft Subgrade: If subgrade is encountered that may require removal to prevent pipe settlement, notify Engineer. Engineer will determine depth of overexcavation, if any required.

3.03 BEDDING

- A. Furnish imported bedding material where, in the opinion of Engineer, excavated material is unsuitable for bedding or insufficient in quantity.
- B. Place over full width of prepared trench bottom in two equal lifts when required depth exceeds 8 inches.
- C. Hand grade and compact each lift to provide a firm, unyielding surface.
- D. Minimum Thickness: 4 inches.
- E. Check grade and correct irregularities in bedding material. Loosen top 1 inch to 2 inches of compacted bedding material with a rake or by other means to provide a cushion before laying each section of pipe, conduit, direct-buried cable, or duct bank.
- F. Install to form continuous and uniform support except at bell holes, if applicable, or minor disturbances resulting from removal of lifting tackle.
- G. Bell or Coupling Holes: Excavate in bedding at each joint to permit proper assembly and inspection of joint and to provide uniform bearing along barrel of pipe or conduit.

3.04 BACKFILL PIPE ZONE

- A. Minimize movement during backfill operations.
- B. Place material simultaneously in lifts on both sides of pipe and, if applicable, between pipes, conduit, cables, and duct banks installed in same trench.
 - 1. Pipe 10-Inch and Smaller Diameter: First lift less than or equal to 1/2 pipe diameter.
 - 2. Pipe Over 10-Inch Diameter: Maximum 6-inch lifts.
- C. Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by “walking in” and slicing material under haunches with a shovel to ensure voids are completely filled before placing each succeeding lift.

3.05 MARKING TAPE INSTALLATION

- A. Continuously install marking tape along centerline of buried piping, at depth of 2 feet. Coordinate with piping installation drawings.

3.06 BACKFILL ABOVE PIPE ZONE

- A. General:
 - 1. Process excavated material to meet specified gradation requirements.
 - 2. Adjust moisture content as necessary to obtain specified compaction.
 - 3. Do not allow backfill to free fall into trench or allow heavy, sharp pieces of material to be placed as backfill until after at least 2 feet of backfill has been provided over top of pipe.
 - 4. Do not use power driven impact type compactors for compaction until at least 4 feet of backfill is placed over top of pipe.
 - 5. Backfill to grade with proper allowances for topsoil, crushed rock surfacing, and pavement thicknesses, wherever applicable.
 - 6. Backfill around structures with same class backfill as specified for adjacent trench, unless otherwise shown or specified.
- B. Class A Backfill:
 - 1. Place in lifts not exceeding thickness of 9 inches.
 - 2. Mechanically compact each lift to a minimum of 95 percent relative compaction.

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3.07 MAINTENANCE OF TRENCH BACKFILL

- A. After each section of trench is backfilled, maintain surface of backfilled trench even with adjacent ground surface until final surface restoration is completed.
- B. Concrete Pavement: Replace settled slabs as specified in Section 32 12 16, Asphalt Paving.
- C. Asphaltic Pavement: Replace settled areas or fill with asphalt as specified in Section 32 12 16, Asphalt Paving.
- D. Other Areas: Add excavated material where applicable and keep surface of backfilled trench level with adjacent ground surface.

3.08 SETTLEMENT OF BACKFILL

- A. Settlement of trench backfill, or of fill, or facilities constructed over trench backfill will be considered a result of defective compaction of trench backfill.

END OF SECTION

**SECTION 31 32 19.16
GEOTEXTILE**

PART 1 GENERAL

1.01 DEFINITIONS

- A. Fabric: Geotextile, a permeable geosynthetic comprised solely of textiles.
- B. Maximum Average Roll Value (MaxARV): Maximum of series of average roll values representative of geotextile furnished.
- C. Minimum Average Roll Value (MinARV): Minimum of series of average roll values representative of geotextile furnished.
- D. Nondestructive Sample: Sample representative of finished Work, prepared for testing without destruction of Work.
- E. Overlap: Distance measured perpendicular from overlapping edge of one sheet to underlying edge of adjacent sheet.
- F. Seam Efficiency: Ratio of tensile strength across seam to strength of intact geotextile, when tested according to ASTM D4884.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Manufacturer material specifications and product literature.
- B. Informational Submittals:
 - 1. Certifications from each geotextile manufacturer that furnished products have specified property values. Certified property values shall be either minimum or maximum average roll values, as appropriate, for geotextiles furnished.
 - 2. Field seam efficiency test results.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Deliver each roll with sufficient information attached to identify it for inventory and quality control.

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- B. Handle products in manner that maintains undamaged condition.
- C. Do not store products directly on ground. Ship and store geotextile with suitable wrapping for protection against moisture and ultraviolet exposure. Store geotextile in way that protects it from elements. If stored outdoors, elevate and protect geotextile with waterproof cover.

1.04 SCHEDULING AND SEQUENCING

- A. Where geotextile is to be laid directly upon ground surface, prepare subgrade as specified in Section 31 23 13, Subgrade Preparation, first.
- B. Notify Engineer whenever geotextiles are to be placed. Do not place geotextile without Engineer's approval of underlying materials.

PART 2 PRODUCTS

2.01 NONWOVEN GEOTEXTILE

- A. Pervious sheet of polyester, polypropylene, or polyethylene fabricated into stable network of fibers that retain their relative position with respect to each other. Nonwoven geotextile shall be composed of continuous or discontinuous (staple) fibers held together through needle-punching, spun-bonding, thermal-bonding, or resin-bonding.
- B. Geotextile Edges: Selvaged or otherwise finished to prevent outer material from pulling away from geotextile.
- C. Unseamed Sheet Width: Minimum 12 feet.
- D. Physical Properties: Conform to requirements in Table No. 2.

Table No. 2 Physical Property Requirements for Nonwoven Geotextile		
Property	Requirement	Test Method
Water Permittivity	0.5 sec. ⁻¹ , MinARV	ASTM D4491 (Falling Head)
Apparent Opening Size (AOS)	No. 100 U.S. Standard Sieve Size	ASTM D4751
Grab Tensile Strength, Machine Direction	375 lb/in, MinARV	ASTM D4632
Grab Elongation, Machine Direction	50 percent, MaxARV	ASTM D4632

Table No. 2 Physical Property Requirements for Nonwoven Geotextile		
Property	Requirement	Test Method
Puncture Strength	225 lb, MinARV	ASTM D4833
Trapezoid Tear Strength	125 lb, MinARV	ASTM D4533
Ultraviolet Radiation Resistance	70 percent strength retention, MinARV after 500 hours	ASTM D4355

2.02 SEWING THREAD

- A. Polypropylene, polyester, or Kevlar thread.
- B. Durability: Equal to or greater than durability of geotextile sewn.

2.03 SECURING PINS

- A. Steel Rods or Bars:
 - 1. 3/16-inch diameter.
 - 2. Pointed at one end.
 - 3. With head on other end sufficiently large to retain washer.
 - 4. Minimum Length: 12 inches.
- B. Steel Washers for Securing Pins:
 - 1. Outside Diameter: Not less than 1.5 inches.
 - 2. Inside Diameter: 1/4 inch.
 - 3. Thickness: 1/8 inch.
- C. Steel Wire Staples:
 - 1. U-shaped.
 - 2. 10-gauge.
 - 3. Minimum Length: 6 inches.

PART 3 EXECUTION

3.01 LAYING GEOTEXTILE

- A. Lay and maintain geotextile smooth and free of tension, folds, wrinkles, or creases.

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3.02 SHEET ORIENTATION ON SLOPES

- A. Orient geotextile with long dimension of each sheet parallel to direction of slope.
- B. Geotextile may be oriented with long dimension of sheet transverse to direction of slope only if sheet width, without unsewn seams, is sufficient to cover entire slope and anchor trench and to extend at least 18 inches beyond toe of slope.

3.03 JOINTS

- A. Unseamed Joints:
 - 1. Overlapped.
 - 2. Overlap, unless otherwise shown:
 - a. Foundation/Subgrade Stabilization: Minimum 18 inches.
 - b. Riprap: Minimum 18 inches.
 - c. Drain Trenches: Minimum 18 inches, except overlap shall equal trench width if trench width is less than 18 inches.
 - d. Other Applications: Minimum 12 inches.
- B. Sewn Seams: Made wherever stress transfer from one geotextile sheet to another is necessary. Sewn seams, as approved by Engineer, also may be used instead of overlap at joints for applications that do not require stress transfer.
 - 1. Seam Efficiency:
 - a. Minimum 70 percent.
 - b. Verified by preparing and testing minimum of one set of nondestructive Samples per acre of each type and weight of geotextile installed.
 - c. Tested according to ASTM D4884.
 - 2. Types:
 - a. Preferred: "J" type seams.
 - b. Acceptable: Flat or butterfly seams.
 - 3. Stitch Count: Minimum three to maximum seven stitches per inch.
 - 4. Stitch Type: Double-thread chainstitch according to ASTM D6193.
 - 5. Sewing Machines: Capable of penetrating four layers of geotextile.
 - 6. Stitch Location: 2 inches from geotextile sheet edges, or more, if necessary to develop required seam strength.

3.04 SECURING GEOTEXTILE

A. Secure geotextile during installation as necessary with sandbags or other means approved by Engineer.

B. Secure Geotextile with Securing Pins or Staples:

1. Insert securing pins with washers through geotextile.
2. Securing Pin Alignment:
 - a. Midway between edges of overlaps.
 - b. 6 inches from free edges.
3. Spacing of Securing Pins:

<u>Slope</u>	<u>Maximum Pin Spacing</u>
Steeper than 3:1	2 feet
3:1 to 4:1	3 feet
Flatter than 4:1	5 feet

4. Install additional pins across each geotextile sheet as necessary to prevent slippage of geotextile or to prevent wind from blowing geotextile out of position.
5. Push each securing pin through geotextile until washer bears against geotextile and secures it firmly to subgrade.
6. Where staples are used instead of securing pins, install in accordance with alignment and spacing above. Push in to secure geotextile firmly to subgrade.

3.05 PLACING PRODUCTS OVER GEOTEXTILE

A. If tears, punctures, or other geotextile damage occurs during placement of overlying products, remove overlying products as necessary to expose damaged geotextile. Repair damage as specified in Article Repairing Geotextile.

3.06 INSTALLING GEOTEXTILE IN TRENCHES

A. Place geotextile in a way to completely envelope granular drain material to be placed in trench and with specified overlap at joints. Overlap geotextile in direction of flow. Place geotextile in a way and with sufficient slack for geotextile to contact trench bottom and sides fully when trench is backfilled.

B. After granular drain material is placed to required grade, fold geotextile over top of granular drain material, unless otherwise shown. Maintain overlap until overlying fill or backfill is placed.

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3.07 SILT FENCE APPLICATIONS

- A. Install geotextile in one piece, or continuously sewn to make one piece, for full length and height of fence, including portion of geotextile buried in toe trench.
- B. Install bottom edge of sheet in toe trench and backfill in a way that securely anchors geotextile in trench.
- C. Securely fasten geotextile to wire mesh backing and each support post in a way that will not result in tearing of geotextile when fence is subjected to service loads.
- D. Promptly repair or replace silt fence that becomes damaged.

3.08 REPAIRING GEOTEXTILE

- A. Repair or replace torn, punctured, flawed, deteriorated, or otherwise damaged geotextile.
- B. Repair Procedure:
 - 1. Place patch of undamaged geotextile over damaged area and at least 18 inches in all directions beyond damaged area.
 - 2. Remove interfering material as necessary to expose damaged geotextile for repair.
 - 3. Sew patches or secure them with heat fusion tacking or with pins and washers, as specified above in Article Securing Geotextile, or by other means approved by Engineer.

3.09 REPLACING CONTAMINATED GEOTEXTILE

Protect geotextile from contamination that would interfere, in Engineer's opinion, with its intended function. Remove and replace contaminated geotextile with clean geotextile.

END OF SECTION

**SECTION 31 63 16
AUGER CAST-IN-PLACE PILES**

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Work specified herein consists of furnishing all labor, materials, products, tools, and equipment necessary for the installation and testing of auger cast-in-place piles as shown on the Drawings.
- B. The pile load capacity and movement shall be verified by testing as specified in Section 31 09 18, Static Pile Testing.
- C. The Contractor shall install the piles to the length, diameter, and configuration shown, as necessary to comply with the design requirements herein.

1.02 QUALIFICATIONS

- A. The auger cast-in-place pile Contractor shall be fully experienced in all aspects of auger cast-in-place pile construction, and shall furnish all necessary equipment, materials, skilled labor, and supervision to carry out the Contract. The pile Contractor shall have successfully completed at least five projects in the previous 5 years of similar scope and size. Key personnel shall include a superintendent, driller, and Project Engineer, each with a minimum of 5 years of experience.

1.03 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Concrete Institute (ACI): 315R Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.
 - 2. ASTM International (ASTM):
 - a. A82, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - b. A276, Standard Specification for Stainless Steel Bars and Shapes.
 - c. A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - d. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - e. C33, Standard Specification for Concrete Aggregates.
 - f. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

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- g. C109, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 in. or (50-mm) Cube Specimens).
- h. C150, Standard Specification for Portland Cement.
- i. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
- j. C937, Standard Specification for Grout Fluidifier for Preplaced-Aggregate Concrete.
- k. C939, Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete.
- l. E329, Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

1.04 SUBSURFACE CONDITIONS

- A. The subsurface conditions at the Site are described in the geotechnical report submitted by Ardaman & Associates, Inc.
 - 1. Subsurface Soil Exploration Proposed Clearwell Structure, Dyal Water Treatment Plan, Orange County, Florida, dated September 15, 2014.

1.05 DEFINITIONS

- A. Auger Refusal: Auger penetration rate of less than 1 foot per minute of drilling applicable for a power unit of suitable type and size when operating in accordance with manufacturer's specifications, wherein to continue drilling particular piling would be impractical.
- B. Auger Tip: The cutting and or bottom of the auger.
- C. Centralizers or Spacers: Permanent devices attached to the reinforcing steel at specific intervals to keep the reinforcing centered in the grouted pile.
- D. Design Position: The location of the centroid of the pile at cutoff elevation (x, y, and z coordinates) as shown.
- E. Elevations: Referenced to NGVD29.
- F. Grout Factor: Ratio of the actual grout volume pumped to the theoretical pile volume of the same length; also referred as the grout ratio or overtake.
- G. Grout or Pressure Head: Height of grout column on the auger flighting above the auger tip.

- H. Obstruction: Sudden and significant decrease of auger penetration and deviation out of tolerance resultant of encountering a subsurface or physical condition.
- I. Pile Tip: The toe or bottom of the completed pile.
- J. Pile Top: The head or top of the completed pile.
- K. Production Piles: Piles incorporated into the Work, using a uniform selection of materials and workmanship, and which are determined acceptable by Engineer based on observation and pile test results.
- L. Pump Stroke: A full cycle of the grout pump piston.
- M. Test Pile: Pile installed with the same equipment, materials, and procedures as production piles; but subject to static load test, as specified herein. The test pile can be used as production pile, if approved by the Engineer and if the pile is not damaged and is not loaded to plunging failure as defined in Section 31 09 18, Static Pile Testing.

1.06 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Prepared, stamped, and signed by an engineer registered in the State of Florida.
 - 2. Product data on portland cement, mineral admixture (if applicable), fluidifier (water reducing agent and retardant).
 - 3. Drawing(s) showing production and testing piles location and identification numbering.
 - 4. Shop and Erection Details and Reinforcement Requirements: ACI 315.
 - 5. Show that augering, mixing, installation methods and procedures, and pumping and augering equipment comply with Contract Documents, and include details for:
 - a. Establishing Pile Location: Scaled pile placing plan with identifying numbers for piles, pile size, and location referenced to known point(s) defined by the building grid system.
 - b. Augering.
 - c. Grout injection.
 - d. Reinforcement placement.
 - e. Pile cutoff.

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B. Informational Submittals:

1. Installer qualifications.
2. Manufacturer's Certification of Compliance: Commercial products.
3. Certified Test Results: Grout mix, including certification of minimum 28-day compressive strength.
4. Mill Certificates: Reinforcing steel.
5. Certification of Calibration:
 - a. Pressure Meter Gauges: Monitor pressure during grout injection.
 - b. Grout Pump: Indicate volume per stroke.
6. Method to layout and maintain pile locations.
7. Manufacturer's Data/Specifications/Maintenance Instructions:
 - a. Pile Drilling System: Crane and leads, power unit, auger rotary head and hydraulic pack, auger flights, sizes, dimensions, depth measurement system, tolerance measurement, and auxiliary equipment.
 - b. Grout Pumping System: Pump, type, and model number, volume measurement type and calibration, pressure gauge type and calibration, and location.
 - c. Automated monitoring equipment (AME) proposed to measure and record drilling progress during the augering phase, and incremental volume pumped during the grouting phase.
8. Methods and materials for transporting and placing specified grout during extreme hot and cold weather conditions.
9. Reinforcement Placement System: Method to set and maintain proper cage alignment.
10. Batch Plant System: System type, transportation method, cycle time, and measurement.
11. Daily Log and Record: At end of each working day, submit two copies of each record for every pier constructed that day.

1.07 DESIGN CRITERIA

- A. Allowable Compressive Load: 105 tons.
- B. Allowable Tension Load: 80 tons.
- C. The geotechnical capacity of the pile design shall be verified by preproduction verification testing of pile(s) with the same diameter and length used for production piles. The contractor shall design the pile and reactions system used for verification testing for the loading sequence specified in Section 31 09 18, Static Pile Testing.

1.08 SEQUENCING AND SCHEDULING

- A. Complete earthwork in vicinity of pile to top elevation of augered pile prior to commencing drilling.
- B. Begin production piling after successful completion of testing as specified in Section 31 09 18, Static Pile Testing.

PART 2 PRODUCTS

2.01 CEMENT GROUT

- A. Cement: Portland cement shall conform to ASTM C150 Type I and as specified in Section 03 30 00, Cast-in-Place Concrete.
- B. Mineral Admixture: Fly ash or natural pozzolan as specified in Section 03 30 00, Cast-in-Place Concrete.
- C. Fluidifier: Grout fluidifier shall conform to ASTM C937, except that expansion shall not exceed 4 percent. The fluidifier shall be a compound possessing characteristics which will increase the flowability of the mixture, assist in the dispersal of cement grains, and neutralize the setting shrinkage of the cement mortar.
- D. Aggregate:
 - 1. Fine and Coarse Aggregates: As specified in ASTM C404.

2.02 WATER

- A. Potable, fresh, clean and free of sewage, oil, acid, alkali, salts, or organic matter.

2.03 REINFORCING STEEL

- A. As specified in Section 03 21 00, Reinforcing Steel:
 - 1. Deformed Bars: ASTM A615, Grade 60.
 - 2. Spiral Steel Reinforcing: ASTM A82.
 - 3. Rebar Spacers: ASTM A276, Type 304 stainless steel.
 - 4. Centralizers: Plastic.
- B. End Cap: Plastic.

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2.04 GROUT MIX

- A. Proportion by weight to produce a grout capable of being satisfactorily pumped and of penetrating and filling all voids.
- B. Minimum Compressive Strength: 4,000 psi at 28 days.
- C. Minimum Flow Cone Rate: 10 to 25 seconds with modified 3/4-inch opening flow cone, ASTM C939.
- D. Grout Mix: Contractor's certified and successfully tested grout design approved by Engineer for incorporation into piles.

2.05 FABRICATION

- A. Reinforcement Cage: Fabricate to maintain straightness and rigidity during picking and installation process.

2.06 EQUIPMENT

- A. Pile Rig:
 - 1. Auger Leads:
 - a. Capable of supporting auger rotary head, auger flight, and pump hoses without deviation from vertical or specified batter during pile augering and grout injection, on the site ground surface.
 - b. Prevent rotation during pile construction by a stabilizing arm or by firmly placing the bottom of the leads into the ground or by other acceptable means.
 - c. Mark clearly at 1- and 5-foot intervals to allow measurement of auger penetration and removal.
 - 2. Auger Hoisting Equipment: Capable of withdrawal and rotation of the auger during grout injection at a smooth and constant rate.
- B. Augering Equipment:
 - 1. Auger Flighting:
 - a. Continuous from auger head to top of the auger without gaps or other breaks.
 - b. Capable of augering a minimum 16-inch diameter hole.
 - c. Uniform in diameter throughout its length, tolerance of no more than 3 percent of specified diameter.
 - d. Over 50 Feet in Length: Support and contain in rig leads by appropriately sized intermediate guides.
 - e. Exit Hole for Grout Injection: Locate at bottom of the auger.
 - 2. Auger Rotary Head and Power Unit: Suitable type and size to produce completed pile.

- C. Grout mixing Equipment: Use during preparation and handling such as to produce a homogeneous specified grout mix.
- D. Grout Pumping Equipment:
 - 1. Pump:
 - a. Positive displacement type, capable of developing displacement pressures at the pump not less than 350 psi.
 - b. Calibrate pump discharge capacity in strokes per cubic foot. Attach digital or mechanical stroke counters or other acceptable methods to pump to determine volume by number of pump strokes.
 - c. Equip with a screen with clear openings of 0.125-inch maximum size at pump inlet to remove oversized particles and accessible for inspection and cleaning.
 - 2. Pressure Gauges:
 - a. Locate at Grout Pump: Mount in clear view of operator.
- E. Reinforcement insertion Equipment: Capable of installing specified reinforcement type to required depth without damage or disturbance to augered hole, in-place grout, or reinforcing steel.
- F. Automated Monitoring Equipment (AME):
 - 1. AME shall be PIR-A manufactured by Pile Dynamics, Inc., or equal.
 - 2. The AME shall have the following components:
 - a. Display Unit: To display numerically and/or graphically the collected information from various sensors, and transfer results to onsite printer for permanent record. This unit shall be mounted in the cab to provide immediate feedback to the crane operator, particularly during the critical grouting phase to verify minimum grout volume per depth increment. The results shall be stored in electronic format on retrievable memory card for possible further evaluation.
 - b. Depth Sensor (Rotary Encoder on Self-Retracting Cable Spool Attached to Drill Top or Gear Box): To monitor auger tip depth at all times during installation. A real time clock shall be included so that the installation drilling rate (foot per minute) is displayed during drilling. The depth sensor shall record pile depth (referenced to ground elevation) to confirm pile length.
 - c. Magnetic Flow Meter (MFM) (or Other Flow Measuring Device): To be installed in the grout line near the crane to measure grout volume pumped within accuracy of plus or minus 2 percent.
 - d. Grout Pressure Sensor: To monitor maximum and minimum grout pressure in the grout line.

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- e. Field Printer: To record a hard copy of results for each pile. One copy of printed results shall be provided to the Engineer immediately following completion of each pile.
- f. Torque Pressure Sensor: To monitor the hydraulic pressure provided to the gearbox. This pressure can then be approximately converted to torque on some equipment.
- g. Angle Analyzer: To determine angle of installation of the pile.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide Engineer 7 days' notice prior to pile installation and perform only in presence of the Engineer.
- B. A pre-construction meeting shall be held prior to pile installation equipment mobilization to the Site. The meeting shall be attended by the Engineer, independent testing agency, and Contractor.
- C. Perform static load tests, as specified in Section 31 09 18, Static Pile Testing, prior to starting installation of the production piles.
- D. Piles shall be located as shown on the Drawings. Pile centers shall be located to an accuracy of plus or minus 3 inches. Piles shall be plumb within 2 percent.
- E. Sequence pile installation adjacent to recently installed piles to avoid disturbance, such as a drop in existing pile grout surface.
 - 1. Load of Drilling Equipment: Far enough away from pile being drilled to avoid compressing or shearing of soil.
 - 2. Piles shall not be installed within 6 pile diameters of adjacent piles until grout in adjacent piles has set for one 24-hour period.
 - 3. Piles may be located less than 6 pile diameters and no closer than 4 pile diameters once the adjacent pile has set for 24 hours.
- F. Perform continuous operation during installation process.
- G. Remove equipment failing to perform and replace with acceptable equipment.

3.02 DRILLING

- A. Drill all piles to specified pile length or to auger refusal.
- B. Check verticality or batter of leads at start and maintain throughout drilling.

- C. Place suitable plug or disposable plug material in outlet hole at the bottom of the auger to keep hole closed throughout drilling.
- D. Auger Advancement: Continuous rate that prevents removal of excess soil.
- E. Auger Diameter: Verify daily and report to Engineer.
- F. Defective Piles: Will be rejected. Install new pile or piles at location(s) designated by the Engineer. Cut off rejected piles below grade and abandon.

3.03 GROUT INJECTION

- A. At the start of grout pumping, raise auger from 12 inches for the pile toe depth, and after the grout pressure has built up sufficiently to blow out the bottom plug and create a head of grout above the discharge point, redrill auger to original toe elevation.
- B. Maintain a positive slow rotation of the auger during grout injection and auger withdrawal, do not permit counterclockwise rotation.
- C. If (i) auger jumps upward during withdrawal, (ii) grouting process is interrupted, or (iii) there is decreased grouting pressure, then reinsert auger to original toe elevation and decrease rate of withdrawal to prevent further jumping.
- D. Maintain a minimum grout (pressure) head of at least 10 feet of grout on the auger flighting above the injection point during auger raising. Coordinate rate of auger withdrawal to maintain 10 feet minimum grout head.
- E. Total volume of grout pumped: At least 115 percent of the theoretical volume for each foot of pile installation. If the volume is less than 115 percent in any 1-foot interval, stop pumping and advance auger by redrilling 10 feet or to bottom of pile (whichever is less) and reinstall pile from that point.
- F. After grout reaches the ground surface from auger flighting, rate of grout injection and auger withdrawal shall maintain a constant flow of grout at surface. If pumping of grout is interrupted, advance the auger by redrilling at least 5 feet below auger toe and resume pumping from that point.
- G. Prior to reinforcement installation, promptly clear away spoil that has accumulated from grout injection and screen from grout inclusions of spoil in the top of pile.

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- H. Spoil that has accumulated from the grout injection shall be disposed of properly with no environmental impact to the disposal area.
- I. Completely install and protect piles at end of each day's operations. Do not leave partially completed piles overnight.
- J. Driving Tolerances:
 - 1. Install piles with a variation of not more than 2 percent from vertical.
 - 2. Pile centroid at cut off elevation shall not vary from design position shown by more than 3 inches after installation.
- K. Defective Piles: Correct piles drilled in excess of specified tolerances by reaming to a larger diameter or by redrilling in correct locations, as determined by Engineer. Fill abandoned piles with concrete.

3.04 PILE CUTOFF

- A. Obtain final pile cutoff elevations after successful completion of installation and testing.
- B. Either remove fresh grout from pile head or by cut off hardened grout after initial set has occurred.

3.05 AUTOMATIC MONITORING

- A. Contractor shall provide an AME for each drilling rig. Each pile installed shall be monitored by an AME.
- B. The depth increment for grouting shall be selected based on pile diameter and pump size so that a minimum of seven or more strokes are required per increment. The MFM and depth sensor shall be sufficient to determine volume pumped per unit depth increment. The minimum grout ratio shall be clearly displayed as a guide. The printout shall be inspected for abnormalities prior to moving the rig. If the grout pumped falls below the specified allowable minimum grout ratio for any depth increment, the pile shall be re-augered immediately to 5 feet past the abnormality and re-grouted to correct the deficiency while the grout is still fluid.
- C. The AME shall be installed prior to installation of the piles and shall be maintained during the installation of production piles unless otherwise directed by the Engineer. In the unlikely event that the unit is not fully operative, the Contractor shall notify and work with the manufacturer to rectify the situation. In a brief interim duration as approved by the Engineer, the field monitor shall manually record incremental volume until the unit is fully operative.

- D. The AME does not replace the Contractor's field monitor, but rather assists the field monitor during the critical grouting phase by accurately monitoring grout pumped versus depth. The field monitor shall still observe and manually record arrival times of grout trucks, obtain grout samples, pile location versus planned location, grout return depth, rebar placement, excavation, and other unusual activities or installation information as directed by the Engineer. The field monitor shall collect AME printout for each pile installed and transmit them to the Engineer daily.

3.06 REINFORCEMENT STEEL

- A. Install in center of pile with minimum 3-inch clear cover and as specified in Section 03 21 00, Reinforcing Steel.
- B. Install reinforcing steel cages after grout injection has been completed.
- C. Centralizers shall be in placed every 5 feet along the reinforcements steel cage.
- D. End Cap: Install end cap at with each single bar reinforcement.

3.07 FIELD QUALITY CONTROL

- A. Grout Sampling and Testing: As specified in Section 03 30 00, Cast-in-Place Concrete, including:
 - 1. Flow cone test requirements. Flow cone test frequency, one test for every 50 cubic yards of grout.
 - 2. Temperature requirements.
 - 3. Age of grout requirements.
 - 4. Sampling for representative test cubes required for compressive strength tests during pile injection and cured as specified in Section 03 30 00, Cast-in-Place Concrete. Sampling frequency, one set of samples for every 50 cubic yards of grout.
- B. Daily Log and Record: Document for each pile showing as a minimum:
 - 1. Identification mark, shaft diameter, date drilled, location, equipment used.
 - 2. Installation time data, including start and completion of drilling, grout injection, reinforcing steel placement, capping, inspection, test samples with identification numbers.
 - 3. Ground elevation at start of drilling, depth drilled, top and bottom elevation of each pile.
 - 4. Top and bottom elevation of reinforcing steel within the pile.
 - 5. Concrete pump calibration (volume/stroke).

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6. Grout Injection Data: Batch quantity, field test samples for flowable consistency, test cubes, water added, and temperature.
 7. Continuous quantity of grout placed per 3-foot depth (interval).
 8. Theoretical and actual volume of grout placed.
 9. Nature and location of obstructions encountered, water conditions during drilling and grout placement, Site activities near freshly completed piles, and as Engineer may otherwise reasonably request.
 10. Completed Pile Installation Data Record form for each pile installed.
 11. Data collected from AME for each pile.
- C. Pile Integrity Testing: Plan, coordinate, and accomplish pile integrity testing as specified in Section 31 09 17, Dynamic Pile Testing.
- D. Static Pile Testing: Plan, coordinate, and accomplish static pile load testing as specified in Section 31 09 18, Static Pile Testing.

3.08 SUPPLEMENTS

- A. The supplement listed below, following “END OF SECTION,” is part of this Specification.
1. Supplement 1, Geotech Report, Subsurface Soil Exploration.

END OF SECTION

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 GENERAL

1.01 DEFINITIONS

- A. Completed Course: Compacted, unyielding, free from irregularities, with smooth, tight, even surface, true to grade, line, and cross-section.
- B. Completed Lift: Compacted with uniform cross-section thickness.
- A. Standard Specifications: When referenced in this section, shall mean the Alabama Department of Transportation Standard Specifications for Highway Construction, Latest Edition.

1.02 SUBMITTALS

- A. Informational Submittals:
 - 1. Certified Test Results on Source Materials: Submit copies from commercial testing laboratory 15 days prior to delivery of materials to Project showing materials meeting the physical qualities specified.
 - 2. Certified results of in-place density tests from independent testing agency.

PART 2 PRODUCTS

2.01 AGGREGATE BASE COURSE

- A. Meeting the requirements of Type A or B Crushed Aggregate Base Material in Section 825 of the ALDOT Standard Specifications.
- B. For gravel surface applications, Type A crushed aggregate base material in accordance with Section 825 shall be used.

2.02 SOURCE QUALITY CONTROL

- A. Perform tests necessary to locate acceptable source of materials meeting specified requirements.
- B. Final approval of aggregate material will be based on test results of installed materials.

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- C. Should separation of coarse from fine materials occur during processing or stockpiling, immediately change methods of handling materials to correct uniformity in grading.

PART 3 EXECUTION

3.01 SUBGRADE PREPARATION

- A. As specified in Section 31 23 13, Subgrade Preparation.
- B. Obtain Engineer's acceptance of subgrade before placing surface course.
- C. Do not place surface course or surfacing materials in snow or on soft, muddy, or frozen subgrade.

3.02 EQUIPMENT

- A. **Compaction Equipment:** Adequate in design and number to provide compaction and to obtain specified density for each layer.

3.03 HAULING AND SPREADING

- A. **Hauling Materials:**
 - 1. Do not haul over surfacing in process of construction.
 - 2. Loads: Of uniform capacity.
 - 3. Maintain consistent gradation of material delivered; loads of widely varying gradations will be cause for rejection.
- B. **Spreading Materials:**
 - 1. Distribute material to provide required density, depth, grade, and dimensions with allowance for subsequent lifts.
 - 2. Produce even distribution of material upon roadway or prepared surface without segregation.
 - 3. Should segregation of coarse from fine materials occur during placing, immediately change methods of handling materials to correct uniformity in grading.

3.04 CONSTRUCTION OF COURSES

- A. **Untreated Aggregate Base Course:**
 - 1. Maximum Completed Lift Thickness: 8 inches.
 - 2. Completed Course Total Thickness: As shown.
 - 3. Spread lift on preceding course to required cross-section.
 - 4. Lightly blade and roll surface until thoroughly compacted.

5. Add keystone to achieve compaction and as required when aggregate does not compact readily due to lack of fines or natural cementing properties, as follows:
 - a. Use leveling course or surfacing material as keystone.
 - b. Spread evenly on top of surface course, using spreader boxes or chip spreaders.
 - c. Roll surface until keystone is worked into interstices of surface course without excessive displacement.
 - d. Continue operation until course has become thoroughly keyed, compacted, and will not creep or move under roller.
6. Blade or broom surface to maintain true line, grade, and cross-section.

3.05 ROLLING AND COMPACTION

- A. Commence compaction of each layer of surface after spreading operations and continue until density of 95 percent of maximum density has been achieved as determined by AASHTO T99.
- B. Roll each layer of material until material does not creep under roller before succeeding layer is applied.
- C. Commence rolling at outer edges and continue toward center; do not roll center of road first.
- D. Apply water as needed to obtain specified densities.
- E. Place and compact each lift to required density before succeeding lift is placed.
- F. Surface Defects: Remedy by loosening and rerolling. Reroll entire area, including surrounding surface, until thoroughly compacted.
- G. Finished surface shall be true to grade and crown before proceeding with surfacing.

3.06 SURFACE TOLERANCES

- A. Blade or otherwise work surfacing as necessary to maintain grade and cross-section at all times, and to keep surface smooth and thoroughly compacted.
- B. Finished Surface of Untreated Aggregate Surface Course: Within plus or minus 0.04 foot of grade shown at any individual point.

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3.07 FIELD QUALITY CONTROL

A. In-Place Density Tests:

1. Provide testing laboratory at least 2 hours advance notification prior to testing.
2. Refer to Table 1 for minimum sampling and testing requirements for aggregate surface course.

Property	Test Method	Frequency	Sampling Point
Gradation	AASHTO T11 and AASHTO T27	One sample every 20 tons but at least every 4 hours of production	Roadbed after processing
Moisture Density (Maximum Density)	AASHTO T99, Method D	One test for every aggregate grading produced	Production output or stockpile
In-Place Density and Moisture Content	ALDOT-222	One for each 20 ton but at least every 2,000 sq ft of area	In-place completed, compacted area

3.08 CLEANING

- A. Remove excess material from the Work area. Clean stockpile and staging areas of all excess aggregate.

END OF SECTION

**SECTION 32 92 00
TURF AND GRASSES**

PART 1 GENERAL

1.01 DEFINITIONS

- A. Maintenance Period: Begin maintenance immediately after each area is planted (seed, sod, or sprig) and continue for a period of 8 weeks after all planting under this section is completed.
- B. Satisfactory Stand: Grass that has:
 - 1. No bare spots larger than 3 square feet.
 - 2. Not more than 10 percent of total area with bare spots larger than 1 square foot.
 - 3. Not more than 15 percent of total area with bare spots larger than 6 square inches.

1.02 SUBMITTALS

- A. Action Submittals: Product labels/data sheets.
- B. Informational Submittals:
 - 1. Seed: Certification of seed analysis, germination rate, and inoculation:
 - a. Certify that each lot of seed has been tested by a testing laboratory certified in seed testing, within 6 months of date of delivery.
Include with certification:
 - 1) Name and address of laboratory.
 - 2) Date of test.
 - 3) Lot number for each seed specified.
 - 4) Test Results: (i) name, (ii) percentages of purity and of germination, and (iii) weed content for each kind of seed furnished.
 - b. Mixtures: Proportions of each kind of seed.
 - 2. Seed Inoculant Certification: Bacteria prepared specifically for legume species to be inoculated.
 - 3. Description of required maintenance activities and activity frequency.

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1.03 DELIVERY, STORAGE, AND PROTECTION

A. Seed:

1. Furnish in standard containers with seed name, lot number, net weight, percentages of purity, germination, and hard seed and maximum weed seed content, clearly marked for each container of seed.
2. Keep dry during storage.

B. Sod:

1. Do not harvest if sod is excessively dry or wet to the extent survival may be adversely affected.
2. Harvest and deliver sod only after laying bed is prepared for sodding.
3. Roll or stack to prevent yellowing.
4. Deliver and lay within 24 hours of harvesting.
5. Keep moist and covered to protect from drying from time of harvesting until laid.

C. Hydroseeding Mulch: Mark package of wood fiber mulch to show air dry weight.

1.04 WEATHER RESTRICTIONS

- #### A. Perform Work under favorable weather and soil moisture conditions as determined by accepted local practice.

1.05 SEQUENCING AND SCHEDULING

- #### A. Complete Work under this section within 10 days following completion of soil preparation.

B. Notify Engineer at least 3 days in advance of:

1. Each material delivery.
2. Start of planting activity.

C. Planting Season: Between March 1 and September 30.

1.06 MAINTENANCE SERVICE

- #### A. Contractor: Perform maintenance operations during maintenance period to include:

1. Watering: Keep surface moist.
2. Washouts: Repair by filling with topsoil, liming, fertilizing, seeding, and mulching.

3. Mulch: Replace wherever and whenever washed or blown away.
4. Mowing: Mow to 2 inches after grass height reaches 3 inches, and mow to maintain grass height from exceeding 3-1/2 inches.
5. Reseed unsatisfactory areas or portions thereof immediately at the end of the maintenance period if a satisfactory stand has not been produced.
6. Reseed/replant during next planting season if scheduled end of maintenance period falls after September 30.
7. Reseed/replant entire area if satisfactory stand does not develop by July 1 of the following year.

PART 2 PRODUCTS

2.01 FERTILIZER

- A. Commercial, uniform in composition, free-flowing, suitable for application with equipment designed for that purpose. Minimum percentage of plant food by weight.
- B. Application Rates: Determined by soil analysis results.
- C. Mix:
 1. Nitrogen: 10.
 2. Phosphoric Acid: 10.
 3. Potash: 10.
 4. Bonemeal: Commercial, raw, finely ground, with minimum analysis of 4 percent nitrogen and 20 percent phosphoric acid.
 5. Superphosphate: Soluble mixture of phosphate obtained from treated mineral phosphates with minimum analysis of 20 percent available phosphoric acid.

2.02 SEED

- A. Fresh, clean new-crop seed that complies with the tolerance for purity and germination established by Official Seed Analysts of North America.
- B. Seeds of Legumes: Inoculated with pure culture of nitrogen-fixing bacteria prepared specifically for legume species in accordance with inoculant manufacturer's instructions.
- C. Summer Seed: Bermuda.
- D. Winter Protective Seed: Annual ryegrass.

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2.03 SOD

- A. Certified, containing grass mix: Bermuda.
- B. Strongly rooted pads, capable of supporting own weight and retaining size and shape when suspended vertically from a firm grasp on upper 10 percent of pad.
 - 1. Grass Height: Normal.
 - 2. Strip Size: 16 inches wide and at least 3 feet long.
 - 3. Soil Thickness: Uniform; 1 inch plus or minus 1/4 inch at time of cutting.
 - 4. Age: Not less than 10 months or more than 30 months.
 - 5. Condition: Healthy, green, moist; free of diseases, nematodes and insects, and of undesirable grassy and broadleaf weeds. Yellow sod, or broken pads, or torn or uneven ends will not be accepted.

2.04 HYDROSEEDING MULCH

- A. Wood Cellulose Fiber Mulch:
 - 1. Specially processed wood fiber containing no growth or germination inhibiting factors.
 - 2. Dyed a suitable color to facilitate inspection of material placement.
 - 3. Manufactured such that after addition and agitation in slurry tanks with water, the material fibers will become uniformly suspended to form homogenous slurry.
 - 4. When hydraulically sprayed on ground, material will allow absorption and percolation of moisture.

PART 3 EXECUTION

3.01 PREPARATION

- A. Grade areas to smooth, even surface with loose, uniformly fine texture.
 - 1. Roll and rake, remove ridges, fill depressions to meet finish grades.
 - 2. Limit such Work to areas to be planted within immediate future.
 - 3. Remove debris, and stones larger than 1-1/2-inch diameter, and other objects that may interfere with planting and maintenance operations.
- B. Moisten prepared areas before planting if soil is dry. Water thoroughly and allow surface to dry off before seeding. Do not create muddy soil.
- C. Restore prepared areas to specified condition if eroded or otherwise disturbed after preparation and before planting.

3.02 FERTILIZER

- A. Apply evenly over area in accordance with manufacturer's instructions. Mix into top 2 inches of topsoil, when applied by broad cast method.
- B. Application Rate: 23 pounds per 1,000 square feet (1,000 pounds per acre).

3.03 SEEDING

- A. Start within 2 days of preparation completion.
- B. Hydroseeding:
 - 1. Application Rate: Per manufacturer's recommendations.
 - 2. Apply on moist soil, only after free surface water has drained away.
 - 3. Prevent drift and displacement of mixture into other areas.
 - 4. Upon application, allow absorption and percolation of moisture into ground.
 - 5. Mixtures: Seed and fertilizer may be mixed together, apply within 30 minutes of mixing to prevent fertilizer from burning seed.
- C. Mulching: Apply uniform cover per manufacturer's recommendations.
- D. Water: Apply with fine spray after mulching to saturate top 4 inches of soil.

3.04 SODDING

- A. Do not plant dormant sod, or when ground is frozen.
- B. Lay sod to form solid mass with tightly fitted joints; butt ends and sides, do not overlap.
 - 1. Stagger strips to offset joints in adjacent courses.
 - 2. Work from boards to avoid damage to subgrade or sod.
 - 3. Tamp or roll lightly to ensure contact with subgrade; work sifted soil into minor cracks between pieces of sod, remove excess to avoid smothering adjacent grass.
 - 4. Complete sod surface true to finished grade, even, and firm.
- C. Fasten sod on slopes to prevent slippage with wooden pins 6 inches long driven through sod into subgrade, until flush with top of sod. Install at sufficiently close intervals to securely hold sod.
- D. Water sod with fine spray immediately after planting. During first week, water daily or more frequently to maintain moist soil to depth of 4 inches.
- E. Apply top dress fertilizer at rate of 1 pound per 1,000 square feet.

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3.05 FIELD QUALITY CONTROL

- A. 8 weeks after seeding is complete and on written notice from Contractor, Engineer will, within 15 days of receipt, determine if a satisfactory stand has been established.
- B. If a satisfactory stand has not been established, Engineer will make another determination after written notice from Contractor following the next growing season.

3.06 PROTECTION

- A. Protect from pedestrian traffic by erecting temporary fence around each newly seeded area.

END OF SECTION

**SECTION 33 05 01.09
POLYVINYL CHLORIDE (PVC) PRESSURE PIPE AND FITTINGS**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Water Works Association (AWWA):
 - a. C110, Ductile-Iron and Gray-Iron Fittings.
 - b. C153, Ductile-Iron Compact Fittings, for Water Service.
 - c. C605, Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.
 - d. C900, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 Inches Through 12 Inches (100 mm Through 300 mm), for Water Transmission and Distribution.
 - e. C905, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 Inches through 48 Inches (350 mm through 1,200 mm) for Water Transmission and Distribution.
 - f. C907, Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 Inches through 12 Inches (100 mm Through 300 mm), for Water, Wastewater, and Reclaimed Water Service.
 2. ASTM International (ASTM):
 - a. D2241, Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
 - b. D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - c. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - d. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - e. D2672, Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement.
 - f. D2855, Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
 - g. D3139, Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
 3. NSF International (NSF).

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1.02 SUBMITTALS

- A. Action Submittals: Product data and drawings showing pipe diameter, pipe class, dimension ratio (DR) and fitting details.
- B. Informational Submittals:
 - 1. Manufacturer's Certificate of Compliance, in accordance with Section 01 33 00, Submittal Procedures.
 - 2. Hydrostatic Testing Plan: Submit at least 15 days prior to testing and at minimum, include the following:
 - a. Testing dates.
 - b. Piping systems and section(s) to be tested.
 - c. Method of isolation.
 - d. Method of conveying water from source to system being tested.
 - e. Method of disposing of test water.
 - f. Calculation of maximum allowable leakage for piping section(s) to be tested.
 - 3. Certification of Calibration: Approved testing laboratory certificate if pressure gauge for hydrostatic test has been previously used. If pressure gauge is new, no certificate is required.
 - 4. Test report documentation.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Per manufacturer's recommendations.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Pipe:
 - 1. PVC, conforming to requirements of AWWA C900.
 - 2. DR 25 rating.
- B. Joints:
 - 1. Rubber gasketed.
 - 2. Conform to AWWA C900.
- C. Fittings: Ductile iron, conforming to AWWA C153 or AWWA C110.

PART 3 EXECUTION

3.01 INSTALLATION

- A. In accordance with AWWA C605.
- B. Joints:
 - 1. Rubber Gasketed: In accordance with manufacturer's written instructions.
- C. Pipe Bending for Horizontal or Vertical Curves:
 - 1. Bending of pipe barrels larger than 12 inches in diameter is not allowed.
 - 2. Radius of curves shall not exceed 75 percent of manufacturer's recommended values.
 - 3. Use blocks or braces at pipe joints to ensure axial deflection in gasketed or mechanical joints does not exceed allowable deflection.
- D. Maximum Joint Deflection at Mechanical Joint: 75 percent of manufacturer's recommended values.

3.02 INSPECTION AND HYDROSTATIC TESTING

- A. General:
 - 1. Notify Engineer in writing at least 5 days in advance of testing. Perform testing in presence of Engineer.
 - 2. Using water as test medium, all newly installed pipelines must successfully pass hydrostatic leakage test prior to acceptance.
 - 3. Conduct field hydrostatic test on buried piping after trench has been completely backfilled and compacted. Testing may, as approved by Engineer, be done prior to placement of asphaltic concrete or roadway structural section.
 - 4. Contractor may, if field conditions permit and as approved by Engineer, partially backfill trench and leave joints open for inspection and conduct an initial informal service leak test. Final field hydrostatic test shall not, however, be conducted until backfilling has been completed as specified above.
 - 5. Supply of Temporary Water: In accordance with Section 01 50 00, Temporary Facilities and Controls.
 - 6. Dispose of water used in testing in accordance with federal, state, and local requirements.

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7. Install temporary thrust blocking or other restraint as necessary to prevent movement of pipe and protect adjacent piping or equipment. Make necessary taps in piping prior to testing.
 8. Wait a minimum of 5 days after concrete thrust blocking is installed to perform pressure tests. If high-early strength cement is used for thrust blocking, wait may be reduced to 2 days.
 9. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.
 10. New Piping Connected to Existing Piping:
 - a. Isolate new piping with grooved-end pipe caps, blind flanges, or other means as acceptable to Engineer.
 - b. Provide appropriate thrust blocking.
- B. Hydrostatic Testing Procedure: Refer to Specification Section 40 80 01, Process Piping Leakage Testing.

END OF SECTION

SECTION 33 16 19
ELEVATED POTABLE-WATER STORAGE TANKS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Water Works Association (AWWA):
 - a. C205, Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in. (100 mm) and Larger - Shop Applied.
 - b. C210, Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
 - c. C652, Disinfection of Water - Storage Facilities.
 - d. D100, Welded Steel Tanks for Water Storage.
 - e. D107, Composite Elevated Tanks for Water Storage.
 2. American Welding Society (AWS):
 - a. D1.1, Structural Welding Code - Steel.
 - b. QC 1, Standard for AWS Certification of Welding Inspectors.
 3. ASTM International (ASTM):
 - a. A6/A6M, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
 - b. A20/A20M, Standard Specification for General Requirements for Steel Plates for Pressure Vessels.
 - c. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - d. A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
 - e. B88, Standard Specification for Seamless Copper Water Tube.
 4. International Code Council (ICC): 2020 Florida Building Code 7th Edition (FBC).
 5. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components - Lead Content.

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1.02 DESIGN REQUIREMENTS

- A. General: Design, fabricate, and erect elevated steel water tank in accordance with AWWA D100 and D107, except as modified herein. No additional thickness for corrosion allowance shall be required.
- B. Basis of Design: Landmark Composite Elevated Storage Tank, Landmark Structures, Ft. Worth, TX.
- C. Other Approved Manufacturers.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Manufacturer's Catalog Data:
 - 1) Tank, including accessories and components.
 - 2) Coating systems for tank.
 - 3) Structural steel.
 - 4) Available performance test data.
 - b. Drawings of Elevated Tank and Foundation:
 - 1) Details of steel, pipe, and concrete work.
 - 2) Details of fabrication and assembling of items required for installation.
 - 3) Describe method of fabrication for steel sections and double curvature plates.
 - c. Design calculations for elevated tank design.
- B. Informational Submittals:
 - 1. Manufacturer's instructions for coating systems.
 - 2. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
 - 3. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.
 - 4. Test Reports:
 - a. Mill test on steel tank plates.
 - b. Mill test on structural steel.
 - c. Weld inspections.
 - 5. Statements of Qualification:
 - a. Tank manufacturer.
 - b. Tank installer.
 - c. Registered professional engineer.

6. Welding inspector.
7. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.

1.04 QUALIFICATIONS

- A. Tank Manufacturer: At least five tanks presently in potable water service, of similar size and character required for this Project, and minimum of 10 years' satisfactory operation.
- B. Tank Installer: Certified by manufacturer that installer is qualified to do the Work.
- C. Tank Designer: Registered professional engineer licensed in the state of Project.
- D. Welding Inspector: Certified welding inspector (CWI) in accordance with AWS QC 1.

PART 2 PRODUCTS

2.01 GENERAL

- A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
 1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 WATER TANK

- A. Foundations:
 1. Foundations for tank columns, riser, and valve chamber from reinforced concrete as specified in Section 03 30 00, Cast-in-Place Concrete, and Section 31 63 16, Auger Cast Grout Piles.
 2. Design foundations shall be auger cast piles in accordance with Section 31 63 16, Auger Cast Grout Piles.

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3. Factor of safety on overturning of elevated tanks under design wind load shall be 1.50 minimum.
4. Bottom of column and riser foundations, minimum of 2 feet below existing grade. Size riser foundation large enough to house piping and fittings.

B. Seismic Constraints: Earthquake design in accordance with FBC, AWWA D107, and the following:

Parameter	Value
Risk category	IV
Seismic importance factor, I_e	1.5
S_s	.081 g
S_1	.056 g
Site class	D

- C. Snow Load: 0 psf in accordance with AWWA D100, Section 3.1.3.
- D. Wind Load: Ultimate wind speed of 155 mph (nominal wind speed 120 mph) exposure C, in any direction in accordance with FBC.
- E. Storage Capacity: 500,000 U.S. gallons.
- F. Elevations: Overflow shall be at elevation 292.3' with tops of circular concrete support wall foundations at elevation 166.50'.
- G. Tank: Composite single-pedestal type.
- H. Pedestal:
 1. Pedestal supporting the elevated tank shall be constructed of a concrete circular wall, 8-inch minimum thickness excluding any architectural relief. The top of the concrete pedestal shall have a circular domed concrete slab that will serve as the tank floor slab. The domed slab shall be a minimum of 8 inches thick.

2. The concrete pedestal shall be designed in accordance with ACI 318 and ACI 350. The minimum concrete strength shall be 4,000 psi at 28 days. Reinforcing steel shall be Grade 60.
3. Provide a ring beam at the interface of the dome tank floor with the top of the concrete wall. A finite element analysis shall be performed for the design of the ring beam.

2.03 MATERIALS

- A. General: Materials in accordance with AWWA D100 and D107.
- B. Cast Iron Pipe:
 1. As specified in Section 40 27 00, Process Piping—General.
 2. Paint exterior of piping within reservoir and riser as specified in Section 09 90 00, Painting and Coating.
 3. Paint exterior of piping to match adjacent surfaces.
- C. Steel Pipe:
 1. In accordance with ASTM A53 or A106, Schedule 40.
 2. Line interior of steel piping with cement-mortar in accordance with AWWA C205.
 3. Paint exterior of steel piping to match adjacent surfaces.
- D. Reinforced Concrete:
 1. As specified in Section 03 30 00, Cast-in-Place Concrete.
 2. Proportions and mix design of concrete shall develop minimum compressive field strength of 4,000 psi in 28 days.
- E. Machine Bolts and Fittings: Galvanized.

2.04 ACCESSORIES

- A. In accordance with AWWA D100 and D107.
- B. Upper Platform:
 1. Located below the domed tank floor slab and provides access to the access tube, the tank floor manhole, and the opening for access to the painters rail at the ring beam.
 2. Minimum 4 feet wide.

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3. Galvanized steel grating floor.
4. Minimum 42-inch high galvanized steel, 2 rail guardrail with 4-inch toeboard in compliance with OSHA and FBC.
5. All components shall be galvanized steel.

C. Ladders:

1. General: Furnish ladders in accordance with AWWA D100.
2. Pillar Ladder:
 - a. Extend from interior floor to upper platform below domed tank floor slab.
 - b. Furnish lockable ladder guard as shown.
3. Upper Platform to Roof Ladder:
 - a. Extend from the upper platform to the tank roof.
 - b. Mount inside access tube through tank.
4. Upper Platform to Tank Floor Manhole.
 - a. Extend from upper platform to tank floor manhole as shown on the Drawings.
5. Interior Ladder:
 - a. Ladder access to interior of reservoir from tank roof to interior tank floor.
 - b. Mount to exterior of access tube inside tank.
6. Ladders Construction:
 - a. Conform to OSHA.
 - b. Ladder width shall be 16 inches between side rails.
 - c. Rungs shall be 3/4-inch diameter and plug welded to side rails.
 - d. Ladders not in contact with water shall be hot-dip galvanized.
 - e. Ladders in contact with water shall be Type 316L stainless steel.
7. Safety Climb Device:
 - a. Furnish complete safety climb fall prevention systems, Saf-T-Climb System, for all interior ladder and exterior ladders.
 - b. Equipment must be tested according to ANSI 14.3. Belts and harnesses must be tested according to ANSI 10.14.
 - c. Safety climb device shall be an aluminum system.
 - d. Each complete system shall allow worker to operate freely in a normal climbing position during ascent or descent.
 - e. Main Components: Saf-T-Lok Sleeve, Saf-T-Belt, and Saf-T-Notch Carrier Rail.
 - f. Ladder rung clamps.
 - g. Removable extension kit for inside ladder with tiedown rod, mandril, and carrier rail.

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- h. Furnish additional accessories required to complete the system for each specific ladder.
- i. Furnish two Saf-T-Belts.
- j. Manufacturer: North Consumer Safety Products Co., a Div. of SIEBE North, Inc., 2644-B Saturn St., Brea, CA.

D. Roof Hatch:

- 1. Provide two weatherproof access hatches on the roof of the tank. One hatch shall allow egress from the access tube to the roof. The second hatch, located adjacent to the first, shall allow access to the interior of the tank via the ladder mounted on the exterior of the access tube.
- 2. Each roof hatch shall be 3-foot square.
- 3. Extend curb minimum 6 inches above roof plates.
- 4. Hatch cover shall lap curb minimum 2 inches when closed with weathertight seal.
- 5. Grind sharp edges and corners smooth.
- 6. Provide hold open arm, hasp and locks, and stainless steel hardware.

E. Roof Vent:

- 1. Locate near the center of the roof above the maximum overflow weir and above the level of any seismic sloshing of the water.
- 2. Continuously weld joints providing watertight seal.
- 3. Vent shall be designed to prevent excess pressure differential during maximum inflow and outflow rates during filling and emptying of the tank. Insect screens shall be provided around all openings. The vent capacity shall be based on the open area of the insect screens.
- 4. Provide a pressure and vacuum relief mechanism located above the maximum weir crest elevation that will return automatically to its original position after operation.
- 5. All components shall be aluminum or stainless steel.

F. Access Tube: Steel access tube 48 inches in diameter. Provide channel at the bottom of the tube to collect condensation and a drain pipe with backflow preventer to drain condensate into the tank drain pipe.

G. Access Tube Manhole:

- 1. Minimum clear opening of 30 inches.
- 2. Furnish flanged and bolted type with confined gasket.
- 3. Hinge cover to riser shell.
- 4. Provide galvanized bolts.

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- H. Tank Floor Manhole:
1. 30 inch diameter manhole through the tank floor.
 2. The manhole shall be operable from a ladder located on the upper platform.
 3. Shall be designed to withstand the pressure of the tank contents without leakage.
 4. Shall include a stainless steel hand wheel operator and threaded components.
- I. Ring Beam Painter's Rail Access:
1. Provide a 24 inch by 36 inch opening at the top of the support wall. This opening shall be accessible from the upper platform and shall provide access to the exterior painter's rail located at the ring beam.
 2. The access opening shall be provided with a removable vent.
- J. Painter's Rail: Continuous around at exterior top of tank shell at sidewall, at exterior of ring beam, on the inside of the tank roof at the tank access hatch, and at the interior of the tank roof at the tank wall. Painter's rail shall not lighter than 3-inch by 3-inch by 1/4-inch structural angle supported 9 inches clear of tank wall at 4-foot intervals by clip angles.
- K. Inlet-Outlet Pipe: Size as shown on the Drawings.
- L. Overflow:
1. Shall be located inside of tank and pillar and shall be size shown on the Drawings.
 2. Furnish overflow with an inlet fitting capable of taking a flow of 1,500 gpm with a 6-inch head.
- M. Tank Drain: A tank drain shall be provided as located on the Drawings. The drain shall be located at the low point of the tank floor and fitted with a threaded plug and tee handle to operate the drain.
- N. Lighting:
1. All interior lighting required shall be provided by the tank manufacturer. All interior lights provided shall be LED type and shall include emergency battery packs to enable an operator to safely exit the area in the event of a loss of normal utility power.
 2. The Contractor shall be responsible for providing all conduit and conductors required to power the various interior lights from the 240/120V panelboard as shown on the Drawings.

ANTIOCH ELEVATED STORAGE TANK

- 3. The manufacturer shall provide a detailed Drawing indicating the location of all interior lights proposed as well as providing detailed cutsheets on the interior lights proposed.
- 4. All interior lights shall operate on 120V, single phase power and shall be fed from the same 20A circuit.
- 5. Obstruction lighting shall be provided in accordance with FAA standards. The obstruction light shall be centrally located on the roof of the tank above all permanent installations. It shall be a steady burning, dual fixture type with a lamp-out relay switch. The fixture shall be weather sealed, corrosion resistant, with aluminum base and housing. Red globes with 116-watt clear traffic signal lamps rated at 8000 hour life shall be provided. A pilot light located near the electrical panel shall be provided to indicate when the primary bulb has failed.

O. Provision for Level Transmitter Connection:

- 1. The Contractor shall be responsible for providing a level transmitter to measure the water level within the water storage tank. However, the tank manufacturer and Contractor shall be responsible for coordinating the provisions necessary to connect the level transmitter to the influent pipe at the base of the tank. The level transmitter shall be installed at 4 feet above the finished floor from the interior of the tank. Refer to the Electrical Drawings for additional detail.

P. Silt Stops:

- 1. Furnish removable silt stop 6 inches high on inlet-outlet pipe at base of riser.
- 2. Furnish permanently attached silt stop at top of riser.

2.05 FABRICATION

A. General: In accordance with AWWA D100 and D107.

B. Tolerances:

- 1. Plumbness: Top for tank shall not exceed 1/200 of the height above ground.
- 2. Roundness: Radii measured at 1 foot above bottom corner weld shall not exceed tolerances as follows:

Diameter (Feet)	Radius Tolerance (Inches)
40	plus or minus 6
150	plus or minus 9

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Diameter (Feet)	Radius Tolerance (Inches)
<250	plus or minus 12
>250	plus or minus 15

3. Peaking and Banding at Welded Joints:
 - a. Using horizontal sweep board 36 inches long, peaking shall not exceed 1/2 inch.
 - b. Using vertical sweep board 36 inches long, banding shall not exceed 1/2 inch.
4. Local Flat Spots: On cylindrical sections, measured in vertical plane, shall not exceed plate flatness and waviness requirements in ASTM A6 and ASTM A20.

C. Welding:

1. Circumferential and longitudinal joints of shell shall have complete penetration butt welds.
2. Roof columns shall be steel pipe or compact structural tubing, cap welded at both ends.

2.06 SOURCE QUALITY CONTROL

- A. Visual Inspection: All shop welds shall meet visual acceptance standards in accordance with AWS D1.1, Paragraph 8.15.1.

PART 3 EXECUTION

3.01 SITE GRADING

- A. As specified in Section 31 23 16, Excavation.

3.02 ERECTION

- A. In accordance with AWWA D100 and D107.
- B. Rolling: Shop-rolled or flat plates formed to cylindrical shape during erection shall be assembled to a true cylindrical shape without ridges at welded joints and without flat spots.

ANTIOCH ELEVATED STORAGE TANK

C. Inaccessible Areas: Seal weld submerged joints and areas inaccessible after erection.

D. Tolerances:

1. Erection tolerances for stability of cylindrical sections shall be as follows:

- $E_x = 0.04\sqrt{RT}$
- $L_x = 4.00\sqrt{RT}$
- $L_x =$ Gauge length to measure local imperfection (inches)
- $F =$ Shell thickness (inches)
- $R =$ Radius of exterior surface of shell, normal to plate at point under consideration and measure from the exterior surface of plate to axis of revolution (inches)

2. Offset of Aligned Shell Courses: Accurately adjoining edges of butt joints and retain in position during welding so offset tolerances in the following table are not exceeded:

Plate Thickness (Inches)	Subject to Primary Stress (Inches)	Subject to Secondary Stress (Inches)
0 - 1/2	1/4T	1/4T
1/2 - 3/4	1/8	1/4T
3/4 - 1-1/2	1/8	3/16
1-1/2 - 2	1/8	1/8T
Over 2	Lesser of (1/6)T or 3/8	Lesser of (1/8)T or 3/4

3.03 FIELD FINISHING

A. As specified in Section 09 90 00, Painting and Coating.

3.04 TESTS AND INSPECTION

A. Welding and Nondestructive Testing (NDT):

- 1. Welding Inspector: Duties of welding inspector shall include:
 - a. Verifying Project material and storage.
 - b. Monitoring conformance of qualified welders.

ANTIOCH ELEVATED STORAGE TANK

- c. Inspecting joint fit up prior to in-process welding inspection and visual inspection of completed welds.
 - d. Supervising nondestructive testing personnel and evaluating test results.
 - e. Maintaining records and preparing reports.
2. Weld Acceptance:
- a. Visual Inspection: All field welds shall meet visual acceptance standards in accordance with AWS D1.1, Paragraph 8.15.1.
 - b. Radiographical Inspection: In accordance with AWWA D100, Sections 11.5 and 11.6 or Appendix C as applicable.
- B. Vacuum test welded flat bottom and test reservoir before painting in accordance with AWWA D100, Section 12.

3.05 DISINFECTION

- A. As specified in Section 33 13 00, Disinfecting of Water Utility Distribution.

END OF SECTION

SECTION 33 41 01.05 REINFORCED CONCRETE	
Item	Description
Pipe	ASTM C76, Wall B. Mark each joint with pipe class. Rotating packer or platform not allowed.
Cement	ASTM C150, Type II, or ASTM C150, Type I, with fly ash; maximum 12 percent Tricalcium Aluminate, or ASTM C595 Rev A, Type IP, with fly ash; Cement: ASTM C150. Minimum 564 pounds per cubic yard without fly ash. Minimum 479 pounds per cubic yard with fly ash.
Ratio: Water to Cementitious Materials	Not over 0.49.
Fly Ash	ASTM C618, Class C or Class F, Tables 1 and 2 modified as follows: Loss on Ignition: Maximum 3 percent Water Requirement: Maximum 100 percent of control Ratio Percent CaO/Fe ₂ O ₃ : Maximum 1.5 or test cement fly ash mix in accordance with ASTM C1012. Mix: Equal to or better than ASTM C150, Type II cement. 85 pounds per cubic yard minimum, 160 pounds per cubic yard maximum. Test: ASTM C311 and ASTM C618.
Joints	ASTM C443 Rev A. Captive gasket in groove.
Rubber Gaskets	ASTM C443.
Tee Fittings	Reinforced concrete, rubber gasketed. Provide plug when service piping is not required.
Plugs	Removable. Removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.
Circumferential Reinforcement	Not closer than 1 inch to inside surface of pipe. Area of outer circular reinforcing cage not less than 75 percent of inner cage.
Elliptical Reinforcement	Not allowed.

ANTIOCH ELEVATED STORAGE TANK

SECTION 33 41 01.05 REINFORCED CONCRETE	
Item	Description
Source Quality Control Testing	<p>Load Bearing 0.01-inch Crack, Compressive Strength and Absorption: ASTM C76 Load Bearing Ultimate: ASTM C76.</p> <p>Permeability: ASTM C497.</p> <p>Voids: Longitudinally sawcut one pipe from each 100 lengths of pipe manufactured in half with saw that will not damage the concrete or reinforcing steel. Inspect for voids adjacent to circumferential bars. Voids will be considered continuous if a 1/16-inch diameter pin can be inserted 1/4 inch deep. If voids exist adjacent to more than 10 percent of the circumferential bars, two additional pipes shall be tested. If either of the two pipes fail, the entire 100 lengths will be rejected.</p>

END OF SECTION

**SECTION 40 80 01
PROCESS PIPING LEAKAGE TESTING**

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Testing Plan:
 - a. Submit prior to testing and include at least the information that follows.
 - 1) Testing dates.
 - 2) Piping systems and section(s) to be tested.
 - 3) Test type.
 - 4) Method of isolation.
 - 5) Calculation of maximum allowable leakage for piping section(s) to be tested.
2. Certifications of Calibration: Testing equipment.
3. Certified Test Report.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PREPARATION

A. Notify Engineer in writing 5 days in advance of testing. Perform testing in presence of Engineer.

B. Pressure Piping:

1. Install temporary thrust blocking or other restraint as necessary to protect adjacent piping or equipment and make taps in piping prior to testing.
2. Wait 5 days minimum after concrete thrust blocking is installed to perform pressure tests. If high-early strength cement is used for thrust blocking, wait may be reduced to 2 days.
3. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.
4. New Piping Connected to Existing Piping: Isolate new piping with grooved-end pipe caps, spectacle blinds, blind flanges, or as acceptable to Engineer.
5. Test Pressure: 150 psi.

C. Test section may be filled with water and allowed to stand under low pressure prior to testing.

ANTIOCH ELEVATED STORAGE TANK

3.02 HYDROSTATIC TEST FOR PRESSURE PIPING

- A. Fluid: Clean water of such quality to prevent corrosion of materials in piping system.
- B. Exposed Piping:
1. Perform testing on installed piping prior to application of insulation.
 2. Maximum Filling Velocity: 0.25 foot per second, applied over full area of pipe.
 3. Vent piping during filling. Open vents at high points of piping system or loosen flanges, using at least four bolts, or use equipment vents to purge air pockets.
 4. Maintain hydrostatic test pressure continuously for 30 minutes, minimum, and for such additional time as necessary to conduct examinations for leakage.
 5. Examine joints and connections for leakage.
 6. Correct visible leakage and retest as specified.
- C. Buried Piping:
1. Test after backfilling has been completed.
 2. Expel air from piping system during filling.
 3. Apply and maintain specified test pressure with hydraulic force pump. Valve off piping system when test pressure is reached.
 4. Maintain hydrostatic test pressure continuously for 2 hours minimum, reopening isolation valve only as necessary to restore test pressure.
 5. Determine actual leakage by measuring quantity of water necessary to maintain specified test pressure for duration of test.
 6. Maximum Allowable Leakage:

$$L = \frac{SD(P)^{1/2}}{148,000}$$

where:

- L = Allowable leakage, in gallons per hour.
S = Length of pipe tested, in feet.
D = Nominal diameter of pipe, in inches.
P = Test pressure during leakage test, in pounds per square inch.

7. Correct leakage greater than allowable, and retest as specified.

3.03 FIELD QUALITY CONTROL

A. Test Report Documentation:

1. Test date.
2. Description and identification of piping tested.
3. Test fluid.
4. Test pressure.
5. Remarks, including:
 - a. Leaks (type, location).
 - b. Repair/replacement performed to remedy excessive leakage.
6. Signed by Contractor and Engineer to represent that test has been satisfactorily completed.

END OF SECTION



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June 21, 2019

Seaside Engineering and Surveying, LLC
6575 Highway 189N
Baker, FL 32531

Attention: Mr. Tim Bowden, P.E., PSM
tim.bowden@seasllc.net

Reference: Geotechnical Exploration
ANTIOCH WATER TOWER PROPERTY
Point Center Road
Crestview, Okaloosa County, Florida
UES Project No. 1730.1900029.0000
UES Report No. 1680586

Dear Mr. Bowden:

Universal Engineering Sciences, Inc. (UES) has completed a geotechnical exploration at the above referenced site in Crestview, Okaloosa County, Florida. This exploration was performed in accordance with generally accepted soil and foundation engineering practices. No other warranty, express or implied, is made.

The following report presents the results of our field exploration with a geotechnical engineering interpretation of those results with respect to the project characteristics as provided to us. We have included soil classifications and our estimates of the seasonal high groundwater level at the boring locations, along with geotechnical recommendations concerning foundation design and site preparation.

We appreciate the opportunity to have worked with you on this project and look forward to a continued association. Please do not hesitate to contact us if you should have any questions, or if we may further assist you as your plans proceed.

Respectfully Submitted,
UNIVERSAL ENGINEERING SCIENCES, INC.
Certificate of Authorization No. 549

Travis Miller
Staff Engineer

Keith Butts, P.E.
Regional Manager 6-21-19
Florida P.E. No. 53986

3 – Client



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ENGINEERING SCIENCES

GEOTECHNICAL EXPLORATION

ANTIOCH WATER TOWER PROPERTY
CRESTVIEW, OKALOOSA COUNTY, FLORIDA

UES PROJECT No. 1730.1900029.0000
UES REPORT No. 1680586

PREPARED FOR:

Seaside Engineering and Surveying, LLC
6575 Highway 189N
Baker, Florida 32531

PREPARED BY:

Universal Engineering Sciences, Inc.
1985 Cope Lane
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(850) 944-5555

June 21, 2019

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1.0 PROJECT DESCRIPTION

Project information was provided to us via email correspondence by Mr. Tim Bowden on January 24, 2019. The subject parcel is located near Point Center Road in Crestview, Okaloosa County, Florida. In addition, we were provided with the requested geotechnical scope of field work for our use in performing this geotechnical evaluation.

We understand that the proposed project will consist of constructing a new elevated water tower with a tank capacity of 500,000 gallons, a tank height of 150 feet, and a pedestal diameter of 24 feet. We anticipate that the elevated water tower will be supported by a pile foundation and that the structural loads will be on the order of 6000 kips in compression.

No site or project facilities/improvements, other than those described herein, should be designed using the soil information presented in this report. Moreover, UES will not be responsible for the performance of any site improvement so designed and constructed.

2.0 PURPOSE

The purposes of this exploration were:

- to explore and evaluate the subsurface conditions at the site with special attention to potential problems that may impact the proposed development,
- to provide our estimates of the seasonal high groundwater level at the boring locations and
- to provide geotechnical engineering recommendations for site preparation procedures and foundation design for the proposed structure

This report presents an evaluation of site conditions on the basis of traditional geotechnical procedures for site characterization. The recovered samples were not examined, either visually or analytically, for chemical composition or environmental hazards. In addition, our work did not address the potential for surface depression or deep geological conditions, such as sinkhole development related to karst activity as the subject site is not located within a known karst sensitive area.

3.0 SITE DESCRIPTION

The subject site is located on the north side of Point Center Road and south of Antioch Elementary in Crestview, Okaloosa County, FL. At the time of drilling, the site was heavily wooded.

3.1 SOIL SURVEY

The soil type mapped within the general area of the site according to the USDA NRCS Soil Survey of Okaloosa County is #12 Lakeland Sand. A summary of the characteristics of this soil series was obtained from the Soil Survey and is included in Table 1.



**TABLE I
SUMMARY OF PUBLISHED SOIL DATA**

Soil Symbol	Soil Type	Hydrologic Group	Drainage Characteristics	Depth of Published Seasonal High GWT (feet)
12	Lakeland Sand	A	Excessively drained	>6

3.2 TOPOGRAPHY

According to information obtained from Google Earth Pro, the current ground surface elevation on site is relatively flat and reported as approximately +180 feet World Geodetic System of 1984 (WGS84).

4.0 SCOPE OF SERVICES

The services conducted by UES during our geotechnical exploration were as follows:

- Drilled three (3) Standard Penetration Test (SPT) borings within the proposed storage tank footprint to depths of approximately 50 feet below existing grade.
- Secured samples of representative soils encountered in the soil borings for review, laboratory analysis and classification by a geotechnical engineer.
- Measured the existing site groundwater levels and provided an estimate of the seasonal high groundwater level at the boring locations.
- Conducted laboratory testing on selected soil samples obtained in the field to determine their engineering properties.
- Assessed the existing soil conditions with respect to the proposed construction.
- Prepared a report which documents the results of our exploration and analysis with geotechnical engineering recommendations.

5.0 FIELD EXPLORATION

The Standard Penetration Test (SPT) soil borings were performed with an ATV mounted drilling rig. The SPT boring locations were staked in the field by a UES representative. The boring locations are approximate and have been shown on the attached Boring Location Plan included in the Appendices.

5.1 STANDARD PENETRATION TEST BORINGS

The SPT borings, designated B-1 through B-3 on the attached Boring Location Plan in Appendix B, were performed in general accordance with the procedures of ASTM D 1586 "Standard Method for Penetration Test and Split-Barrel Sampling of Soils". SPT sampling was performed continuously from the surface to 10 feet to detect variations in the near surface soil profile and on approximate 5 feet centers thereafter.



6.0 LABORATORY TESTING

The soil samples recovered from the test borings were returned to our laboratory and visually classified in general accordance with ASTM D 2487 “Standard Classification of Soils for Engineering Purposes” (Unified Soil Classification System). We selected representative soil samples from the borings for laboratory testing to aid in classifying the soils and to help to evaluate the general engineering characteristics of the site soils. The results of these tests have been shown on the boring logs in Appendix B. A summary of the laboratory tests performed has been shown in Table II.

**TABLE II
LABORATORY METHODOLOGIES**

Test Performed	Number Performed	Reference
Grain Size Analysis (#200 wash only)	3	ASTM D 1140 “Amount of Material in Soils Finer than the No. 200 (75 - μm) sieve”
Moisture Content	3	ASTM D 2216 “Laboratory Determination of Water (Moisture) Content of Soil by Mass”

7.0 SUBSURFACE CONDITIONS

The results of our field exploration and laboratory analysis, together with pertinent information obtained from the SPT borings, such as soil profiles, penetration resistance and groundwater levels have been shown on the boring logs included in Appendix B. The Key to Boring Logs, Soil Classification Chart has been included in Appendix B. The soil profiles were prepared from field logs after the recovered soil samples were examined by a geotechnical engineer. The stratification lines shown on the boring logs represent the approximate boundaries between soil types, and may not depict exact subsurface soil conditions. The actual soil boundaries may be more transitional than depicted. A generalized profile of the soils encountered at our boring locations has been presented in Table III.

**TABLE III
GENERALIZED SOIL PROFILE**

Typical Depth (feet)		Soil Description
From	To	
0	51*	Very loose to dense fine SAND [SP] to fine silty SAND [SM], SPT “N” blow counts ranged from 2 to 52 blows per foot (bpf)

* denotes maximum termination depth of the borings

8.0 GROUNDWATER CONDITIONS

8.1 EXISTING GROUNDWATER LEVEL

At the time of our field exploration groundwater was encountered at a depth of 40 feet below the existing ground surface at boring locations B-1, B-2, and B-3. The groundwater table depth at individual test boring locations can be found on the boring logs presented within Appendix B.



8.2 SEASONAL HIGH GROUNDWATER LEVEL

Fluctuations in groundwater levels should be anticipated throughout the year, primarily due to seasonal variations in rainfall, surface runoff, and other factors that may vary from the time the borings were conducted.

Based on the results of our field exploration and the factors listed above, we estimate that the seasonal high groundwater level at the boring locations will form at depths greater than 6 feet below existing grade. The estimated seasonal high groundwater level at each of the boring locations has been shown on the individual boring logs.

It should be noted that the estimated seasonal high water levels do not provide any assurance that groundwater levels will not exceed these estimated levels during any given year in the future. Should the impediments to surface water drainage be present, or should rainfall intensity and duration, or total rainfall quantities, exceed the normally anticipated rainfall quantities, groundwater levels might exceed our seasonal high estimates. Further, it should be understood that changes in the surface hydrology and subsurface drainage from on-site and/or off-site improvements could have significant effects on the normal and seasonal high groundwater levels.

9.0 FOUNDATION DESIGN RECOMMENDATIONS

The following recommendations have been made based upon a review of the attached soil test data, our understanding of the proposed construction, and experience with similar projects and subsurface conditions. The applicability of geotechnical recommendations is very dependent upon project characteristics such as improvement locations, and grade alterations.

Additionally, if subsurface conditions are encountered during construction, which were not encountered in the borings, report those conditions immediately to us for observation and additional recommendations.

Based upon the findings of our subsurface exploration program, our understanding of the proposed construction, and our understanding of foundation systems used for the existing structures in the vicinity of the project site, it is our opinion that the subject site and subsurface conditions are not conducive for the use of a shallow foundation system to support the proposed structure. Therefore the use of a deep foundation system is recommended for this project. We have considered cast-in-place pile foundations for this project. Provided the site preparation and earthwork construction recommendations outlined in **Section 10.0 Site Preparation** of this report are strictly followed, the following parameters may be used for the foundation design.

9.1 General

Specific details on the Antioch Water Tower including height, structural loads, and preferred foundation type were provided at the time of this report. Therefore, we have provided some preliminary pile capacities based upon these design parameters and the subsurface conditions found on site. Based on the results of our field exploration, our understanding of the project information, and experience with similar structures, we have assumed an auger cast pile deep foundation system will be the preferred foundation type to support the structure.



Our geotechnical engineering evaluation of the site and subsurface conditions at the property with respect to the anticipated foundation system is based on (1) our site observations, (2) the field data obtained, and (3) our understanding of the project information as presented in this report. Should the project information be changed, please contact us so that we can review and possibly amend our evaluation.

9.2 Estimated Pile Capacities

Auger cast piles were evaluated for the foundation system to support the proposed Antioch Water Tower structure. It is our opinion that 14-inch, 16-inch, and 18-inch diameter auger-cast piles could provide allowable pile capacities as shown in Table 4. The allowable capacities incorporate factors of safety against failure of 2.5.

Embedment Depth Below Existing Grade (Feet)	Pile Diameter (inches)	Allowable Compressive Capacity (kips)	Allowable Uplift Capacity (kips)
40	14	145	125
	16	175	140
	18	210	160

9.3 Pile Group Effects

We recommend the minimum pile spacing to pile diameter ratio (S/D) be about 2.5 to 3.0. Using a minimum S/D ratio on this order, we anticipate that any capacity reductions due to nearby piles should be small and therefore, should be considered insignificant in the design of the foundation system. If S/D ratios will be less than 2.5 to 3.0, a reduction in group efficiency may result in reduced allowable group pile capacities.

9.4 Settlement

With the deep foundation system properly installed to bear at the depths noted above, assuming the minimum S/D ratios are maintained as discussed above, we estimate the settlement of the piles to be within tolerable limits (estimated to be about 0.5 to 0.75 inches or less). The settlement estimates have been based upon the use of (1) the field test data obtained during our geotechnical exploration, which has been correlated to geotechnical strength and compressibility characteristics of the subsurface soils beneath the site, and (2) published theoretical and empirical methods of settlement analysis for deep foundations bearing soils similar to those at the site.

9.5 Lateral Capacity

Vertically aligned deep foundations, embedded in subsurface conditions similar to those at this site, can typically support horizontal and lateral loads of about 5 percent of their compressive capacity without experiencing lateral deflections greater than about ½ inch. If the design horizontal loads on the deep foundations exceed the allowable compressive capacity by more than 5 percent, we recommend that a detailed lateral capacity analysis be performed.



9.6 Auger Cast Pile Construction Techniques

Auger-grouted concrete piles should be formed by rotating a continuous, hollow-flight auger to the desired pile tip level followed by slow withdrawal of the auger while pumping a grout under pressure through the auger. The pressure of the pumped grout at the auger tip or injection point should be sufficient to (1) fill the pile shaft created by the augering process and withdrawal, (2) prevent "necking" or shaft area reductions due to lateral inward squeezing of any adjacent soft soils, and (3) cause an outward flow of grout into the adjacent soils. A pressure head within the hollow auger stem equivalent to approximately 10 feet of grout above the auger tip or injection point should be maintained to help verify that a proper grout pressure exists at the injection point. *As previously discussed, very dense soils with N values greater than 30+ blows per foot were encountered within the 50 feet below existing grade (BEG). The Contractor should select auger equipment appropriately to achieve the desired embedment depth.*

A sudden drop in the sustained pressure head often indicates that a soft zone or void has been encountered and, therefore, continued grout injection at this level should be performed until the pressure head has been re-established. Pre-augering and withdrawal of the auger before grouting may result in a reduction of the in-place shear strength characteristics of the adjacent soils and thus may require additional pile embedment upon re-augering and grouting.

9.7 Installation Sequence

Construction of auger-grouted piles located within six pile diameters, center-to-center, should not be performed until the adjacent pile has achieved its initial set, which typically occurs approximately 24 hours after pile construction. This time delay allows the "green" cement grout in the adjacent recently constructed pile to harden, and helps reduce (if not completely eliminate) the possible loss of grout into the adjacent pile during its augering process.

9.8 Steel Placement

Due to the possibility of some uplift and/or lateral loads, which could be exerted upon the piles, a certain amount of steel reinforcement may be required within the piles. We recommend at a minimum that each pile be reinforced with a full length piece of rebar for uplift resistance. The rebar should be placed in the freshly grouted pile while the grout is in a fluid state. Centering devices should be provided at the bottom of the rebar and at appropriate increments to keep the rebar centered in the pile. The full length rebar serves to confirm the pile continuity and aids in the quality control process. Rebar should not be forced into the grout column. Simply rotating the rebar or rebar cage and allowing the steel to fall under its weight with only manual assistance should be sufficient to affect placement in a pile of continuous cross section.

For lateral resistance, a 4 bar cage is typically placed in the upper 20 to 25 feet of the pile. This cage should also be equipped with spacers to assure sufficient steel embedment and coverage. The rebar cage should be carefully threaded over the single rebar and lowered into place. The reinforcement for the piles should be designed by the Structural Engineer.



9.9 Pile Load Testing

One full-scale compression load test is recommended for the pile foundation system. Compression load tests should be performed in general accordance with ASTM D 1143, "Testing Piles Under Axial Compressive Load," with the exception that the maximum loading period per load increment should be limited to one hour. A tension pile load test, if required, should be performed in general accordance with ASTM D 3689, "Testing Individual Piles Under Static Axial Tensile Load".

If at all possible, we recommend that the load test be performed to failure, which is defined as excessive pile movement or plunge. This can enable a determination of the actual factor of safety of the test pile, along with providing settlement or pile top deformation data under various test loads up to failure. As a minimum, however, the load test should be performed to at least twice the design load to provide a proof test of the necessary minimum factor of safety against failure of two. Test and reaction piles installed in an acceptable manner and test piles not loaded to failure may be used as permanent job piles. We recommend that the test pile and associated reaction piles be installed at a location approved by the geotechnical engineer. The pile installations and load test should be witnessed by the Geotechnical Engineer or his designated representative. The test pile should also be installed in the same manner and with the same equipment as the remaining job piles.

9.10 Quality Control

Since the auger cast pile is "cast-in-place", the quality of the pile is highly dependent upon the skill, experience, and techniques used by the Foundation Contractor. Since the piles are not visible or accessible for direct inspection after construction, and problems during installation are not as self-evident and easily observed as with driven piles, we recommend that a geotechnical engineer or his qualified representative observe and monitor the auger cast pile installations. His duties should consist of, but not be limited to, the following:

- Verify that the piles are augered to the design tip level.
- Monitor the auger withdrawal rate and grouting operations to help verify that a sufficient mortar grout pressure head is maintained above the injection point at all times during construction.
- Confirm the pumping equipment is operating satisfactorily throughout the construction process.
- Record the volume of grout required to construct the piles.
- If steel reinforcement is required, the size, length, configuration, and placement of the steel should be checked to verify adherence to the job specifications.
- Observe and monitor the pile load test program.



10.0 SITE PREPARATION

We recommend normal, good practice site preparation procedures. These procedures include stripping the proposed construction areas of surficial vegetation, trees, roots, stumps, and other deleterious materials present; compacting the exposed subgrade, verifying subgrade compaction, and placing engineered fill to the desired grades. An expanded and more detailed synopsis of this work is provided below.

10.1 TEMPORARY GROUNDWATER CONTROL

Based on the groundwater conditions encountered and expected on site, the control of the groundwater is not likely to be required to achieve the necessary excavation, construction, backfilling and compaction requirements presented in the preceding sections. If dewatering becomes necessary, we suggest drawing down the water level at least 2 feet below the bottom of the excavations to preclude "pumping" and/or compaction-related problems with the foundation and/or subgrade soils.

Dewatering may consist of ditching, well points, or other means. However, groundwater control means and methods are the sole responsibility of the Contractor. Furthermore, we recommend that the Contractor determine the actual groundwater levels at the time of construction to determine the groundwater impact on the construction procedures. If groundwater is encountered during trenching or foundation installation, the Geotechnical Engineer of Record should be notified so that they can determine whether there is a need for perimeter drains or other recommendations for dewatering.

10.2 NEARBY STRUCTURES & VIBRATIONS

Care should be exercised to avoid damaging any nearby structures while the site preparation and earthwork operations are underway. Prior to commencing site work operations in areas of this site that will be constructed near adjacent structures and/or developments, we recommend that occupants of adjacent structures should be notified and the existing conditions of the structures be documented with photographs and survey. Compaction should cease if deemed detrimental to adjacent structures.

Pre-construction building surveys of all off-site adjacent structures are also recommended, but absent these surveys, we recommend that the vibratory function of the compaction equipment be turned off when operating within 50 feet of any adjacent structures. UES can provide vibration monitoring services to help document and evaluate the effects of the surface compaction operations on existing structures.

10.3 EXISTING UNDERGROUND UTILITIES

The location of any existing underground utility lines within the proposed construction areas should be established prior to initiating construction. Provisions should then be made to relocate or abandon interfering utilities. It should be noted that if underground pipes are not properly removed or plugged, they may serve as conduits for subsurface erosion, which may subsequently lead to excessive settlement of overlying structures.



10.4 SITE PREPARATION & GRADING

Strip the proposed construction limits of all deleterious materials including topsoil, surface vegetation, demolition and removal of existing structures, foundations, underground utilities, tanks, and construction debris present within and 5 feet beyond the perimeter of the proposed structure areas. Expect typical stripping at this site to a depth of about 6 to 12 inches, with greater depths being necessary to remove larger root systems/tree stumps.

After stripping, removal of unsuitable surface soils, and rough excavation grading, we recommend that areas to provide support for structural fill be evaluated carefully for the presence of soft, surficial soils, and/or plastic soils, by proof-rolling and inspection by the Geotechnical Engineer of Record or his representative.

The proof-roll should be performed using a loaded tandem axle dump truck, or similar rubber-tired equipment, weighing between 15 and 20 tons. The vehicle should make at least eight (8) passes in perpendicular directions in the construction areas. Areas that wave, rut, or deflect significantly and continue to do so after several passes of the proof-roller should be undercut to firmer soils or the compaction operations should be immediately halted to allow time for the excess pore water pressures built up within the disturbed soils to dissipate before re-compacting. Undercut areas should be backfilled in thin lifts with approved, compacted fill materials. Proof-roll operations should be monitored carefully by the Geotechnical Engineer of Record or his designated representative.

10.5 FILL PLACEMENT

- Once the site has been stripped and prepared, place fill material as required to meet finished grades. The recommended criteria for soil fill characteristics (both on-site and imported materials) and compaction procedures are listed below. The project design documents should include the following recommendations to address proper placement and compaction of project fill materials. Earthwork operations should not begin until representative samples are collected and tested (allow 3 to 4 days for sampling and testing). The maximum dry density and optimum moisture content should be determined.

10.6 EARTH FILL MATERIALS

- Imported fill and on-site material satisfactory for structural fill should include clean soil material with USCS classifications of (SP, SP-SM). The fill material should have a modified proctor (ASTM D1557) Maximum Dry Density of at least 100 pcf, contain less than 10 percent passing the No. 200 sieve, and be non-plastic (NP).
- Organic content or other foreign matter (debris) should be no greater than 3 percent by weight, and no large roots (greater than ¼ inch in diameter) should be allowed.
- Material utilized as fill should not contain rocks greater than 3 inches in diameter or greater than 30 percent retained on the ¾-inch sieve.

10.7 COMPACTION RECOMMENDATIONS

- Maximum loose lift thickness – 10 inches, mass fill.



- Compaction requirements – 95 percent of the Maximum Dry Density as determined by the modified proctor (ASTM D 1557) compaction test.
- Soil moisture content– within ± 2 percent of the optimum moisture content to obtain minimum compaction level.

10.8 RECOMMENDED SOIL TEST METHODS AND FREQUENCY

- One modified proctor compaction test, one No. 200 sieve analysis test for each soil type used as project fill.
- Foundation Bottom – Perform density tests to a depth of 2 feet below the foundation bearing level to confirm 95 percent of the Maximum Dry Density as determined by the modified proctor (ASTM D 1557) compaction test. Test each foundation location.
- Foundation Backfill – Perform density tests for each lift of backfill required to achieve finished grade to confirm 95 percent of the Maximum Dry Density as determined by the modified proctor (ASTM D 1557) compaction test. Test each foundation location.

10.9 EXCAVATION CONSIDERATIONS

In Federal Register, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its “Construction Standards for Excavations, 29 CFR, Part 1926, Subpart P”. This document was issued to allow for the safety of workers entering trenches or excavations. It is mandated by this federal regulation that excavations, whether they be utility trenches, basement excavations or footing excavations, be constructed in accordance with the new OSHA guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the Owner and the Contractor could be liable for substantial penalties.

The Contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The Contractor's “responsible person”, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the Contractor’s safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in all local, state, and federal safety regulations.

We are providing this information solely as a service to our Client. Universal Engineering Sciences does not assume responsibility for construction site safety or the Contractor's or other parties' compliance with local, state, and federal safety or other regulations.

11.0 CONSTRUCTION RELATED SERVICES

We recommend the Owner retain UES to provide inspection services during the site preparation procedures for confirmation of the adequacy of the auger cast-in-place foundation. Field tests and observations include monitoring earthwork operations and performing quality assurance tests of the placement of compacted structural fill courses.



The geotechnical engineering design does not end with the advertisement of the construction documents. The design is an on-going process throughout construction. Because of our familiarity with the site conditions and the intent of the engineering design, we are most qualified to address site problems or construction changes, which may arise during construction, in a timely and cost-effective manner.

12.0 LIMITATIONS

This report has been prepared for the exclusive use of **Seaside Engineering and Surveying, LLC.** and other designated members of their Design/Construction Team associated with the proposed construction for the specific project discussed in this report. No other site or project facilities should be designed using the soil information contained in this report. As such, UES will not be responsible for the performance of any other site improvement designed using the data in this report.

This report should not be relied upon for final design recommendations or professional opinions by unauthorized third parties without the expressed written consent of Universal Engineering Sciences. Unauthorized third parties that rely upon the information contained herein without the expressed written consent of Universal Engineering Sciences, Inc. assume all risk and liability for such reliance.

The recommendations submitted in this report have been based upon the data obtained from the soil borings performed at the locations indicated on the Boring Location Plan and from other information as referenced. This report does not reflect any variations that may occur between the boring locations. The nature and extent of such variations may not become evident until the course of construction. If variations become evident, it will then be necessary for a re-evaluation of the recommendations of this report after performing on-site observations during the construction period and noting the characteristics of the variations.

Borings for a typical geotechnical report are widely spaced and generally not sufficient for reliably detecting the presence of isolated, anomalous surface or subsurface conditions, or reliably estimating unsuitable or suitable material quantities. Accordingly, UES does not recommend relying on our boring information for estimation of material quantities unless our contracted services specifically include sufficient exploration for such purpose(s) and within the report we so state that the level of exploration provided should be sufficient to detect anomalous conditions or estimate such quantities. Therefore, UES will not be responsible for any extrapolation or use of our data by others beyond the purpose(s) for which it is applicable or intended.

All users of this report are cautioned that there was no requirement for UES to attempt to locate any man-made buried objects or identify any other potentially hazardous conditions that may exist at the site during the course of this exploration. Therefore, no attempt was made by UES to locate or identify such concerns. UES cannot be responsible for any buried man-made objects or environmental hazards which may be subsequently encountered during construction that are not discussed within the text of this report. We can provide this service if requested.

During the early stages of most construction projects, geotechnical issues not addressed in this report may arise. Because of the natural limitations inherent in working with the subsurface, it is not possible for a geotechnical engineer to predict and address all possible problems. A Geotechnical Business Council (GBC), "Important Information About Your Geotechnical



Engineering Report" appears in Appendix D, and will help explain the nature of geotechnical issues.

Further, we present documents in Appendix D: Constraints and Restrictions, to bring to your attention the potential concerns and the basic limitations of a typical geotechnical report.

* * * * *



APPENDIX A





1730.1900029-A



UNIVERSAL
ENGINEERING SCIENCES

ANTIOCH WATER TOWER PROPERTY
CENTER POINT ROAD
CRESTVIEW, FLORIDA

SITE LOCATION MAP

DRAWN BY: KD	DATE: 06/11/19	CHECKED BY: MJ	DATE: 06/11/19
SCALE: NTS	PROJECT NO: 1730.1900029.0000	REPORT NO: 1680586	PAGE NO: A - 1



1730.1900029-A



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ANTIOCH WATER TOWER PROPERTY
CENTER POINT ROAD
CRESTVIEW, FLORIDA

USDA SOIL SURVEY MAP

DRAWN BY: KD	DATE: 06/11/19	CHECKED BY: MJ	DATE: 06/11/19
SCALE: NTS	PROJECT NO:1730.1900029.0000	REPORT NO: 1680586	PAGE NO: A - 2

APPENDIX B





LEGEND



STANDARD PENETRATION TEST BORING LOCATION

NOTE: ALL SOIL TEST BORING LOCATIONS SHOWN ARE APPROXIMATE.



1730.1900029-A



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ANTIOCH WATER TOWER PROPERTY
CENTER POINT ROAD
CRESTVIEW, FLORIDA

BORING LOCATION PLAN

DRAWN BY: KD	DATE: 06/11/19	CHECKED BY: MJ	DATE: 06/11/19
SCALE: NTS	PROJECT NO:1730.1900029.0000	REPORT NO: 1680586	PAGE NO: B - 1



UNIVERSAL ENGINEERING SCIENCES BORING LOG

PROJECT NO.: 1730.1900029.0000

REPORT NO.: 1680586

PAGE: B-2

PROJECT: ANTIOCH WATER TOWER PROPERTY
CENTER POINT ROAD
CRESTVIEW, FLORIDA

CLIENT: SEASIDE ENGINEERING AND SURVEYING, LLC
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

BORING NO: **B-1** SHEET: **1 of 1**

SECTION: TOWNSHIP: RANGE:

GS ELEVATION(ft): DATE STARTED: 5/1/19

WATER TABLE (ft): 41 DATE FINISHED: 5/1/19

DATE OF READING: 5/1/19 DRILLED BY: G. PEACOCK

EST. WSWT (ft): >6 TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	S A M P L E	BLOWS PER 6" INCREMENT	N VALUE	W.T.	S Y M B O L	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT/DAY)	ORG CONT. (%)
									LL	PI		
0												
1	X					Medium dense to loose tan fine SAND [SP]						
2	X	5-5-5-5	10									
3	X											
4	X	3-3-2-1	5									
5	X											
6	X	1-1-1-2	2									
7	X											
8	X	2-3-2-3	5									
9	X					Loose light tan fine SAND [SP]						
10	X	3-3-3-3	6									
11												
12												
13												
14												
15	X					Medium dense red silty SAND [SM]						
16	X	5-5-7	12				15	11				
17												
18												
19												
20	X					Dense red, white SAND [SP]						
21	X	8-20-24	44									
22												
23												
24												
25	X					Dense white, orange SAND [SP]						
26	X	14-20-20	40									
27												
28												
29												
30	X					Dense white SAND [SP]						
31	X	14-17-25	42									
32												
33												
34												
35	X											
36	X	15-14-20	34									
37												
38												
39												
40	X											
41	X	15-14-17	31	▼								
42												
43												
44												
45	X											
46	X	15-17-14	31									
47												
48												
49												
50	X											
51	X	17-19-22	41			Boring Terminated at 51'						



UNIVERSAL ENGINEERING SCIENCES BORING LOG

PROJECT NO.: 1730.1900029.0000

REPORT NO.: 1680586

PAGE: B-3

PROJECT: ANTIOCH WATER TOWER PROPERTY
CENTER POINT ROAD
CRESTVIEW, FLORIDA

CLIENT: SEASIDE ENGINEERING AND SURVEYING, LLC
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

BORING NO: **B-2** SHEET: **1 of 1**

SECTION: TOWNSHIP: RANGE:

GS ELEVATION(ft): DATE STARTED: 5/13/19
WATER TABLE (ft): 40 DATE FINISHED: 5/14/19
DATE OF READING: 5/14/19 DRILLED BY: G. PEACOCK
EST. WSWT (ft): >6 TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	S A M P L E	BLOWS PER 6" INCREMENT	N VALUE	W.T.	S Y M B O L	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT/DAY)	ORG CONT. (%)
									LL	PI		
0												
1	X					Very loose to loose brown SAND [SP]						
2	X	1-1-1-2	2									
3	X											
4	X	1-1-1-1	2									
5	X											
6	X	2-2-2-3	4									
7	X											
8	X	3-3-3-4	6									
9	X											
10	X	3-4-4-6	8									
11												
12												
13												
14												
15	X					Medium dense red SAND, with silt [SP-SM]						
16	X	7-8-14	22									
17												
18												
19												
20	X					Medium dense orange SAND, with silt [SP-SM]						
21	X	13-14-13	27									
22												
23												
24												
25	X					Dense orange, white SAND, with silt [SP-SM]	9	9				
26	X	17-21-24	45									
27												
28												
29												
30	X					Dense to very dense white SAND, with silt [SP-SM]						
31	X	15-15-20	35									
32												
33												
34												
35	X											
36	X	19-22-26	48									
37												
38												
39												
40	X			▼								
41	X	16-16-20	36									
42												
43												
44												
45	X											
46	X	20-22-22	44									
47												
48												
49												
50	X											
51	X	23-25-27	52			Boring Terminated at 51'						



UNIVERSAL ENGINEERING SCIENCES BORING LOG

PROJECT NO.: 1730.1900029.0000

REPORT NO.: 1680586

PAGE: B-4

PROJECT: ANTIOCH WATER TOWER PROPERTY
CENTER POINT ROAD
CRESTVIEW, FLORIDA

CLIENT: SEASIDE ENGINEERING AND SURVEYING, LLC
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

BORING NO: **B-3** SHEET: **1 of 1**






SECTION: TOWNSHIP: RANGE:

GS ELEVATION(ft): DATE STARTED: 5/15/19
WATER TABLE (ft): 40 DATE FINISHED: 5/15/19
DATE OF READING: 5/15/19 DRILLED BY: G. PEACOCK
EST. WSWT (ft): >6 TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N VALUE	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT/DAY)	ORG CONT. (%)
									LL	PI		
0												
1						Loose light brown silty SAND [SM] (Topsoil)						
2		2-2-2-2	4			Loose brown SAND, with silt [SP-SM]						
3												
4		2-2-1-1	3									
5												
6		2-2-2-3	4				7	7				
7												
8		3-3-3-6	6									
9												
10		3-2-3-5	5									
11												
12												
13												
14												
15						Medium dense red SAND, with silt [SP-SM]						
16		7-7-7	14									
17												
18												
19												
20						Dense tan, white SAND [SP]						
21		13-16-22	38									
22												
23												
24												
25												
26		13-16-21	37									
27												
28												
29												
30												
31		18-18-22	40									
32												
33												
34												
35						Very dense to dense white SAND, with silt [SP-SM]						
36		22-22-23	55									
37												
38												
39												
40												
41		16-16-14	30	▼								
42												
43												
44												
45												
46		14-14-16	30									
47												
48												
49												
50												
51		16-17-14	31			Boring Terminated at 51'						



SYMBOLS AND ABBREVIATIONS

<u>SYMBOL</u>	<u>DESCRIPTION</u>
N-Value	No. of Blows of a 140-lb. Weight Falling 30 Inches Required to Drive a Standard Spoon 1 Foot
WOR	Weight of Drill Rods
WOH	Weight of Drill Rods and Hammer
	Sample from Auger Cuttings
	Standard Penetration Test Sample
	Thin-wall Shelby Tube Sample (Undisturbed Sampler Used)
RQD	Rock Quality Designation
	Stabilized Groundwater Level
	Seasonal High Groundwater Level (also referred to as the W.S.W.T.)
NE	Not Encountered
GNE	Groundwater Not Encountered
BT	Boring Terminated
-200 (%)	Fines Content or % Passing No. 200 Sieve
MC (%)	Moisture Content
LL	Liquid Limit (Atterberg Limits Test)
PI	Plasticity Index (Atterberg Limits Test)
NP	Non-Plastic (Atterberg Limits Test)
K	Coefficient of Permeability
Org. Cont.	Organic Content
G.S. Elevation	Ground Surface Elevation

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS More than 50% retained on the No. 200 sieve*	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW Well-graded gravels and gravel-sand mixtures, little or no fines
			GP Poorly graded gravels and gravel-sand mixtures, little or no fines
	SANDS More than 50% of coarse fraction passes No. 4 sieve	GRAVELS WITH FINES	GM Silty gravels and gravel-sand-silt mixtures
			GC Clayey gravels and gravel-sand-clay mixtures
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS 5% or less passing No. 200 sieve	SW** Well-graded sands and gravelly sands, little or no fines
			SP** Poorly graded sands and gravelly sands, little or no fines
SANDS with 12% or more passing No. 200 sieve		SM** Silty sands, sand-silt mixtures	
FINE-GRAINED SOILS 50% or more passes the No. 200 sieve*	SILTS AND CLAYS Liquid limit 50% or less		ML Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
			CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
			OL Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid limit greater than 50%		MH Inorganic silts, micaceous or diamicaceous fine sands or silts, elastic silts
			CH Inorganic clays or clays of high plasticity, fat clays
			OH Organic clays of medium to high plasticity
			PT Peat, muck and other highly organic soils

*Based on the material passing the 3-inch (75 mm) sieve

** Use dual symbol (such as SP-SM and SP-SC) for soils with more than 5% but less than 12% passing the No. 200 sieve

RELATIVE DENSITY

(Sands and Gravels)

- Very loose – Less than 4 Blow/Foot
- Loose – 4 to 10 Blows/Foot
- Medium Dense – 11 to 30 Blows/Foot
- Dense – 31 to 50 Blows/Foot
- Very Dense – More than 50 Blows/Foot

CONSISTENCY

(Sils and Clays)

- Very Soft – Less than 2 Blows/Foot
- Soft – 2 to 4 Blows/Foot
- Firm – 5 to 8 Blows/Foot
- Stiff – 9 to 15 Blows/Foot
- Very Stiff – 16 to 30 Blows/Foot
- Hard – More than 30 Blows/Foot

RELATIVE HARDNESS

(Limestone)

- Soft – 100 Blows for more than 2 Inches
- Hard – 100 Blows for less than 2 Inches

MODIFIERS

These modifiers Provide Our Estimate of the Amount of Minor Constituents (Silt or Clay Size Particles) in the Soil Sample

- Trace – 5% or less
- With Silt or With Clay – 6% to 11%
- Silty or Clayey – 12% to 30%
- Very Silty or Very Clayey – 31% to 50%

These Modifiers Provide Our Estimate of the Amount of Organic Components in the Soil Sample

- Trace – Less than 3%
- Few – 3% to 4%
- Some – 5% to 8%
- Many – Greater than 8%

These Modifiers Provide Our Estimate of the Amount of Other Components (Shell, Gravel, Etc.) in the Soil Sample

- Trace – 5% or less
- Few – 6% to 12%
- Some – 13% to 30%
- Many – 31% to 50%

APPENDIX C



FIELD PROCEDURES

Auger Borings (Flight and Hand-Held Bucket)

To aid in evaluating the subsurface conditions present on the site, we located and drilled flight and hand-held bucket type auger borings to the depths indicated on the attached Boring Logs.

In the flight-auger procedure, the boring was advanced using a drilling-rig to rotate a spiral type auger slowly until the auger blades were filled with representative samples of the soils. Once the blades were filled, the auger assembly was retrieved from the borehole and the sample was removed from the blades, placed in a labeled plastic container, and sealed.

In the hand-held bucket auger procedure, the boring was advanced by rotating a hand-held bucket type auger until the receiving end of the auger filled with soil. Once the bucket was filled, the auger assembly was removed from the borehole and the sample was retrieved from the bucket, placed in a labeled plastic container, and sealed.

After completing the auger borings, the samples obtained were transported to our laboratory where they were examined by a member of our geotechnical staff. This procedure was performed in general accordance with the latest revision of ASTM D 1452, Standard Practice for Soil Investigation and Sampling by Auger Borings.

Auger Borings (Flight)

To aid in evaluating the subsurface conditions present on the site, we located and drilled one or more flight auger borings to the depths indicated on the attached Boring Logs.

In the flight-auger procedure, the boring was advanced using a drilling-rig to rotate a spiral type auger slowly until the auger blades were filled with representative samples of the soils. Once the blades were filled, the auger assembly was retrieved from the borehole and the sample was removed from the blades, placed in a labeled plastic container, and sealed.

After completing the flight auger boring(s), the samples obtained were transported to our laboratory where they were examined by a member of our geotechnical staff. This procedure was performed in general accordance with the latest revision of ASTM D 1452, Standard Practice for Soil Investigation and Sampling by Auger Borings.

Auger Borings (Hand-Held Bucket)

To aid in evaluating the subsurface conditions present on the site, we located and drilled one or more hand-held bucket type auger borings to the depths indicated on the attached Boring Logs.

In the hand-held bucket auger procedure, the boring was advanced by rotating a hand-held bucket type auger until the receiving end of the auger filled with soil. Once the bucket was filled, the auger assembly was removed from the borehole and the sample was retrieved from the bucket, placed in a labeled plastic container, and sealed.

After completing the auger boring(s), the samples obtained were transported to our laboratory where they were examined by a member of our geotechnical staff. This procedure was performed in general accordance with the latest revision of ASTM D 1452, Standard Practice for Soil Investigation and Sampling by Auger Borings.

Standard Penetration Test Borings (Flight Auger Advanced)

To aid in evaluating the subsurface conditions present on the site, we located and drilled one or more Standard Penetration Test (SPT) borings to the depths indicated on the attached Boring Logs.

FIELD PROCEDURES

In this procedure, the boring was advanced by rotary drilling techniques using a 3-inch flight-auger assembly. At 1½- to 5-foot intervals, the drilling tools were removed from the borehole and a split-barrel sampler was inserted to the borehole bottom and driven 18-inches into the soil using a 140-pound hammer falling on the average 30 inches per hammer blow. The number of blows for the final 12 inches of penetration is termed the “penetration resistance, blow count, or N-value.” This value is an index to several in-place geotechnical properties of the material tested, such as relative density and Young’s Modulus.

After driving the sampler 18 inches (or less if in extremely dense/hard materials), the sampler was retrieved from the borehole and a representative sample of the material within the split-barrel sampler was placed in a labeled plastic container and sealed. After completing the drilling operations, the samples obtained from the boring were transported to our laboratory where they were examined by a member of our geotechnical staff. This procedure was performed in general accordance with the latest revision of ASTM D 1586, Standard Test Method for Standard Penetration Test and Split-Barrel Sampling of Soils.

Standard Penetration Test Borings (Mud-Rotary Advanced)

To aid in evaluating the subsurface conditions present on the site, we located and drilled one or more Standard Penetration Test (SPT) borings to the depths indicated on the attached Boring Logs.

In this procedure, the boring was advanced by rotary drilling techniques using a circulating bentonite fluid for borehole flushing and stability. At 1½- to 5-foot intervals, the drilling tools were removed from the borehole and a split-barrel sampler was inserted to the borehole bottom and driven 18 inches into the soil using a 140-pound hammer falling an average 30 inches per hammer blow. The number of blows for the final 12 inches of penetration is termed the “penetration resistance, blow count, or N-value”. This value is an index to several in-place geotechnical properties of the material tested, such as relative density and Young’s Modulus.

After driving the sampler 18 inches (or less if in extremely dense/hard materials), the sampler was retrieved from the borehole and a representative sample of the material within the split-barrel sampler was placed in a labeled plastic container and sealed. After completing the drilling operations, the samples obtained from the boring were transported to our laboratory where they were examined by a member of our geotechnical staff. This procedure was performed in general accordance with the latest revision of ASTM D 1586, Standard Test Method for Standard Penetration Test and Split-Barrel Sampling of Soils.

Standard Penetration Test Borings (Tripod Advanced)

To aid in evaluating the subsurface conditions present on the site, we located and drilled one or more Standard Penetration Test (SPT) borings to the depths indicated on the attached Boring Logs.

In this procedure, the boring was advanced by wash drilling techniques using a circulating bentonite fluid for borehole flushing and stability. At 1½- to 5-foot intervals, the drilling tools were removed from the borehole and a split-barrel sampler was inserted to the borehole bottom and driven 18 inches into the soil using a 140-pound hammer falling an average 30 inches per hammer blow. The number of blows for the final 12 inches of penetration is termed the “penetration resistance, blow count, or N-value”. This value is an index to several in-place geotechnical properties of the material tested, such as relative density and Young’s Modulus.

After driving the sampler 18 inches (or less if in extremely dense/hard materials), the sampler was retrieved from the borehole and a representative sample of the material within the split-barrel sampler was placed in a labeled plastic container and sealed. After completing the drilling operations, the samples obtained from the boring were transported to our laboratory where they were examined by a member of our geotechnical staff. This procedure was performed in general accordance with the latest revision of ASTM D 1586, Standard Test Method for Standard Penetration Test and Split-Barrel Sampling of Soils.

FIELD PROCEDURES

Double Ring Infiltrometer (DRI) Test

Double Ring Infiltrometer (DRI) testing was conducted in the field in the proposed stormwater management system area of the site. The depth and location of each DRI test was determined from the results of the test borings performed in the proposed stormwater management system area.

In this test, the test area is excavated with a flat blade shovel to the indicated test depth (typically 1 to 3 feet below existing grades). The test area was widened and smoothed such that the 24-inch outer ring could be easily placed in the excavated area and tamped 6 inches into the subsurface from a relatively level plane. Once the outer ring was in place and tamped into the subsurface, the inner ring was placed in the approximate center of the outer ring and driven 4 inches into the underlying soils.

Once the inner and outer rings were in place, presaturation of the subsurface soils was initiated. Tap water (in prefilled barrels) was placed in the inner and outer rings to 6 inches above the excavated surface in each ring. The water was placed such that “tunneling” of the soils between the inner and outer rings did not occur (this will cause stabilization of the water levels in the inner and outer rings, making the test useless). The water levels in the rings were kept at a constant 6-inch level by adding water as needed for a period of thirty minutes to an hour. Note that saturation times become longer in low permeability soils.

The DRI test was initiated once the saturation period was complete. The water levels in both rings were kept at the 6-inch level and time readings were started. The appropriate schedule of readings may be determined only through experience. Time reading intervals typically range from 2 to 60 minutes in sandy materials, while for low-permeability materials, the reading interval may be up to 24 hours, or more. During the designated time period, the water was kept at a constant 6-inch level in both rings. The volume of water (in mL) added to the inner ring during this procedure was recorded adjacent to the time period the reading was taken. This process was continued until the volume readings in the inner ring became stabilized. Once the test stabilized and the results were recorded, the DRI equipment was removed from the excavation area and the test area was backfilled with soil cuttings.

The DRI testing was performed in general accordance with ASTM D 3385, Standard Test Method for Infiltration Rate of Soils in Field Using Double Ring Infiltrometer.

Soil Electrical Resistivity Test

To aid in evaluating the subsurface conditions present on the site, soil electrical resistivity testing was performed for this project. The soil resistivity test was performed using the Wenner method (a.k.a., the four-point method) utilizing a Nilsson Soil Resistivity Meter Model 400. The Wenner method involves placing four, equally spaced probes in the test area, perpendicular of any underground utilities. The resistivity was measured at probe spacing's of 5, 10, 15, 20, and 30 linear feet by adjusting the coarse and fine adjustment knobs on the meter until the null indicator on the meter was balanced. The resistivity at the above probe spacing's roughly corresponds to resistivity measurements at depths of 5, 10, 15, 20, and 30 feet below existing grade. This test was performed in general accordance with the methodology outlined in ASTM G 57, Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method.

Muck Probing

To aid in evaluating the subsurface conditions present on the site, we located and performed muck probing on select areas of the site. The muck probes were completed by manually advancing a probe-rod into the loose surficial and organic laden soils (muck) present on the site until firm resistance was encountered. The results of the muck probes were recorded in the field and were reported to the geotechnical engineer for analysis. No specific method applies to this procedure.

FIELD PROCEDURES

Limerock Bearing Ratio (LBR) Test Sample Collection

One or more samples of the shallow, near-surface, subgrade soils were collected for LBR testing. To collect the sample, the topsoil and the upper few inches of the in-situ soils were scraped away with a shovel as to expose the soil chosen for testing. Once the refuse soils were removed, two five-gallon buckets of the soils were collected and returned to our laboratory for LBR testing. The sample was combined and spread out to air dry prior to running the LBR test. No specific test method applies to this procedure.

Dynamic Cone Penetrometer Testing

In order to evaluate the relative density of the in situ soils, we performed the Dynamic Cone Penetrometer at shallow depths in the auger borings. The Dynamic Cone Penetrometer test was performed at one foot intervals in depth. The DCP test was performed according to the procedures developed by Professor G. F. Sowers and Charles S. Hedges (ASCE, 1966) and outlined in ASTM STP 399. The test procedure involves first seating the conical point of the penetrometer two inches into the bearing materials. The conical point is then driven two additional 1¾-inch increments using a 15-pound weight falling 20 inches. The penetrometer reading is the average number of blows required to drive the conical point two 1¾-inch increments. Correlations have been developed using the penetrometer results to evaluate the level of compaction of soils and to estimate the allowable net soil bearing capacity.

Asphalt Coring

To aid in determining the general condition of the asphalt section present on the site, we located and drilled on or more asphalt cores to collect samples of the asphaltic concrete for thickness measurement and/or to provide access to the underlying base and subgrade soils. The asphalt coring was performed by the use of an electric coring machine. A four-inch, water cooled, coring drill bit is placed on the pavement and rotated while simultaneously being pushed slowly into the asphalt and base soil/rock materials (note that a six-inch coring bit is used for FDOT projects). The coring is terminated when the asphalt has been bypassed and the core bit has been inserted in to the underlying base soils. Note that for hard or cemented base materials such as crushed limerock or soil cement; the core bit is used to bypass and collect those materials as well. The asphalt and base soil/rock cores were then transported to our laboratory for further analysis. No specific test method applies to this procedure.

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Natural Moisture Content Test

One or more samples of the soils found during our subsurface exploration were chosen for natural moisture content testing. In this test, the soil sample is placed into a metal pan of known weight, weighed, dried for a minimum of 12 hours in a $110 \pm 5^\circ\text{C}$ oven, and then weighed again to record the weight of water released during drying. The natural moisture content of the soil is termed the ratio of “pore” or “free” water in a given mass of material to the mass of solid material particles. This test was conducted in general accordance with ASTM D 2216, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

Percent -200 Soil Fines Content Test

One or more samples of the soils found during our subsurface exploration were chosen to determine the percentage of silt and clay fines present in the individual samples. In this test, the Natural Moisture Content test (ASTM D 2216) was performed and the sample was then washed over a No. 200 mesh sieve. The materials present in the sample that did not pass through the No. 200 sieve was then placed back in its original pan and dried until the water retained from the wet-sieve process was totally evaporated. Once dried, the sample was weighed again to determine the weight of fines removed during the wet-sieve process. The percent of soil by weight passing the No. 200 sieve is termed the percentage of fines or portion of the sample in the silt and clay size range. This test was conducted in general accordance with ASTM D 1140, Standard Test Methods for Amount of Material in Soils Finer Than the No. 200 (75- μm) Sieve.

Organic Content Test

One or more samples of the soils found during our subsurface exploration were chosen to determine the organic contents of the individual samples. The organic content test involves performing the Natural Moisture Content test (ASTM D 2216) and then placing 10 to 40 grams of the mixed and dried soil sample into a porcelain crucible of known weight. The crucible (with sample) was then placed into a Barnstead|Thermolyne Model 1400 Muffle Furnace and ignited at a temperature of $455 \pm 10^\circ\text{C}$ for 6 hours. After six hours, the crucible was then allowed to cool in a desiccator to prevent moisture entry from the lab’s atmosphere. Once cool to the touch, the crucible was removed from the desiccator and then weighed to determine the mass of organic materials disintegrated during the ignition process. The organic content of the soil is defined as the percentage of combustible organic materials present in a given amounts of the dried soil sample. This test was conducted in general accordance with AASHTO T 267, Standard Method of Test for Determination of Organic Content in Soils by Loss on Ignition.

Constant-Head Permeability Test

One or more samples of the soils found during our subsurface exploration were chosen to determine the permeability rates (a.k.a., hydraulic conductivity values) of the soils. In this test, the remolded sampled material was compacted in two or three lifts in a 1.5-in diameter, 2.5 inch long permeameter of known weight and volume. Once the material was compacted into the mold, the mold and material were then weighed. In addition to weighing the mold and soil, the Natural Moisture Content test (ASTM D 2216) was performed on the trimmings left over from the sample compaction. The Dry Density of the material was then calculated using the volume, weight, and moisture content of the compacted sample.

Once the density procedure was performed, the permeability mold with the compacted material was then covered with a porous stone. A constant-head water source was then connected to the permeameter and the sample was allowed to saturate.

After equilibrium flow was established through the sample, a minimum of three time measurements were taken for a specified volume of water flowing out through the sample. This was accomplished using a graduated cylinder and a stop watch. The recorded times were averaged and used in calculation for the determination of the permeability rate.

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Falling-Head Permeability Test

One or more samples of the soils found during our subsurface exploration were chosen to determine the permeability rates (a.k.a., hydraulic conductivity values) of the soils. In this test, the sampled material was compacted in two or three lifts in a 4-in permeability mold of known weight and volume. Once the material was compacted into the mold, the mold and material were then weighed. In addition to weighing the mold and soil, the Natural Moisture Content test (ASTM D 2216) was performed on the trimmings left over from the sample compaction. The Dry Density of the material was then calculated using the volume, weight, and moisture content of the compacted sample.

Once the density procedure was performed, the permeability mold with the compacted material was then covered with a porous stone and spring system to control loosening of the materials during the permeability test. A support collar and top plate was then placed atop the permeability mold (the top plate is equipped with a vent port to allow air to escape the mold/sample as well as an influent port to allow water to saturate the compacted sample). Once the apparatus was assembled and properly tightened, a one-half inch diameter vertical tube, marked with one-foot increments, is attached to the influent port. The tubing was then filled with water and permitted to drain into the influent port, thru the sample, and out of the effluent tube at the bottom of the apparatus. Once the sample was saturated and nearly devoid of air, the tubing was filled with water to seven feet above the apparatus and allowed to drain thru the sample while the time (in seconds) it took for the water to drop each one foot increment was recorded. The hydraulic conductivity of the sample was then calculated using data obtained from the procedure. This test was conducted in general accordance with FM 5-513, Florida Method of Test for Coefficient of Permeability – Falling Head Method.

Atterberg Limits Test

One or more samples of the soils found during our subsurface exploration were selected to determine their liquid limits, plastic limits, and plasticity indices (a.k.a., the Atterberg Limits). The liquid limit (LL) of the sample tested was determined using the multi-point method. In this method, the soil sample was dried per ASTM D 2216 (Natural Moisture Content) and then sieved through a No. 40 (425- μ m) sieve until approximately 200 grams of sieved material was obtained. Once 200 grams of the sieved material was obtained, distilled water was added until a specific material consistency was reached (as determined only by experience). The wet material was then spread into a brass cup utilizing a spatula, divided into two parts using a grooving tool, and then allowed to flow together using the shocks made by dropping the brass cup onto a standard mechanical device. Once this has been performed several times (typically three times), the moisture content of the sample and the number of blows required to make the material flow together after grooving was plotted to derive the liquid limit of the sample.

The plastic limit (PL) of the sample was determined by rolling a small portion of the sieved, wet sample, into a 0.5-in (3.2-mm) thread until the moisture content of the sample was reduced such that the thread crumbled and the soil could no longer be pressed together and re-rolled. The moisture content of the sample at that point is its plastic limit. The plasticity index (PI) is reported as the difference between the liquid limit and plastic limit of the samples (LL minus PL).

This test was conducted in general accordance with ASTM D 4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

Limerock Bearing Ratio (LBR) Test

One or more samples of the predominant, near surface, soils found during our subsurface exploration were collected and returned to our laboratory for LBR testing. In this test, a minimum of four, preferably five, samples of the material are compacted at varying moisture contents to establish a moisture-density relationship for the material. The samples were then soaked for a period of 48 hours under a surcharge mass of at least 2.5 lb (1.13 kg). A penetration test was then performed on each sample by causing a 1.95-in (49.5-mm) diameter piston to penetrate the soil at a constant rate to a depth of 0.5 in (12.7 mm). A

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load-penetration curve was then plotted for each sample and the LBR corresponding to 0.1 in (2.5 mm) penetration was calculated. The maximum LBR for a material is determined from a plot of the LBR versus moisture content. This test was performed in general accordance with FM 5-515, Florida Method of Test for Limerock Bearing Ratio.

California Bearing Ratio (CBR) Test

One or more samples of the predominant, near surface, soils found during our subsurface exploration were collected and returned to our laboratory for CBR testing. In this test, a minimum of four, preferably five, samples of the material are compacted at varying moisture contents to establish a moisture-density relationship for the material. The samples were then soaked for a period of 96 hours under a surcharge mass of at least 2.5 lb (1.13 kg). A penetration test was then performed on each sample by causing a 1.95-in (49.5-mm) diameter piston to penetrate the soil at a constant rate to a depth of 0.5 in (12.7 mm). A load-penetration curve was then plotted for each sample and the CBR corresponding to 0.1 in (2.5 mm) penetration was calculated. The maximum CBR for a material is determined from a plot of the CBR versus moisture content. This test was performed in general accordance with ASTM D1883, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.

Asphalt Core Measurement

One or more samples of the asphalt (asphalt cores) collected during our field exploration were returned to our laboratory for thickness measurements. In this procedure, the asphalt core is stripped of all base/subgrade materials which have cemented to the bottom of the core. Once clean, the core is measured by taking a minimum of four measurements using a caliper along the edges of the core. The four measurements are then averaged to obtain the average thickness of the asphalt core. No specific test method applies to this procedure.

Grainsize Distribution Test

One or more samples of the soils found during our subsurface exploration were selected for grainsize distribution testing. In this test, the Natural Moisture Content (ASTM D 2216) and the Percent -200 Soil Fines Content Test (ASTM D 1140) was performed on the sample. The materials which did not pass through the No. 200 sieve were then dried and weighed and then placed into a stack of mesh sieves (sieve sizes typically range from the 2-in sieve to the No. 200 sieve) and were then shaken for approximately 540 seconds (9 minutes) in a mechanical shaker. Once the sample was agitated, the amount of sample retained on each of the stacked sieves was measured and plotted. The grainsize distribution of the sample tested is defined as the percentage of material retained on a specific set of sieves when compared to the weight of the original washed and dried sample. This test was performed in general accordance with ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

pH Level Test

One or more samples of the soils found during our subsurface exploration were selected to evaluate the pH (potential of Hydrogen) levels of the soils. For this test, approximately 100 ml of soil was added to a like amount of distilled water in a 250-ml glass beaker. The soil and water mixture was then mixed thoroughly in ten minute intervals for thirty minutes, ensuring that any clumps of soil were no longer intact. The pH of the soil was then tested using a Hanna Model LA 3410 pH probe. Solutions with a pH of less than 7.0 are considered acidic, while solutions with a pH greater than 7.0 are considered basic (alkaline). This test was conducted in general accordance with FM 5-550, Florida Method of Test for Determining pH of Soil and Water.

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Chloride Content Test

One or more samples of the soils found during our subsurface exploration were selected to evaluate the chloride levels present in the soils. For this test, approximately 400 grams of soil was air dried to a constant weight and then sieved through a No. 10 sieve (please note that for muck or clay soils, the sample is pulverized with a mallet after drying). Approximately 100 grams of the dried soil was then placed in a 500-ml Erlenmeyer flask. Approximately 300 ml of distilled water was then added to the soil, the flask was capped with a stopper, and the soil/water mixture was shaken vigorously for 20 seconds; the mixture was allowed to stand for 1 hour, was shaken again, and then allowed to stand for 12 hours. The water used in the above procedure was then filtered through a No. 4 filter paper until the water stopped dripping from the filter paper. A 10-ml measuring tube was then over-filled with the filtered water and then the filtered water was transferred to a mixing bottle. The contents of one potassium dichromate indicator pillow was completely dissolved in the sample and then a silver nitrate catalyst was added (with a dropper, swirling after each drop) until the solution became orange in color. The number of drops used to obtain the orange color was then multiplied by 20 to obtain the concentration of chloride present in the samples (in ppm). This test was conducted in general accordance with FM 5-552, Florida Method of Test for Chloride in Soil and Water.

Sulfate Content Test

One or more samples of the soils found during our subsurface exploration were selected to evaluate the sulfate levels present in the soils. For this test, approximately 400 grams of soil was air dried to a constant weight and then sieved through a No. 10 sieve (note that for muck or clay soils, the sample is pulverized with a mallet after drying). Approximately 100 grams of the dried soil was then placed in a 500-ml Erlenmeyer flask. Approximately 300 ml of distilled water was then added to the soil, the flask was capped with a stopper, and the soil/water mixture was shaken vigorously for 20 seconds; the mixture was allowed to stand for one hour, was shaken again, and then allowed to stand for 12 hours. The water used in the above procedure was then filtered through a No. 4 filter paper until the water stopped dripping from the filter paper. A 10-ml measuring tube was then over-filled with the filtered water and then the filtered water was transferred to a mixing bottle. Note that if the filtered water was still cloudy after filtering, three to five drops of hydrochloric acid was added to half of the filtered water to clear up the solution. Once the filtered water sample was prepared, 10 ml of the sample water was pipetted into a 10-ml sample vial. The contents of one Barium chloride pillow were added to the sample and the sample was inverted several times until the contents of the Barium chloride pillow were dissolved. The solution was allowed to react for at least 5 minutes (but no more than 10 minutes) before measurement. A small portion of the unreacted sample (sample without Barium chloride) was then placed into sample cell and then into a prewarmed and zeroed HACH DR/2400 Spectrophotometer set to 100% transmittance. The spectrophotometer was then adjusted to read zero concentration. The sample cell was then emptied and filled with sample water reacted with Barium chloride and the spectrophotometer procedure above was then repeated. The percent transmittance (%T) of the reacted sample was then obtained from the spectrophotometer. Once the %T was obtained from the spectrophotometer, the sulfate content was determined utilizing the %T versus Concentration (ppm) adjustments for the spectrophotometer unit. This test was conducted in general accordance with FM 5-553, Florida Method of Test for Sulfate in Soil and Water.

Soil Electrical Resistivity Test

One or more of the soil samples found during our subsurface exploration were selected for electrical resistivity testing. This test was performed with a Nilsson Soil Resistivity Meter Model 400 and soil box. For this test, approximately 1000 grams of the thoroughly mixed soil was placed into the soil box at its natural moisture content. The resistivity was obtained by adjusting the fine and coarse ohm adjustments on the meter. The soil was placed back into a mixing pan and then 50 to 100 ml of deionized water was thoroughly mixed into the material. The resistivity was obtained again by adjusting the fine and coarse ohm adjustments on the meter. This procedure was repeated until the resistivity stopped dropping or began to rise. The result of the resistivity test is the lowest reading obtained during the procedure. This test was conducted in general accordance with the concepts outlined in FM 5-551, Florida Method of Test

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for Resistivity of Soil and Water. Note that while the equipment used to perform the procedure is the same, this procedure provides data different than that of the electrical resistivity test performed in the field.

Corrosive Series Test

One or more samples of the soil samples found were selected for corrosive series testing. The corrosive series test involves several tests including: pH level, chloride content, sulfate content, and resistivity. The individual testing methods are outlined below.

APPENDIX D



Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply this report for any purpose or project except the one originally contemplated.*

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an

assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by:* the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help

others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold-prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical-engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your GBC-Member geotechnical engineer for more information.



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CONSTRAINTS & RESTRICTIONS

The intent of this document is to bring to your attention the potential concerns and the basic limitations of a typical geotechnical report.

WARRANTY

Universal Engineering Sciences has prepared this report for our client for his exclusive use, in accordance with generally accepted soil and foundation engineering practices, and makes no other warranty either expressed or implied as to the professional advice provided in the report.

UNANTICIPATED SOIL CONDITIONS

The analysis and recommendations submitted in this report are based upon the data obtained from soil borings performed at the locations indicated on the Boring Location Plan. This report does not reflect any variations which may occur between these borings.

The nature and extent of variations between borings may not become known until excavation begins. If variations appear, we may have to re-evaluate our recommendations after performing on-site observations and noting the characteristics of any variations.

CHANGED CONDITIONS

We recommend that the specifications for the project require that the contractor immediately notify Universal Engineering Sciences, as well as the owner, when subsurface conditions are encountered that are different from those present in this report.

No claim by the contractor for any conditions differing from those anticipated in the plans, specifications, and those found in this report, should be allowed unless the contractor notifies the owner and Universal Engineering Sciences of such changed conditions. Further, we recommend that all foundation work and site improvements be observed by a representative of Universal Engineering Sciences to monitor field conditions and changes, to verify design assumptions and to evaluate and recommend any appropriate modifications to this report.

MISINTERPRETATION OF SOIL ENGINEERING REPORT

Universal Engineering Sciences is responsible for the conclusions and opinions contained within this report based upon the data relating only to the specific project and location discussed herein. If the conclusions or recommendations based upon the data presented are made by others, those conclusions or recommendations are not the responsibility of Universal Engineering Sciences.

CHANGED STRUCTURE OR LOCATION

This report was prepared in order to aid in the evaluation of this project and to assist the architect or engineer in the design of this project. If any changes in the design or location of the structure as outlined in this report are planned, or if any structures are included or added that are not discussed in the report, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions modified or approved by Universal Engineering Sciences.

USE OF REPORT BY BIDDERS

Bidders who are examining the report prior to submission of a bid are cautioned that this report was prepared as an aid to the designers of the project and it may affect actual construction operations.

Bidders are urged to make their own soil borings, test pits, test caissons or other investigations to determine those conditions that may affect construction operations. Universal Engineering Sciences cannot be responsible for any interpretations made from this report or the attached boring logs with regard to their adequacy in reflecting subsurface conditions which will affect construction operations.

STRATA CHANGES

Strata changes are indicated by a definite line on the boring logs which accompany this report. However, the actual change in the ground may be more gradual. Where changes occur between soil samples, the location of the change must necessarily be estimated using all available information and may not be shown at the exact depth.

OBSERVATIONS DURING DRILLING

Attempts are made to detect and/or identify occurrences during drilling and sampling, such as: water level, boulders, zones of lost circulation, relative ease or resistance to drilling progress, unusual sample recovery, variation of driving resistance, obstructions, etc.; however, lack of mention does not preclude their presence.

WATER LEVELS

Water level readings have been made in the drill holes during drilling and they indicate normally occurring conditions. Water levels may not have been stabilized at the last reading. This data has been reviewed and interpretations made in this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, tides, and other factors not evident at the time measurements were made and reported. Since the probability of such variations is anticipated, design drawings and specifications should accommodate such possibilities and construction planning should be based upon such assumptions of variations.

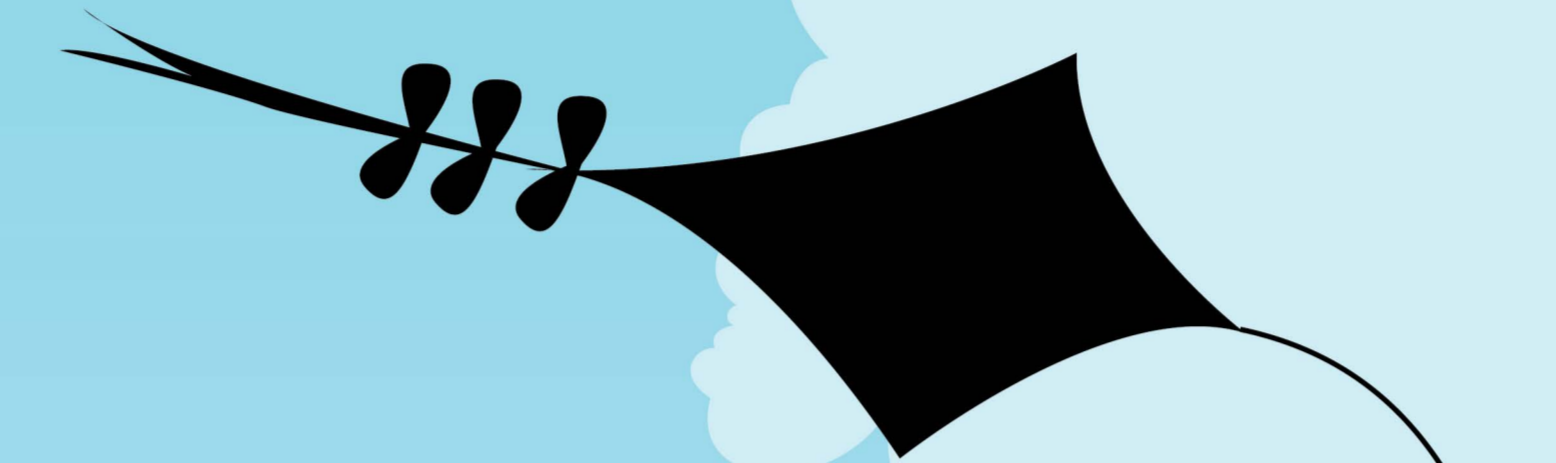
LOCATION OF BURIED OBJECTS

All users of this report are cautioned that there was no requirement for Universal Engineering Sciences to attempt to locate any man-made buried objects during the course of this exploration and that no attempt was made by Universal Engineering Sciences to locate any such buried objects. Universal Engineering Sciences cannot be responsible for any buried man-made objects which are subsequently encountered during construction that are not discussed within the text of this report.

TIME

This report reflects the soil conditions at the time of exploration. If the report is not used in a reasonable amount of time, significant changes to the site may occur and additional reviews may be required.





The Hub City of Northwest Florida

CITY OF CRESTVIEW, FLORIDA

OKALOOSA COUNTY 1916

DRAWINGS

ANTIOCH ROAD ELEVATED WATER STORAGE TANK

BID DOCUMENTS THE CITY OF CRESTVIEW PUBLIC SERVICES JACOBS PROJECT NO. D3282100



LOCATION MAP
SCALE: 1" = 1000'

SITE INFORMATION

OWNER INFORMATION:
THE CITY OF CRESTVIEW
ANTIOCH ELEVATED WATER TANK
715 N FERDON BLVD
CRESTVIEW, FL 32536
PHONE: (850)-682-6132
ATTN: WAYNE STEELE

ENGINEER:
JACOBS

ENGINEER INFORMATION:
25 W CEDAR STREET, SUITE 350
PENSACOLA, FL 32502
PHONE: (850) 941-7282



VICINITY MAP
SCALE: 1" = 400000'

DRAWING INDEX

SHEET NUMBER	DRAWING NUMBER	DRAWING NAME
01	G-01	COVER SHEET, LOCATION MAPS AND DRAWING INDEX
02	G-02	GENERAL NOTES AND LEGEND
03	G-03	STRUCTURAL NOTES AND LEGEND
04	G-04	STRUCTURAL NOTES AND LEGEND
05	G-05	CIVIL DETAILS
06	G-06	CIVIL DETAILS
07	G-07	CIVIL DETAILS
08	G-08	ELECTRICAL LEGEND SHEET 1
09	G-09	ELECTRICAL LEGEND SHEET 2
10	C-01	EXISTING CONDITIONS
11	C-02	GRADING, DRAINAGE, AND EROSION CONTROL PLAN
12	C-03	PROPOSED SITE IMPROVEMENTS
13	C-04	GEOMETRIC CONTROL PLAN
14	S-01	STRUCTURAL PLANS
15	S-02	STRUCTURAL ELEVATION AND SECTION
16	S-03	STRUCTURAL DETAILS
17	S-04	STRUCTURAL DETAILS
18	S-05	STRUCTURAL DETAILS
19	E-01	SITE PLAN AND ONE LINE DIAGRAM
20	E-02	PANEL SCHEDULE AND WATER TOWER ELEVATION
21	E-03	STANDARD DETAILS

NO.	DATE	REVISION	CHK	APVD

ANTIOCH ROAD COMPOSITE WATER TOWER
PUBLIC SERVICES
CITY OF CRESTVIEW
CRESTVIEW, FLORIDA

ANTIOCH WATER TOWER
DESIGN PLANS

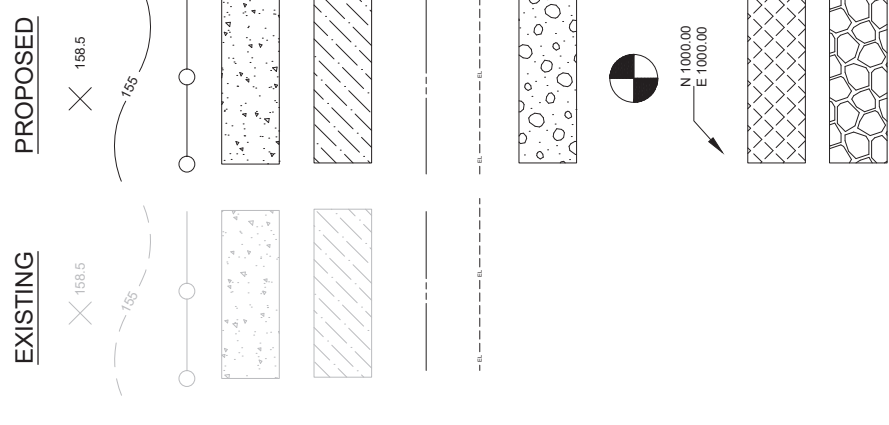


VERIFY SCALE	DATE	PROJ	DWG	SHEET
BAR IS ONE INCH ON ORIGINAL DRAWING 1"	MARCH 2021	D3282100	D3282100	1 of 21

GENERAL SITE NOTES:

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CITY OF CRESTVIEW STANDARD DETAILS AND SPECIFICATIONS.
2. CONTRACTOR TO OBTAIN OKALOOSA COUNTY AND FLORIDA DOT UTILITY PERMITS AND MAINTENANCE OF TRAFFIC PLAN FOR WORK IN THE RIGHT-OF-WAYS.
3. STAGING AREA SHALL BE FOR CONTRACTOR'S EMPLOYEE PARKING, CONTRACTOR'S TRAILERS AND ON-SITE STORAGE OF MATERIALS.
4. CONTRACTOR SHALL NOT DISTURB AREAS OUTSIDE EXISTING RIGHTS-OF-WAY OR TEMPORARY CONSTRUCTION EASEMENTS.
5. CONTRACTOR TO ADJUST ALL EXISTING UTILITY CASTINGS INCLUDING VALVE BOXES, MANHOLES, HAND HOLES, PULL BOXES, INLETS AND SIMILAR STRUCTURES WITHIN PAVED AREAS TO MATCH FLUSH WITH FINISHED GRADE.
6. THE CONTRACTOR SHALL REPAIR AND RESTORE EXISTING PAVEMENT, SIDEWALKS, CURBS, DRIVEWAYS, PIPES, IRRIGATION LINES, CONDUIT, CABLES, ETC. AS A RESULT OF THE CONSTRUCTION ACTIVITIES.
7. NO DEBRIS OR CONSTRUCTION MATERIALS WILL BE BURIED OR DISPOSED OF ONSITE. ALL SUCH MATERIAL SHALL BE DISPOSED OF IN ACCORDANCE WITH LOCAL AND STATE REGULATIONS.
8. SEE SEPARATE VOLUME FOR PROJECT SPECIFICATIONS.
9. SOURCE OF TOPOGRAPHY SHOWN ON THE CIVIL PLANS ARE BASE MAPS PROVIDED BY SEAS SURVEYING 2019. EXISTING CONDITIONS MAY VARY FROM THOSE SHOWN ON THESE PLANS. THE CONTRACTOR SHALL VERIFY EXISTING CONDITIONS AND ADJUST WORK PLAN ACCORDINGLY PRIOR TO BEGINNING CONSTRUCTION. NOTIFY ENGINEER AND OWNER OF DISCREPANCIES AND CONFLICTS.
10. EXISTING TOPOGRAPHY, STRUCTURES, AND SITE FEATURES ARE SHOWN SCREENED AND/OR LIGHT-LINED. NEW FINISH GRADE, STRUCTURES, AND SITE FEATURES ARE SHOWN HEAVY-LINED.
11. MAINTAIN, RELOCATE, OR REPLACE EXISTING SURVEY MONUMENTS, CONTROL POINTS, AND STAKES WHICH ARE DISTURBED OR DESTROYED. PERFORM THE WORK TO PRODUCE THE SAME LEVEL OF ACCURACY AS THE ORIGINAL MONUMENT(S) IN A TIMELY MANNER, AND AT THE CONTRACTOR'S EXPENSE.
12. COORDINATES AND DIMENSIONS SHOWN FOR ROADWAY IMPROVEMENTS ARE TO FACE OF CURB OR EDGE OF PAVEMENT.
13. PROVIDE TEMPORARY FENCING AS NECESSARY TO MAINTAIN SECURITY AT ALL TIMES.
14. ELEVATIONS GIVEN ARE TO FINISH GRADE UNLESS OTHERWISE SHOWN.
15. SLOPE UNIFORMLY BETWEEN CONTOURS AND SPOT ELEVATIONS SHOWN.
16. CONTRACTOR SHALL BE RESPONSIBLE FOR IMPLEMENTING AND MAINTAINING EROSION CONTROL DEVICES DURING CONSTRUCTION. EROSION CONTROL DEVICE (SHOWN ON C-302) IS THE MINIMUM REQUIRED.
17. CONTRACTOR SHALL TAKE ALL OTHER MEASURES TO POSITIVELY PRECLUDE EROSION MATERIALS FROM LEAVING THE SITE. CONTRACTOR TO SUBMIT EROSION CONTROL PLAN.

CIVIL LEGEND



GENERAL YARD PIPING AND UTILITY NOTES

1. EXISTING UNDERGROUND UTILITIES OBTAINED FROM AS-BUILTS AND FROM FIELD SURVEY. CONTRACTOR SHALL FIELD VERIFY DEPTH AND LOCATION PRIOR TO EXCAVATION. PROTECT ALL EXISTING UTILITIES DURING CONSTRUCTION.
2. UNLESS OTHERWISE SHOWN ALL PIPING SHALL HAVE A MINIMUM OF 3'-0" COVER.
3. ALL PIPES SHALL HAVE A CONSTANT SLOPE BETWEEN INVERT ELEVATIONS UNLESS A FITTING IS SHOWN.
4. ALL INTERNAL TANK COATINGS SHALL MEET NSF 61 STANDARDS.
5. ALL PIPE, APPURTENANCES, AND ASSOCIATED COATINGS SHALL MEET NSF 61 STANDARDS.
6. FOR TRENCHING AND BACKFILL, SEE (3123-11D).
7. FOR SURFACE RESTORATION OF ASPHALT CONCRETE, SEE (3123-11E).

GENERAL INFORMATION

1. FOR ABBREVIATIONS NOT LISTED, SEE ASME Y14.38 "ABBREVIATIONS AND ACRONYMS; PUBLICATION AS DISTRIBUTED BY THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME).
2. DESIGN DETAILS ARE INTENDED TO BE TYPICAL AND SHALL APPLY TO SIMILAR SITUATIONS OCCURRING THROUGHOUT THE PROJECT, WHETHER OR NOT THEY ARE INDIVIDUALLY CALLED OUT.
3. VERIFY FINAL OPENING DIMENSIONS IN WALLS, SLABS, AND DECKS WITH OTHER DISCIPLINE DRAWINGS PRIOR TO CONSTRUCTION OF THESE ELEMENTS.
4. DO NOT CUT OR MODIFY STRUCTURAL MEMBERS FOR PIPES, DUCTS, ETC. UNLESS SPECIFICALLY DETAILED OR APPROVED IN WRITING BY THE ENGINEER.
5. INFORMATION (DETAILING, DIMENSIONS, CONFIGURATIONS, AND ELEVATIONS, ETC.) OF EXISTING CONSTRUCTION SHOWN REFLECTS AVAILABLE EXISTING DESIGN DOCUMENTS, AND DOES NOT NECESSARILY REPRESENT THE AS-CONSTRUCTED CONDITIONS. THE CONTRACTOR SHALL FIELD VERIFY DIMENSIONS, ELEVATIONS AND DETAILING OF THE EXISTING STRUCTURES PRIOR TO UNDERTAKING ANY WORK THAT IS AFFECTED BY THE EXISTING STRUCTURE.



CIVIL
ANTIOCH WATER TOWER
GENERAL NOTES AND LEGEND

ANTIOCH ROAD COMPOSITE WATER TOWER
PUBLIC SERVICES
CITY OF CRESTVIEW
CRESTVIEW, FLORIDA

NO.	DATE	REVISION	CHK	APVD

DGNS
S. TATMAN
DR
S. TATMAN
CHK
J. NESSL
APVD
S. JERNIGAN

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING 1"

DATE	MARCH 2021
PROJ	D3282100
DWG	G-02
SHEET	2 of 21

PLOT TIME: \$PLOTTIME

DESIGN CRITERIA

- APPLICABLE CODE: FLORIDA BUILDING CODE SIXTH EDITION (2017)
 - REFER TO THE DRAWINGS FOR ADDITIONAL AND SPECIFIC STRUCTURE LOADINGS AND REQUIREMENTS.
 - ALL LOADS SHOWN ARE SERVICE LEVEL (UNFACTORED) UNLESS SPECIFICALLY NOTED OTHERWISE.
 - DEAD LOADS:
 - SELF WEIGHT
 - ROOF LOADS:
 - = 0 PSF
 - = 20 PSF
 - STRUCTURES SHALL BE DESIGNED FOR REDUCED ROOF LIVE LOADS IN ACCORDANCE WITH THE FBC.
 - FLOOR LIVE LOADS:
 - = 100 PSF
 - = 100 PSF
 - = 125 PSF
 - STAIRS:
 - WALKWAYS AND ELEVATED PLATFORMS
 - LIGHT STORAGE
 - COLUMNS, FOOTINGS, AND FLOOR FRAMING MEMBERS HAVE BEEN DESIGNED FOR REDUCED LIVE LOADS IN ACCORDANCE WITH THE BUILDING CODE.
 - DEFLECTION CRITERIA FOR CONTRACTOR DESIGNED FLOOR FRAMING MEMBERS:
 - INDUSTRIAL/PROCESS FLOOR (ELECTRICAL/MECHANICAL ROOMS, STORAGE, ETC):
 - TOTAL LOAD =L/240
 - LIVE LOAD =L/360
 - OCCUPIED SPACE FLOOR (CORRIDORS, EXITS, ETC):
 - TOTAL LOAD =L/360
 - LIVE LOAD =L/480
 - WHERE L IS THE MEMBER SPAN LENGTH
 - WIND LOADS:
 - ASCE 7 METHOD= ALL HEIGHTS
 - WVFRS DIRECTIONAL PROCEDURE
 - BASIC WIND SPEED, V_{ref} (1-150 MPH
 - NOMINAL WIND SPEED, V_{base} = 117 MPH
 - EXPOSURE CATEGORY= C
 - RISK CATEGORY=IV
 - SEISMIC LOADS:
 - MAPPED SPECTRAL RESPONSE ACCELERATIONS
 - S_s = 0.091g
 - S_1 = 0.055g
 - DESIGN SPECTRAL RESPONSE ACCELERATIONS
 - SDS = 0.097g
 - S01 = 0.088g
 - SITE CLASS= D
 - SEISMIC DESIGN CATEGORY= C
 - IMPORTANCE FACTOR, I_p = 1.5
 - STRUCTURES SHALL BE ANALYZED FOR SEISMIC PROCEDURES IN ACCORDANCE WITH ASCE 7.
 - SPECIAL LOADS SEE PLANS FOR STRUCTURE SPECIFIC LOADS
 - HYDRAULIC LOADS: SEE PLANS FOR STRUCTURE SPECIFIC LOADS
 - SOIL DESIGN PARAMETERS:
 - WATER TOWER SHALL BE SUPPORTED ON DEEP FOUNDATIONS. REFER TO RECOMMENDATION IN GEOTECHNICAL REPORT. SEE FOUNDATION SECTION.
 - GROUND WATER (GW) ELEVATION:
 - NORMAL HIGH GW EL +/-40 FT BELOW GRADE
 - EL .xx
 - FACTOR OF SAFETY FOR UPLIFT RESISTANCE (SOIL FRICTION AND WEDGE FAILURE NOT CONSIDERED):
 - NORMAL HIGH GW ELEVATION FOS = 1.25
 - 100 YEAR FLOOD ELEVATION FOS = 1.10
 - NEED FROM GEOTECH
 - FROST DEPTH
 - ICE LOADS:
 - NOMINAL ICE THICKNESS 0.25 IN
 - CONCURRENT WIND SPEED (3-SECOND GUST): 30 MPH
 - ICE IMPORTANCE FACTOR THICKNESS: 1.25
 - ICE IMPORTANCE FACTOR WIND: 1.00
- ## GENERAL INFORMATION
- FOR ABBREVIATIONS NOT LISTED SEE ASME Y14.38 "ABBREVIATIONS AND ACRONYMS: PUBLICATION AS DISTRIBUTED BY THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
 - DESIGN DETAILS ARE INTENDED TO BE TYPICAL AND SHALL APPLY TO SIMILAR SITUATIONS OCCURRING THROUGHOUT THE PROJECT, WHETHER OR NOT THEY ARE INDIVIDUALLY CALLED OUT.
 - FOR NUMBER, TYPE, SIZE, ARRANGEMENT, AND/OR LOCATION OF EQUIPMENT PADS, SEE OTHER DISCIPLINE DRAWINGS. COORDINATE WITH EQUIPMENT SUPPLIER PRIOR TO PLACING SLABS, WALLS AND FOUNDATIONS. COORDINATE PIPING OPENINGS WITH OTHER DISCIPLINE DRAWINGS.
 - DO NOT CUT OR MODIFY STRUCTURAL MEMBERS FOR PIPES, DUCTS, ETC. UNLESS SPECIFICALLY DETAILED OR APPROVED IN WRITING BY THE ENGINEER.
 - VISITS TO THE JOB SITE BY THE ENGINEER TO OBSERVE THE CONSTRUCTION DO NOT IN ANY WAY MEAN THAT ENGINEER IS GUARANTOR OF CONSTRUCTOR'S WORK, NOR RESPONSIBLE FOR THE COMPREHENSIVE OR SPECIAL INSPECTIONS, COORDINATION, SUPERVISION, OR SAFETY AT THE JOB SITE.
 - INFORMATION (DETAILING, DIMENSIONS, CONFIGURATIONS, AND ELEVATIONS, ETC.) OF EXISTING CONSTRUCTION SHOWN REFLECTS AVAILABLE EXISTING DESIGN DOCUMENTS, AND DOES NOT NECESSARILY REPRESENT THE AS-CONSTRUCTED CONDITIONS. THE CONTRACTOR SHALL FIELD VERIFY DIMENSIONS, ELEVATIONS AND DETAILING OF THE EXISTING STRUCTURES PRIOR TO UNDERTAKING ANY WORK THAT IS AFFECTED BY THE EXISTING STRUCTURE. NOTIFY ENGINEER IF CONDITIONS VARY FROM THAT SHOWN PRIOR TO STARTING WORK.

INSPECTION AND TESTING

- ENGINEER OF RECORD FOR WATER TOWER SHALL DETERMINE WHAT SPECIAL INSPECTIONS MAY BE REQUIRED FOR THIS RISK CATEGORY IV STRUCTURE, AND INCLUDE A STATEMENT OF REQUIRED SPECIAL INSPECTIONS
 - SPECIFIED LABORATORY TEST MIXES AND SIMILAR CONFORMANCE TO SPECIFICATIONS, AND SUBMITTED FOR REVIEW PRIOR TO ACCEPTANCE FOR USE ON THE PROJECT, SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.
 - SPECIAL INSPECTION, TESTING AND OBSERVATION (OWNER FURNISHED) IS REQUIRED IN ACCORDANCE WITH FBC SECTIONS 109, 110, AND 1704.
- ## FOUNDATIONS
- REFER TO GEOTECHNICAL DATA REPORT UES REPORT NO. 16805866 BY UNIVERSAL ENGINEERING SCIENCES DATES JUNE 21, 2019.
 - EXCAVATIONS SHALL BE SHORED TO PREVENT SUBSIDENCE AND DAMAGE TO ADJACENT EXISTING STRUCTURES, ROADS, UTILITIES, ETC.
 - FOUNDATION SLABS AND SLABS-ON-GRADE SPECIFICALLY NOTES TO BE ON FILL SHALL BEAR ON 6 INCHES OF COMPACTED GRANULAR FILL.
 - FOUNDATION BEARING SURFACES SHALL BE OBSERVED BY THE GEOTECHNICAL ENGINEER OR QUALIFIED DESIGNEE PRIOR TO PLACEMENT OF FORMWORK OF REINFORCING STEEL. THE OBSERVATION SHALL VERIFY IF THE ACTUAL EXPOSED SUBGRADE IS AS ANTICIPATED BY THE SITE SPECIFIC BORINGS, TESTING, AND DATA REPORT.
 - NO BACKFILL SHALL BE PLACED BEHIND WALLS UNTIL THE WALL'S CONCRETE HAS ATTAINED 100 PERCENT AND TOP SUPPORTING SLABS CONCRETE HAS ATTAINED 80 PERCENT OF THEIR SPECIFIED 28 DAY COMPRESSIVE STRENGTH, OR UNTIL TOP-OF-WALL FRAMING SYSTEMS, INCLUDING STEEL OR WOOD DIAPHRAGMS, HAVE BEEN COMPLETED
 - NO BACKFILL SHALL BE PLACED BEHIND CANTILEVERED, FREE TOP WALLS UNTIL THE CONCRETE HAS ATTAINED 100 PERCENT OF ITS SPECIFIED 28 DAY COMPRESSIVE STRENGTH.
 - USE OF EXPLOSIVES IS ONLY ALLOWED WITH WRITTEN PERMISSION FROM THE ENGINEER.
- ## FORMWORK, SHORING, AND BRACING
- STRUCTURES SHOWN ON THE DRAWINGS HAVE BEEN DESIGNED FOR STABILITY UNDER FINAL CONDITIONS ONLY, DESIGN SHOWN DOES NOT INCLUDE NECESSARY COMPONENTS OR EQUIPMENT FOR STABILITY OF THE STRUCTURES DURING CONSTRUCTION. CONTRACTOR IS RESPONSIBLE FOR WORK RELATING TO CONSTRUCTION ERECTION METHODS, BRACING, SHORING, RIGGING, GUYS, SCAFFOLDING, FORMWORK, AND OTHER WORK AIDS REQUIRED TO SAFELY PERFORM THE WORK SHOWN.
 - TEMPORARY SHORING SHALL REMAIN IN PLACE UNTIL ELEVATED CONCRETE FLOOR OR SLABS HAVE REACHED 80 PERCENT OF THE 28 DAY COMPRESSIVE STRENGTH AS DETERMINED BY FIELD CYLINDER BREAKS.
 - "BURY" BARS OR "CARRIER" BARS ARE NOT ALLOWED FOR THE BOTTOM MATS OF REINFORCING IN ALL ELEVATED SLABS AND ARE NOT ALLOWED FOR THE TOP MATS OF REINFORCING IN ELEVATED SLABS LESS THAN 12 INCHES THICK.

CONCRETE REINFORCING

- REINFORCING STEEL:
 - TYPICAL: ASTM A615, GRADE 60
 - ASTM A706, GRADE 60 (WELDING IS ONLY PERMITTED WITH WRITTEN PERMISSION FROM ENGINEER)
- FABRICATION AND PLACEMENT OF REINFORCING STEEL SHALL BE IN ACCORDANCE WITH CRSI MSP-1 "MANUAL OF STANDARD PRACTICE" AND ACI 301 "SPECIFICATIONS FOR STRUCTURAL CONCRETE".
- MINIMUM REINFORCING FOR CONCRETE WALLS AND SLABS SHALL BE AS FOLLOWS:

THICKNESS	REINFORCING EACH WAY	LOCATION
6"	#4 @ 12"	CENTERED
8"	#5 @ 12"	EACH FACE
10"	#4 @ 12"	EACH FACE
12"	#5 @ 12"	EACH FACE

PROVIDE LARGER SIZES AND MORE REINFORCING IN SECTIONS OR CONCRETE WHERE REQUIRED BY THE DETAILS ON THE DRAWINGS OR BY SPECIFICATIONS.
- CONCRETE COVER FOR REINFORCING, UNLESS SHOWN OTHERWISE, SHALL BE:
 - WHEN CAST AGAINST EARTH: 3"
 - ALL OTHER SURFACES: 2"
- 90 DEGREE BENDS, UNLESS OTHERWISE SHOWN, SHALL BE ACI 318 STANDARD HOOKS.
- REINFORCING STEEL FOR FOOTINGS AND SLABS ON GRADE SHALL BE ADEQUATELY SUPPORTED ON BAR SUPPORTS WITH SPACERS TO KEEP REINFORCING ABOVE THE PREPARED GRADE. LIFTING REINFORCING OFF GRADE DURING CONCRETE PLACEMENT IS NOT PERMITTED.

CONCRETE REINFORCING CONTINUED

- REINFORCEMENT BENDS AND LAPS, UNLESS OTHERWISE NOTED, SHALL SATISFY THE FOLLOWING MINIMUM REQUIREMENTS:

CONCRETE DESIGN STRENGTH = 4,000 PSI MIN AT 28 DAYS ³		GRADE 60 REINFORCING STEEL									
BAR SIZE	LAP SPLICE LENGTH	#3	#4	#5	#6	#7	#8	#9	#10	#11	
SPACING = 3"	TOP BAR 2	1'-4"	1'-8"	2'-1"	3'-0"	5'-2"	6'-8"	8'-5"	10'-10"	13'-4"	
	OTHER BAR	1'-4"	1'-4"	1'-8"	2'-4"	4'-0"	5'-2"	6'-7"	8'-4"	10'-3"	
SPACING = 4"	TOP BAR 2	1'-4"	1'-8"	2'-0"	2'-5"	3'-10"	5'-0"	6'-5"	8'-1"	10'-0"	
	OTHER BAR	1'-4"	1'-4"	1'-7"	1'-10"	3'-0"	3'-11"	4'-11"	6'-3"	7'-8"	
SPACING = 6"	TOP BAR 2	1'-4"	1'-8"	2'-0"	2'-5"	3'-6"	4'-0"	5'-0"	6'-2"	7'-5"	
	OTHER BAR	1'-4"	1'-4"	1'-7"	1'-10"	2'-9"	3'-1"	3'-10"	4'-9"	5'-8"	
EMBEDMENT LENGTH											
SPACING = 3"	TOP BAR 2	1'-0"	1'-3"	1'-8"	2'-4"	4'-0"	5'-2"	6'-7"	8'-4"	10'-3"	
	OTHER BAR	1'-0"	1'-0"	1'-3"	1'-10"	3'-1"	4'-0"	5'-1"	6'-5"	7'-11"	
SPACING = 4"	TOP BAR 2	1'-0"	1'-3"	1'-7"	1'-10"	3'-0"	3'-11"	4'-11"	6'-3"	7'-8"	
	OTHER BAR	1'-0"	1'-0"	1'-3"	1'-5"	2'-4"	3'-0"	3'-10"	4'-10"	5'-11"	
SPACING = 6"	TOP BAR 2	1'-0"	1'-3"	1'-7"	1'-10"	2'-9"	3'-1"	3'-10"	4'-9"	5'-8"	
	OTHER BAR	1'-0"	1'-0"	1'-3"	1'-5"	2'-1"	2'-5"	3'-0"	3'-8"	4'-5"	

- LAP LENGTHS ARE BASED ON MINIMUM CONCRETE COVER OF 2". LONGER LENGTHS ARE REQUIRED FOR CONCRETE COVER LESS THAN 2".
 - TOP BARS SHALL BE DEFINED AS ANY HORIZONTAL BARS PLACED SUCH THAT MORE THAN 12 INCHES OF CONCRETE IS CAST IN THE MEMBER BELOW THE BAR IN ANY SINGLE POUR. HORIZONTAL WALL BARS ARE CONSIDERED TOP BARS.
 - WHERE 3000 PSI CONCRETE IS USED, INCREASE ABOVE LENGTHS BY 16 PERCENT. WHERE 3500 PSI CONCRETE IS USED, INCREASE ABOVE LENGTHS BY 7 PERCENT.
- ## CAST IN PLACE CONCRETE

- 28-DAY COMPRESSIVE STRENGTHS (TO MEET STRUCTURAL STRENGTH REQUIREMENTS):
 - COMPOSITE ELEVATED WATER STORAGE TANK FOUNDATION: 4,000 PSI
 - WALLS: 6,000 PSI
 - DOMES: 5,000 PSI
 - TYPICAL UNLESS OTHERWISE SPECIFIED: 4,000 PSI
 - FIBER REINFORCED CONCRETE FILL: 3,500 PSI
 - CURBS AND SIDEWALKS: 4,500 PSI
 - DUCT BANKS AND PIPE ENCASEMENTS: 3,500 PSI
 - NOT INTEGRAL WITH FOUNDATIONS

- DESIGN STRENGTHS ARE SAME AS 28-DAY COMPRESSIVE STRENGTH.
- ROUGHEN AND CLEAN CONSTRUCTION JOINTS IN WALLS AND SLABS AS SPECIFIED PRIOR TO PLACING ADJACENT CONCRETE.
- COORDINATE PLACEMENT OF OPENINGS, PIPE PENETRATIONS, CURBS, DOWELS, SLEEVES, CONDUITS, BOLTS AND INSERTS PRIOR TO PLACEMENT OF CONCRETE.
- NO ALUMINUM CONDUIT OR PRODUCTS CONTAINING ALUMINUM OR ANY OTHER MATERIAL INJURIOUS TO THE CONCRETE SHALL BE EMBEDDED IN THE CONCRETE.
- PATCH FORM TIE HOLES IN ACCORDANCE WITH DETAILS 0310-051 AND/OR 0310-052.

WELDING

- WELDS SHALL CONFORM TO AMERICAN WELDING SOCIETY (AWS):
 - STRUCTURAL WELDING CODE STEEL
 - STRUCTURAL WELDING CODE ALUMINUM
 - STRUCTURAL WELDING CODE SHEET STEEL
 - STRUCTURAL WELDING CODE REINFORCING STEEL
 - STRUCTURAL WELDING CODE STAINLESS STEEL
- REPAIR WELDS FOUND DEFECTIVE IN ACCORDANCE WITH AWS D1.1 SECTION 6.26
- USE INTERMITTENT WELDS AT FIELD WELDS OF EMBED PLATES AND ANGLES TO AVOID SPALLING OR CRACKING OF THE EXISTING CONCRETE.
- BUTT JOINT WELDS SHALL BE COMPLETE JOINT PENETRATION (CJP) UNLESS INDICATED OTHERWISE.

STRUCTURAL STEEL AND METAL FABRICATIONS

- STRUCTURAL STEEL SHALL CONFORM TO THE FOLLOWING ASTM STANDARDS:
 W-SHAPES A992
 MISCELLANEOUS SHAPES INCLUDING:
 ANGLES, CHANNELS, PLATES, ETC. A36
 MOMENT CONNECTION CONTINUITY PLATES A572, GRADE 50
 HOLLOW STRUCTURAL SECTIONS (HSS) A500, GRADE B
 STEEL PIPE A53, GRADE B
 STAINLESS STEEL SHAPES A276
 ALUMINUM SHALL CONFORM TO THE FOLLOWING ASTM STANDARDS:
 STRUCTURAL SHAPES B306
 PLATES B209
- STRUCTURAL STEEL SHALL BE FABRICATED AND ERECTED IN CONFORMANCE WITH THE AISC MANUAL OF STEEL CONSTRUCTION, CURRENT EDITION, AND CURRENT OSHA STANDARDS.
- FASTENERS SHALL BE HIGH STRENGTH BOLTS CONFORMING TO THE FOLLOWING ASTM STANDARDS EXCEPT WHERE SPECIFICALLY INDICATED OTHERWISE:
 UNLESS SHOWN OTHERWISE: A325-N
 SLIP CRITICAL A325-SC
 DIRECT TENSION INDICATORS OR LOAD INDICATOR WASHER ASTM F959
 TENSION CONTROL (TC) BOLTS ASTM A325 AND ASTM F1862
 ANCHOR BOLTS (AB) F593, AISI TYPE 316, CONDITION CW
 STAINLESS STEEL F1594, GR 36 / A153
 STEEL OR GALVANIZED STEEL MACHINE BOLTS (MB) A307
 STEEL F593, AISI TYPE 316, CONDITION CW
 STAINLESS STEEL A307 / A163
 GALVANIZED STEEL F468, ALLOY 2024-T4
 ALUMINUM
- ITEMS TO BE EMBEDDED IN CONCRETE SHALL BE CLEAN AND FREE OF OIL, DIRT, AND PAINT.
- NO HOLES OTHER THAN THOSE SPECIFICALLY DETAILED SHALL BE ALLOWED THROUGH STRUCTURAL STEEL MEMBERS. NO CUTTING OR BURNING OF STRUCTURAL STEEL IS PERMITTED WITHOUT THE APPROVAL OF THE ENGINEER.

DEFERRED SUBMITTALS

- DEFERRED SUBMITTALS ARE THOSE PORTIONS OF THE DESIGN WHICH ARE NOT SUBMITTED AT THE TIME OF PERMIT APPLICATION AND WHICH ARE TO BE SUBMITTED TO THE PERMITTING AGENCY FOR ACCEPTANCE PRIOR TO INSTALLATION OF THAT PORTION OF THE WORK OR ARE REQUIRED TO BE SUBMITTED FOR REVIEW ONLY BY THE ENGINEER.
- WHERE DEFERRED SUBMITTALS INCLUDE ADDITIONAL MATERIALS, INSTALLATION, ANCHORAGE, OR CERTIFICATION OF COMPONENTS THAT REQUIRE SPECIAL INSPECTION AND/OR STRUCTURAL OBSERVATION TO MEET CODE REQUIREMENTS, THE DEFERRED SUBMITTAL SHALL INCLUDE SPECIFIC LINE ITEMS TO BE ADDED TO THE APPROPRIATE TABLES IN THE PROJECT'S STATEMENT OF SPECIAL INSPECTIONS PLAN IF THEY ARE NOT ALREADY IDENTIFIED.
- THE FOLLOWING IS A LIST OF DEFERRED SUBMITTALS PER FCC SECTION 107.3.4.1 THAT ARE EXPECTED TO CONTAIN STRUCTURAL CALCULATIONS OR SAFETY RELATED SYSTEM INFORMATION FOR REVIEW TO MEET BUILDING PERMITTING REQUIREMENTS FOR DESIGNED SYSTEMS. PRIOR TO INSTALLATION OF THE INDICATED STRUCTURAL ELEMENT, EQUIPMENT, DISTRIBUTION SYSTEM, OR COMPONENT OR ITS ANCHORAGE, THE CONTRACTOR SHALL SUBMIT THE REQUIRED CALCULATIONS AND SUPPORTING DATA AND DRAWINGS FOR REVIEW AND ACCEPTANCE BY THE ENGINEER. ADDITIONALLY, ACCEPTANCE INDICATED ON THE ENGINEER'S COMMENT FORM, ALONG WITH THE COMPLETED, FINAL SUBMITTAL SHALL THEN BE SUBMITTED BY THE CONTRACTOR TO THE PERMITTING AGENCY AND APPROVED PRIOR TO INSTALLATION OF THESE ITEMS.

SPECIFICATION SECTION	CODE REQUIRED DEFERRED SUBMITTALS FOR REVIEW BY PERMITTING AGENCY
01 88 15	ANCHORAGE AND BRACING
05 05 19	POST INSTALLED ANCHORS
33 16 19	ELEVATED POTABLE-WATER STORAGE TANKS
OTHER	ANY EQUIPMENT OR COMPONENT IN WHICH A TECHNICAL SPECIFICATION REQUIRES SUBMITTAL OF EQUIPMENT OR ANCHORAGE SYSTEM CALCULATIONS

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ANTIOCH WATER TOWER
PUBLIC SERVICES
CITY OF CRESTVIEW
CRESTVIEW, FLORIDA

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING

DATE MARCH 2021

PROJ D3282100

DWG G-04

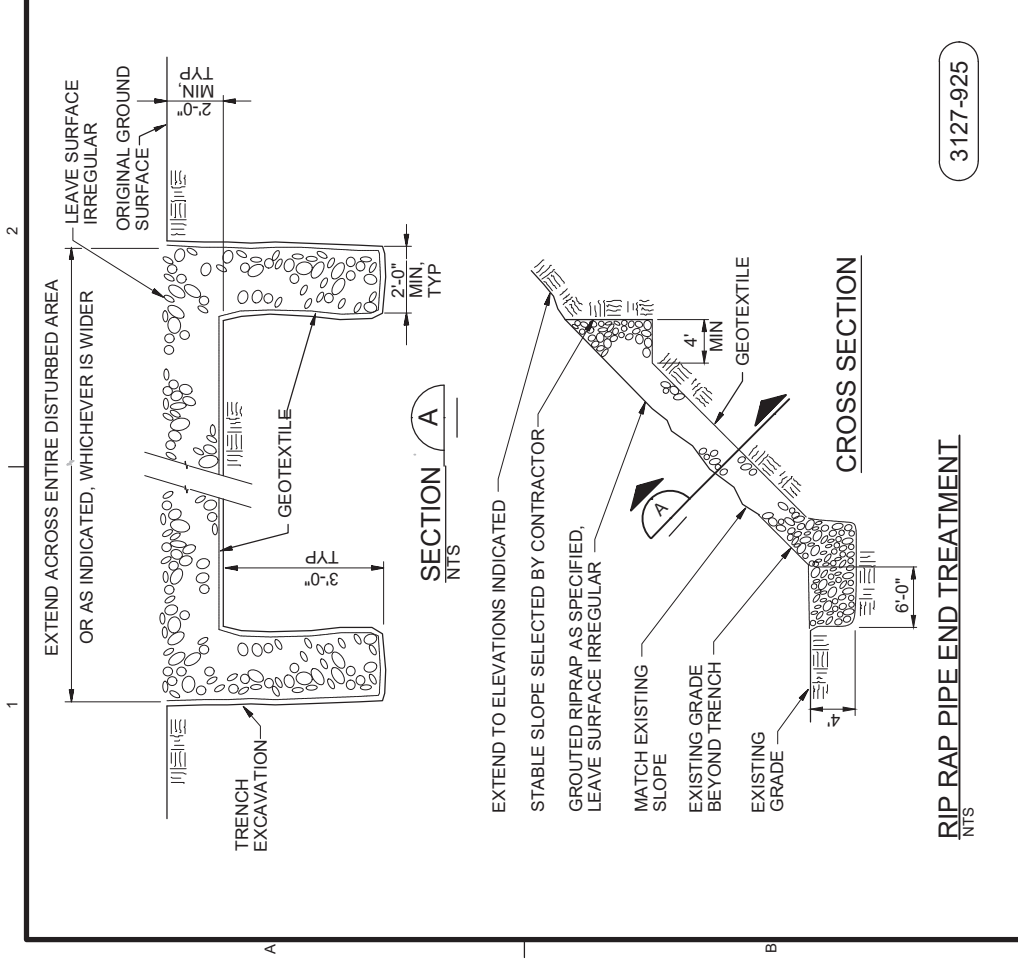
SHEET 4 of 21

PLOT TIME: \$PLOTTIME

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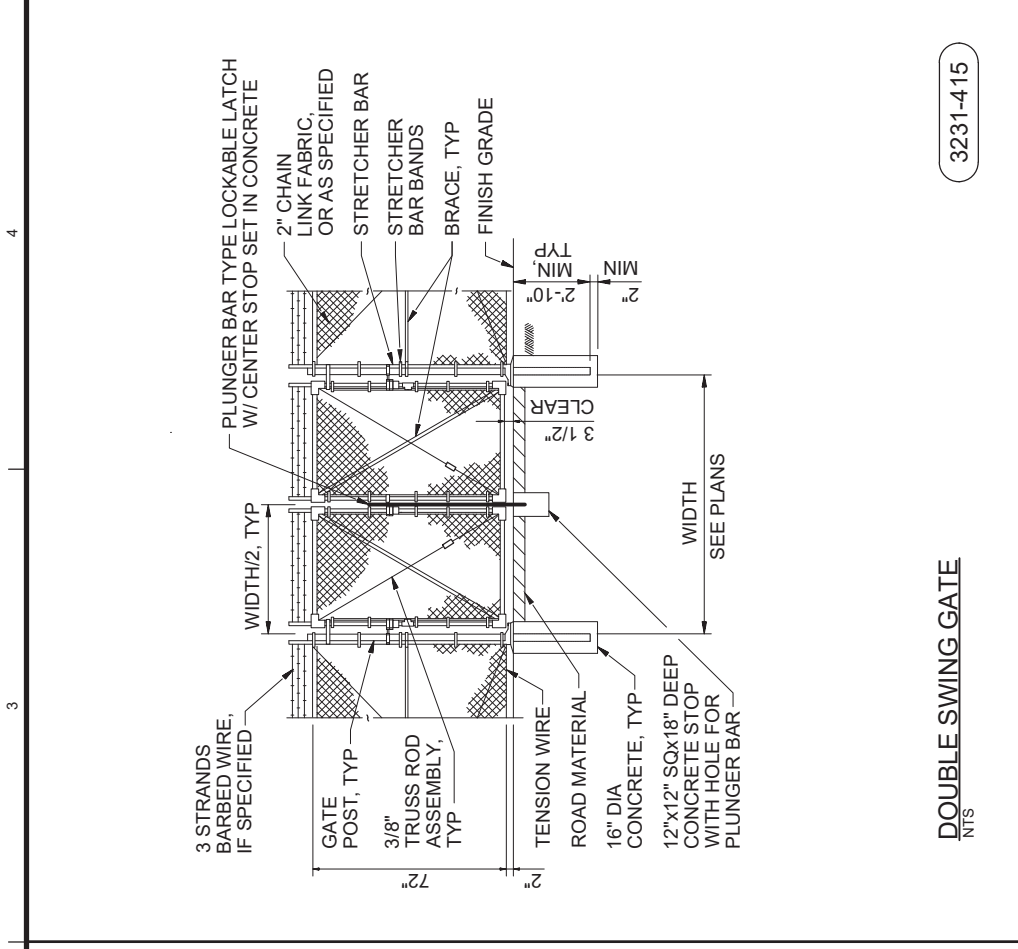
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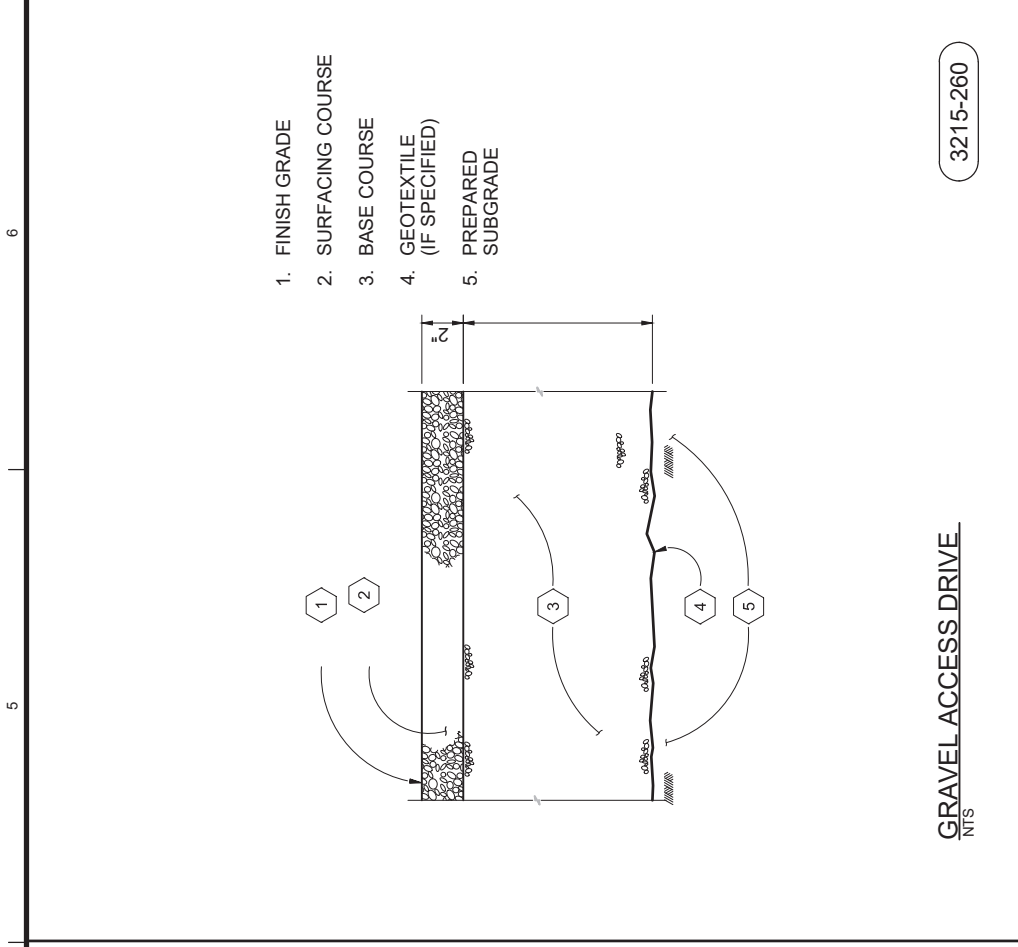


3127-925

RIP RAP PIPE END TREATMENT
NTS



3231-415



3215-260

NO.		DATE	REVISION	BY	APVD
DSGN		S. TAIWAN			
DR		S. TAIWAN			
CHK		S. TAIWAN			
APVD		S. JERNIGAN			

ANTIOCH ROAD COMPOSITE WATER TOWER
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CRESTVIEW, FLORIDA

ANTIOCH WATER TOWER
GENERAL
DETAILS

VERIFY SCALE

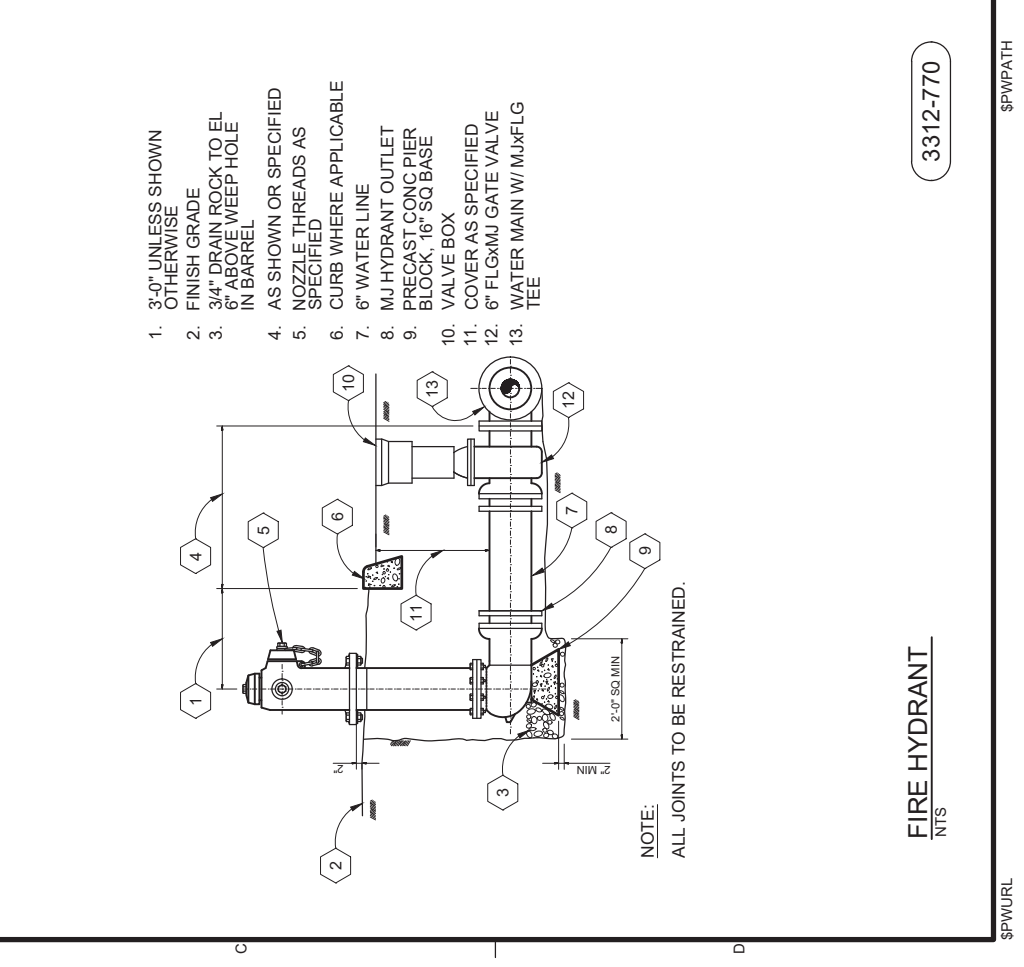
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DATE: MARCH 2021
PROJ: D3282100
DWG: G-06
SHEET: 6 OF 21

PLOT TIME: \$PLOTTIME

FILENAME: 01-G-06_D3282100.DWG

SPWURL



3312-770

FIRE HYDRANT
NTS

NO.		DATE	REVISION	BY	APVD
DSGN		S. TAIWAN			
DR		S. TAIWAN			
CHK		S. TAIWAN			
APVD		S. JERNIGAN			

ANTIOCH ROAD COMPOSITE WATER TOWER
CITY OF CRESTVIEW
PUBLIC SERVICES
CRESTVIEW, FLORIDA

ANTIOCH WATER TOWER
GENERAL
DETAILS

VERIFY SCALE

BAR IS ONE INCH ON
ORIGINAL DRAWING

DATE: MARCH 2021
PROJ: D3282100
DWG: G-06
SHEET: 6 OF 21

PLOT TIME: \$PLOTTIME

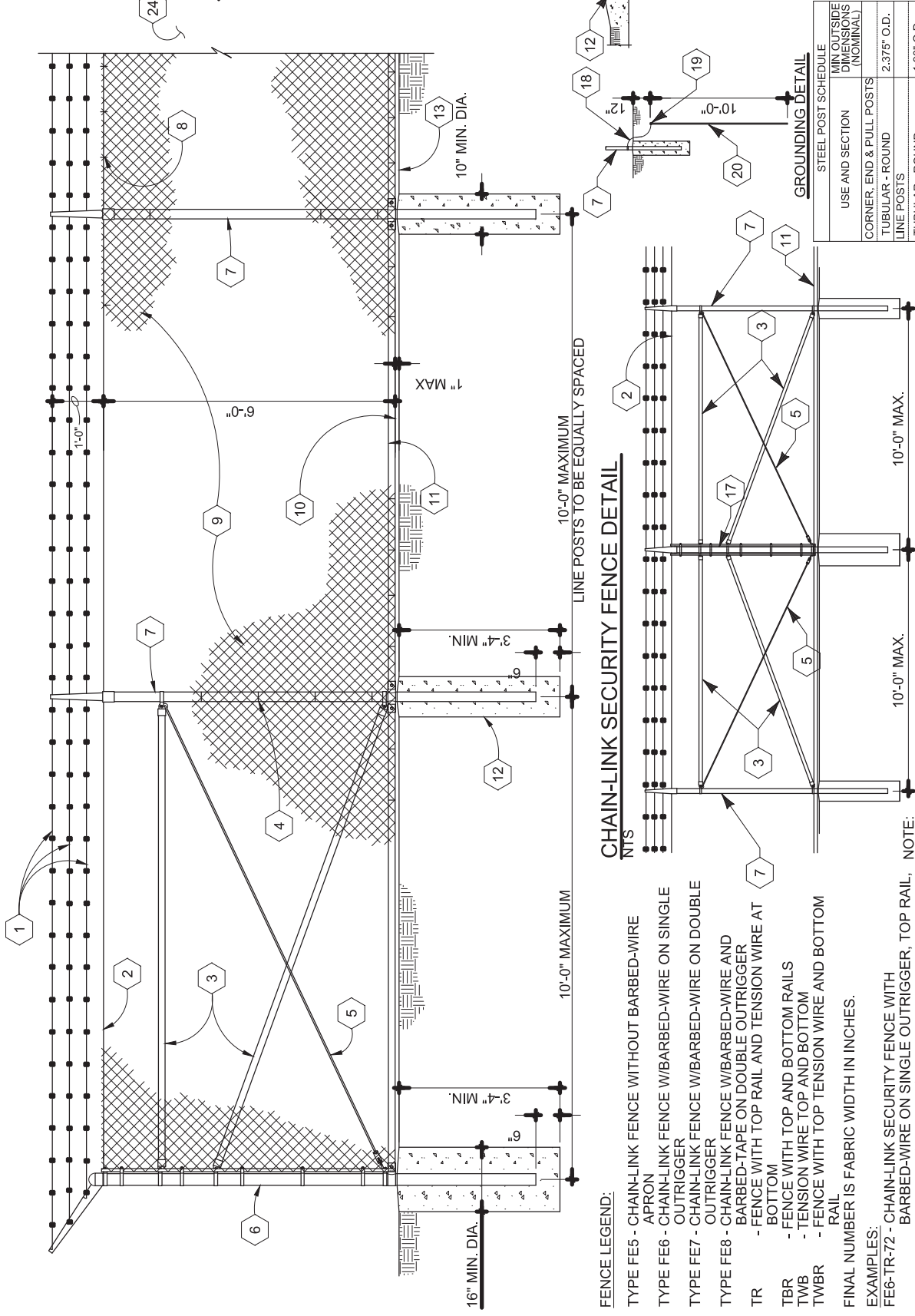
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1 2 3 4 5 6



FENCE LEGEND:

- TYPE FE5 - CHAIN-LINK FENCE WITHOUT BARBED-WIRE APRON
 - TYPE FE6 - CHAIN-LINK FENCE W/BARBED-WIRE ON SINGLE OUTRIGGER
 - TYPE FE7 - CHAIN-LINK FENCE W/BARBED-WIRE ON DOUBLE OUTRIGGER
 - TYPE FE8 - CHAIN-LINK FENCE W/BARBED-WIRE AND BARBED-TAPE ON DOUBLE OUTRIGGER
 - TR - FENCE WITH TOP RAIL AND TENSION WIRE AT BOTTOM
 - TBR - FENCE WITH TOP AND BOTTOM RAILS
 - TWB - TENSION WIRE TOP AND BOTTOM
 - TWBR - FENCE WITH TOP TENSION WIRE AND BOTTOM RAIL
- FINAL NUMBER IS FABRIC WIDTH IN INCHES.

EXAMPLES:

- FE6-TR-72 - CHAIN-LINK SECURITY FENCE WITH BARBED-WIRE ON SINGLE OUTRIGGER, TOP RAIL, AND 72 INCH FABRIC WIDTH.
- FE5-TWB-84 - CHAIN-LINK SECURITY FENCE WITH NO APRON, TOP AND BOTTOM TENSION WIRE, AND 84 INCH FABRIC WIDTH.

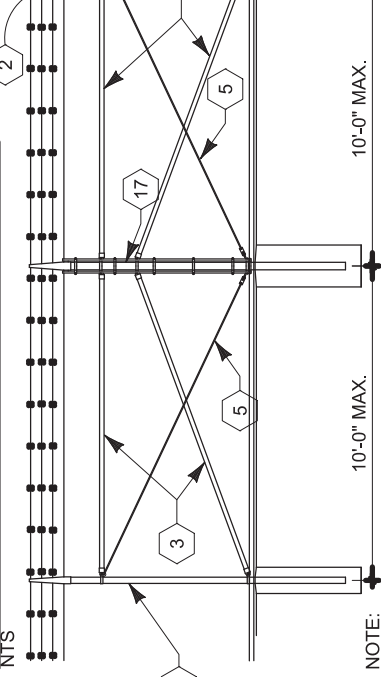
NOTES:

A. WIRE TIES, RAILS, POSTS, AND BRACES SHALL BE CONSTRUCTED ON THE SECURE SIDE OF THE FENCE ALIGNMENT. CHAIN-LINK FABRIC SHALL BE PLACED ON THE SIDE OPPOSITE THE SECURE AREA.

B. ONLY 9-GAGE GALVANIZED STEEL TIE WIRES SHALL BE USED FOR FASTENING THE FENCE FABRIC TO FENCE POSTS AND RAILS. 16-GAGE STAINLESS STEEL TIE WIRES SHALL BE USED FOR FASTENING FENCE FABRIC TO TENSION WIRES. HOG RINGS SHALL NOT BE ALLOWED ON SENSORED FENCES.

C. BOTTOM RAIL SHALL BE ATTACHED TO DOUBLE RAIL ENDS USING 3/8" CARRIAGE BOLTS AS SHOWN. ADDITIONAL HOLES SHALL BE DRILLED THROUGH THE BOTTOM RAIL ENDS TO INSURE THAT CARRIAGE BOLTS PASS THROUGH THE BOTTOM RAIL AS SHOWN.

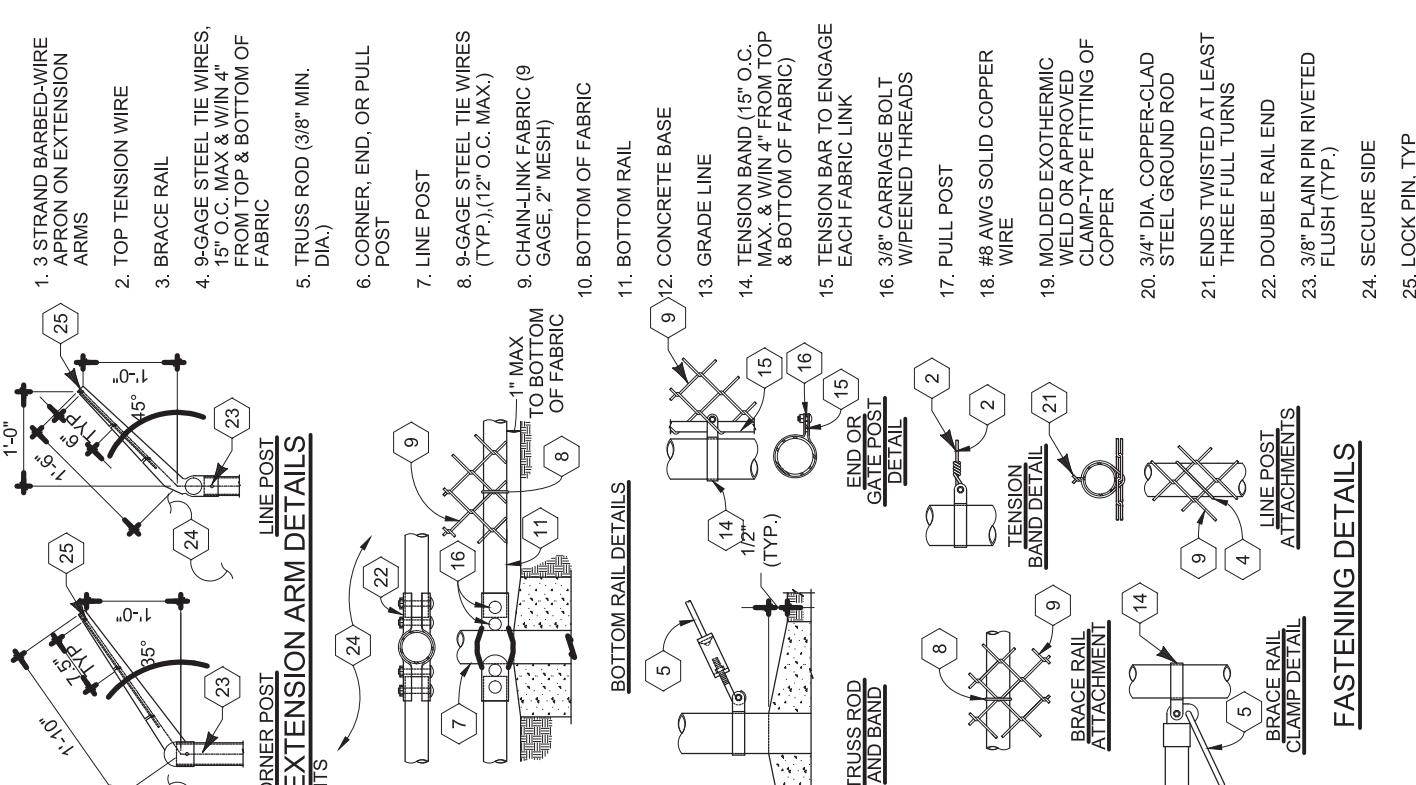
CHAIN-LINK SECURITY FENCE DETAIL
NTS



BRACE PANEL DETAIL
NTS

PROVIDE BRACE PANEL WHENEVER STRAIGHT RUNS EXCEED 500 FEET.

USE AND SECTION	MIN OUTSIDE DIMENSIONS (NOMINAL)
CORNER, END & PULL POSTS	2.375" O.D.
TUBULAR - ROUND	1.90" O.D.
TUBULAR - ROUND	1.66" O.D.
TUBULAR - ROUND	1.50" SQ.
H-SECTION	1.625" x 1.50"
C-SECTION (ROLL-FORMED)	1.625" x 1.25"



FASTENING DETAILS

1. 3 STRAND BARBED-WIRE APRON ON EXTENSION ARMS
2. TOP TENSION WIRE
3. BRACE RAIL
4. 9-GAGE STEEL TIE WIRES, 15" O.C. MAX & WITHIN 4" FROM TOP & BOTTOM OF FABRIC
5. TRUSS ROD (3/8" MIN. DIA.)
6. CORNER, END, OR PULL POST
7. LINE POST
8. 9-GAGE STEEL TIE WIRES (TYP.); (12" O.C. MAX.)
9. CHAIN-LINK FABRIC (9 GAGE, 2" MESH)
10. BOTTOM OF FABRIC
11. BOTTOM RAIL
12. CONCRETE BASE
13. GRADE LINE
14. TENSION BAND (15" O.C. MAX. & WITHIN 4" FROM TOP & BOTTOM OF FABRIC)
15. TENSION BAR TO ENGAGE EACH FABRIC LINK
16. 3/8" CARRIAGE BOLT W/PREENED THREADS
17. PULL POST
18. #8 AWG SOLID COPPER WIRE
19. MOLDED EXOTHERMIC WELD OR APPROVED CLAMP-TYPE FITTING OF COPPER
20. 3/4" DIA. COPPER-GLAD STEEL GROUND ROD
21. ENDS TWISTED AT LEAST THREE FULL TURNS
22. DOUBLE RAIL END
23. 3/8" PLAIN PIN RIVETED FLUSH (TYP.)
24. SECURE SIDE
25. LOCK PIN, TYP

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ANTIOCH ROAD COMPOSITE WATER TOWER
PUBLIC SERVICES
CITY OF CRESTVIEW
CRESTVIEW, FLORIDA

DR S. TATMAN
CHK S. TATMAN
APVD S. JERNIGAN

DSGN J. NESSL

JACOBS

GENERAL
ANTIOCH WATER TOWER
DETAILS

VERIFY SCALE
BAR IS ONE INCH ON
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FOOT
FABRIC DRAWING 1"

DATE MARCH 2021
PROJ D3282100
DWG G-07
SHEET 7 of 21

PLOT TIME: \$PLOTTIME

3231-410

CHAIN LINK FENCE
NTS

SYMBOL	DESCRIPTION
	ONE-LINE DIAGRAM DRAWOUT AIR CIRCUIT BREAKER, LOW VOLTAGE
	CIRCUIT BREAKER, THERMAL MAGNETIC TRIP SHOWN, 3 POLE, UNO
	CIRCUIT BREAKER, STATIC TRIP UNIT, SENSOR AMP TRIP AND FRAME RATINGS SHOWN, 3 POLE, UNO
	CIRCUIT BREAKER, MAGNETIC TRIP ONLY, TRIP RATING SHOWN, 3 POLE, UNO
	CIRCUIT BREAKER WITH CURRENT LIMITING FUSES, TRIP AND FUSE RATING INDICATED, 3 POLE, UNO
	FUSED SWITCH, SWITCH AND FUSE CURRENT RATING INDICATED, 3 POLE, UNO
	SWITCH, CURRENT RATING INDICATED, 3 POLE, UNO
	FUSE, CURRENT RATING AND QUANTITY INDICATED
	MAGNETIC STARTER WITH OVERLOAD, NEMA SIZE INDICATED, FVNR UNO
	ELECTRONIC STARTER/SPEED CONTROL RVSS = REDUCED VOLTAGE SOFT STARTER AFD = AC ADJUSTABLE FREQUENCY DRIVE DC = DC ADJUSTABLE SPEED DRIVE RVAT = REDUCED VOLTAGE AUTO TRANSFORMER TYPE RVRT = REDUCED VOLTAGE REACTOR TYPE
	CABLE OR BUS CONNECTION POINT
	KEY INTERLOCK
	SURGE ARRESTER (GAP TYPE)
	CAPACITOR - KVAR INDICATED, 3 PHASE
	AC MOTOR, SQUIRREL CAGE INDUCTION - HORSEPOWER INDICATED
	GENERATOR, KW/KVA RATING SHOWN
	ANALOG METER WITH SWITCH - SCALE RANGE SHOWN V = VOLTAGE A = AMPERAGE PF = POWER FACTOR KW = KILOWATTS KVAR = KILOWARS
	DIGITAL POWER METER (MULTIFUNCTION)
	UTILITY REVENUE METER
	GROUND
	TRANSFORMER, SIZE, VOLTAGE RATINGS, AND PHASE INDICATED
	SHIELDED ISOLATION TRANSFORMER
	POTENTIAL TRANSFORMER, VOLTAGE RATING AND QUANTITY INDICATED
	CURRENT TRANSFORMER, RATIO(100:5) AND QUANTITY INDICATED (3)
	CONNECTION POINT TO EQUIPMENT SPECIFIED IN OTHER DIVISIONS, RACEWAY, CONDUCTOR AND CONNECTION IN THIS DIVISION
	TRANSIENT VOLTAGE SURGE SUPPRESSOR

SYMBOL	DESCRIPTION
	ONE-LINE DIAGRAM DRAWOUT POWER CIRCUIT BREAKER, MEDIUM VOLTAGE
	NON DRAWOUT FUSED SWITCH, MEDIUM VOLTAGE
	DRAWOUT FUSED SWITCH AND CONTACTOR, MEDIUM VOLTAGE
	DRAWOUT VACUUM CONTACTOR, MEDIUM VOLTAGE
	MEDIUM VOLTAGE CABLE STRESS CONE TYPE TERMINATION, OPEN TERMINATOR OR ELBOW
	SWITCH - LOAD BREAK, GROUP OPERATED, MEDIUM VOLTAGE
	SWITCH WARCNG HORNS, MEDIUM VOLTAGE
	DISCONNECTING FUSE - SOLID MATERIAL, MEDIUM VOLTAGE
	SWITCH - HOOK STICK OPERATED, SINGLE POLE, MEDIUM VOLTAGE
	FUSE - EXPULSION, HOOK STICK OPERATED, SINGLE POLE, MEDIUM VOLTAGE
	GROUND SWITCH, GANG OPERATED
	TERMINAL BLOCK LUG
	DELTA CONNECTION
	WYE GROUNDED CONNECTION, SOLID GROUND
	WYE NEUTRAL GROUND RESISTOR OR IMPEDANCE CONNECTION
	RELAY OR DEVICE, FUNCTION NUMBER AS INDICATED
	CURRENT TRANSFORMER, ZERO SEQUENCE, RATIO AND QUANTITY INDICATED
	BUSHING CURRENT TRANSFORMER, MULTIRATIO AND QUANTITY INDICATED
	MOTOR OPERATOR, BREAKER OR SWITCH
	ENERGY MONITORING UNIT
	MOTOR PROTECTION RELAY

NOTES:
1. THESE ARE STANDARD LEGEND SHEETS. SOME SYMBOLS AND ABBREVIATIONS MAY APPEAR ON THE LEGEND AND NOT ON THE DRAWINGS.
2. FOR ADDITIONAL ABBREVIATIONS OF OTHER DIVISIONS (HVAC, MECHANICAL, AND STRUCTURAL/ARCHITECTURAL) SEE OTHER LEGENDS.

SYMBOL	DESCRIPTION
	POWER SYSTEM PLAN CONNECTION POINT TO EQUIPMENT SPECIFIED, RACEWAY, CONDUCTOR, TERMINATION AND CONNECTION IN THIS DIVISION.
	MAJOR ELECTRICAL COMPONENT OR DEVICE - NAME OR IDENTIFYING SYMBOL AS SHOWN.
	PANELBOARD - SURFACE MOUNTED
	PANELBOARD LETTER OR NUMBER FACILITY NUMBER LP - LOW VOLTAGE PANEL DP - DISTRIBUTION PANEL
	PANELBOARD - FLUSH MOUNTED
	TERMINAL JUNCTION BOX
	MOTOR, SQUIRREL CAGE INDUCTION
	GENERATOR, VOLTAGE AND SIZE AS INDICATED.
	HOME RUN - DESTINATION SHOWN
	EXPOSED CONDUIT AND CONDUCTORS*
	CONCEALED CONDUIT AND CONDUCTORS*
NOTE: ALL UNMARKED CONDUIT RUNS CONSIST OF TWO NO. 12, ONE NO. 12 GROUND CONDUCTORS IN 3/4" CONDUIT. RUNS MARKED WITH CROSSHATCHES INDICATE NUMBER OF NO. 12 CONDUCTORS. CROSSHATCH WITH SUBSCRIPT "G" INDICATES GREEN GROUND WIRE.	
	CONDUIT AND CONDUCTOR CALLOUT, SEE LEGEND.
	CONDUIT DOWN
	CONDUIT UP
	CONDUIT, STUBBED AND CAPPED
	CONDUIT TERMINATION AT CABLE TRAY
	EXISTING CONDUIT/ DUCT BANK
	BUS DUCT - SEE SPECIFICATIONS
	CONCRETE ENCASED CONDUIT
	DIRECT BURIED CONDUIT
	FIBER OPTIC CONDUIT
	CONCRETE ENCASED DUCT BANK WHERE XXXX IS THE DUCT BANK NAME. SEE CIRCUIT AND RACEWAY CODING DEFINITION
	CONCEALED CONDUIT ROUTING AREA
	CONDUIT ROUTING AREA
	CABLE TRAY
	TRANSFORMER
	GENERAL CONTROL OR WIRING DEVICE. LETTER SYMBOLS OR ABBREVIATIONS INDICATE TYPE OF DEVICE
	CONTROL STATION, SEE CONTROL DIAGRAMS FOR CONTROL DEVICE(S) REQUIRED.
	NONFUSED DISCONNECT SWITCH, CURRENT RATING INDICATED, 3 POLE
	FUSED DISCONNECT SWITCH, CURRENT RATING INDICATED (60/40, 60=SWITCH RATING / 40=FUSE RATING) 3 POLE
	COMBINATION CIRCUIT BREAKER AND MAGNETIC STARTER, NEMA SIZE INDICATED

SYMBOL	DESCRIPTION
	POWER SYSTEM PLAN BREAKER, SEPARATELY MOUNTED, CURRENT RATING INDICATED. (100/40, 100 = FRAME SIZE; 40 = TRIP RATING) 3 POLE
	CONTACTOR, MAGNETIC, NEMA SIZE INDICATED
	LIGHTING CONTACTOR, CURRENT RATING INDICATED
	STARTER, MAGNETIC NEMA SIZE INDICATED
	CONVENIENCE RECEPTACLE - DUPLEX UNLESS NOTED OTHERWISE WP- WEATHERPROOF TL- TWIST LOCK CRE- CORROSION RESISTANT GFCI- GROUND FAULT CIRCUIT INTERRUPTER SUBSCRIPT NUMBER AT RECEPTACLE INDICATES CIRCUIT
	240V RECEPTACLE
	CONVENIENCE RECEPTACLE - QUADRUPLEX
	MULTI OUTLET ASSEMBLY
	DUPLEX CONVENIENCE RECEPTACLE - FLUSH IN FLOOR
	CONVENIENCE RECEPTACLE, PEDESTAL, DUPLEX SINGLE FACE UNLESS INDICATED OTHERWISE
	RECEPTACLE, SPECIAL PURPOSE-NEMA CONFIGURATION AND AMPERAGE INDICATED
	THERMOSTAT
	UTILITY REVENUE METERING FACILITY
	ELECTRIC UNIT HEATER
	ELECTRIC AIR CONDITIONER (SELF CONTAINED UNIT)
	UTILITY POLE

GENERAL
ELECTRICAL
LEGEND SHEET 1

ANTIOCH ROAD COMPOSITE WATER TOWER
PUBLIC SERVICES
CITY OF CRESTVIEW
CRESTVIEW, FLORIDA

NO.	DATE	REVISION

DR K. HORTON
CHG G. MESSER
DSGN G. YARBERRY
APVD G. YARBERRY

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FILENAME: 01-G-08_D3282100.dgn PLOT DATE: 3/15/2021 PLOT TIME: 4:12:45 PM

LUMINAIRE SCHEDULE

LUMINAIRE SCHEDULE						
TYPE	SYMBOL	BASIS OF DESIGN	CATALOG #	# OF LAMPS	VOLTS	MOUNTING
B		AMERICAN ELECTRIC HOLOPHANE	LIGHT FIXTURE: ATB2-40BLEDE15-MVOLT-R3-BK POLE: RRATU-25-8E-BMA-US4-BK-AB	133W LED	MVOLT	POLE
A		HOLOPHANE	WG4LED-10C1000-40K-T3M-MVOLT-PE-ELSW-BKSDP	39W LED	MVOLT	WALL

GENERAL CIRCUIT CONDUCTOR AND CONDUIT IDENTIFICATION

POWER CIRCUIT CALLOUTS		CONTROL CIRCUIT CALLOUTS		MULTICONDUCTOR POWER CABLE CIRCUIT CALLOUTS	
[P1]	[1/2" FLEX, 2#12, #12G]	[P24]	[1" C, 3#8, 3#14, #10G]	[PC1]	[3/4" C, 1 (3C#12, #12G) TYPE 2]
[P2]	[3/4" C, 2#12, #12G]	[P25]	[1" C, 3#8, 4#14, #10G]	[PC2]	[3/4" C, 1 (3C#10, #10G) TYPE 2]
[P3]	[3/4" C, 3#12, #12G]	[P26]	[1" C, 3#8, 5#14, #10G]	[PC3]	[3/4" C, 1 (3C#8, #10G) TYPE 2]
[P4]	[3/4" C, 4#12, #12G]	[P27]	[1" C, 2#6, #10G]	[PC4]	[3/4" C, 2 (3C#12, #12G) TYPE 2]
[P5]	[3/4" C, 5#12, #12G]	[P28]	[1" C, 3#6, #10G]	[PC5]	[1" C, 2 (3C#10, #10G) TYPE 2]
[P6]	[3/4" C, 6#12, #12G]	[P29]	[1" C, 3#6, 2#14, #10G]	[PC1A]	[3/4" C, 1 (2C#12, #12G) TYPE 2]
[P7]	[3/4" C, 7#12, #12G]	[P30]	[1 1/4" C, 3#6, 3#14, #10G]	[PC2A]	[3/4" C, 1 (2C#10, #10G) TYPE 2]
[P8]	[3/4" C, 8#12, #12G]	[P31]	[1 1/4" C, 3#6, 4#14, #10G]		
[P9]	[3/4" C, 3#12, 2#14, #12G]	[P32]	[1 1/4" C, 3#6, 5#14, #10G]		
[P10]	[3/4" C, 3#12, 3#14, #12G]	[P33]	[1 1/4" C, 3#4, #10G]		
[P11]	[3/4" C, 3#12, 4#14, #12G]	[P34]	[1 1/4" C, 3#4, 3#14, #10G]		
[P12]	[3/4" C, 3#12, 5#14, #12G]	[P35]	[1 1/4" C, 3#4, 5#14, #10G]		
[P13]	[3/4" C, 3#12, 6#14, #12G]	[P36]	[1 1/4" C, 3#3, #10G]		
[P14]	[1" C, 3#12, 7#14, #12G]	[P37]	[1 1/4" C, 3#3, 3#14, #10G]		
[P15]	[3/4" C, 2#10, #10G]	[P38]	[1 1/4" C, 3#2, #10G]		
[P16]	[3/4" C, 3#10, #10G]	[P39]	[1 1/2" C, 3#1, #10G]		
[P17]	[3/4" C, 3#10, 2#14, #10G]	[P40]	[2" C, 3#1, 3#14, #10G]		
[P18]	[3/4" C, 3#10, 3#14, #10G]	[P41]	[2" C, 3#2/0, #10G]		
[P19]	[3/4" C, 3#10, 4#14, #10G]	[P42]	[2" C, 3#3/0, #10G]		
[P20]	[1" C, 3#10, 5#14, #10G]	[P43]	[2" C, 3#4/0, #10G]		
[P21]	[1" C, 2#8, #10G]	[P44]	[2" C, #4/2]		
[P22]	[1" C, 3#8, #10G]	[P45]	[2" C, ANTENNA CABLE]		
[P23]	[1" C, 3#8, 2#14, #10G]				
ANALOG CIRCUIT CALLOUTS		CONTROL CIRCUIT CALLOUTS		MULTICONDUCTOR CONTROL CABLE CIRCUIT CALLOUTS	
[A1]	[3/4" C, 1 TYPE 3]	[C1]	[3/4" C, MSC]	[CC3]	[3/4" C, 1-3C TYPE 1]
[A2]	[3/4" C, 2 TYPE 3]	[C2]	[3/4" C, 2#14, #14G]	[CC5]	[3/4" C, 1-5C TYPE 1]
[A3]	[1" C, 3 TYPE 3]	[C3]	[3/4" C, 3#14, #14G]	[CC7]	[3/4" C, 1-7C TYPE 1]
[A4]	[1 1/4" C, 4 TYPE 3]	[C4]	[3/4" C, 4#14, #14G]	[CC9]	[1" C, 1-9C TYPE 1]
[A5]	[1 1/4" C, 5 TYPE 3]	[C5]	[3/4" C, 5#14, #14G]	[CC12]	[1" C, 1-12C TYPE 1]
[A6]	[1 1/4" C, 6 TYPE 3]	[C6]	[3/4" C, 6#14, #14G]	[CC19]	[1 1/2" C, 1-19C TYPE 1]
[A7]	[1 1/2" C, 7 TYPE 3]	[C7]	[3/4" C, 7#14, #14G]	[CC25]	[1 1/2" C, 1-25C TYPE 1]
[A8]	[1 1/2" C, 8 TYPE 3]	[C8]	[3/4" C, 8#14, #14G]	[CC37]	[2" C, 1-37C TYPE 1]
[A9]	[1 1/2" C, 9 TYPE 3]	[C9]	[3/4" C, 9#14, #14G]	[CCC1]	[1-7C #12 TYPE 1]
[A10]	[2" C, 10 TYPE 3]	[C10]	[3/4" C, 10#14, #14G]		
[A11]	[2" C, 11 TYPE 3]	[C11]	[3/4" C, 11#14, #14G]		
[A12]	[2" C, 12 TYPE 3]	[C12]	[3/4" C, 12#14, #14G]		
[A13]	[2" C, 13 TYPE 3]	[C13]	[3/4" C, 13#14, #14G]		
[A14]	[2" C, 14 TYPE 3]	[C14]	[1" C, 14#14, #14G]		
[A15]	[3/4" C, 1 TYPE 4]	[C15]	[1" C, 15#14, #14G]		
[A16]	[3/4" C, 2 TYPE 4]	[C16]	[1" C, 16#14, #14G]		
[A17]	[1" C, 3 TYPE 4]	[C17]	[1" C, 17#14, #14G]		
[A18]	[1 1/4" C, 4 TYPE 4]	[C18]	[1" C, 18#14, #14G]		
[A19]	[1 1/4" C, 5 TYPE 4]	[C19]	[1" C, 19#14, #14G]		
[A20]	[1 1/4" C, 6 TYPE 4]	[C20]	[1" C, 20#14, #14G]		
[A21]	[1 1/2" C, 7 TYPE 4]	[C21]	[1" C, 21#14, #14G]		
[A22]	[1 1/2" C, 8 TYPE 4]	[C22]	[1" C, 22#14, #14G]		
[A23]	[2" C, 9 TYPE 4]	[C23]	[1" C, 23#14, #14G]		
[A24]	[3/4" C, 1-4 pr. TYPE 5]	[C24]	[1 1/4" C, 24#14, #14G]		
[A25]	[1" C, 2-4 pr. TYPE 5]	[C25]	[1 1/4" C, 25#14, #14G]		

- NOTES:
- FOR CABLE TYPES, SEE SPECIFICATIONS.
 - POWER CIRCUIT CALLOUTS ARE BASED ON THE AREA OF THW CONDUCTORS. CONTROL CIRCUIT CALLOUTS ARE BASED ON THE AREAS OF SCHEDULE 40 PVC CONDUIT AND TYPES XHHW & XHHW-2 INSULATION.
 - SIZING OF CONDUCTORS #14WG AND SMALLER BASED ON AMPACITIES AT 60 DEGREES C. SIZING OF CONDUCTORS #10AWG AND LARGER BASED ON AMPACITIES AT 75 DEGREES C.
 - WHERE CIRCUITS ARE UNDERGROUND, DIRECT BURIED OR CONCRETE ENCASED, MINIMUM CONDUIT SIZE SHALL BE 1".
 - FOR METRIC CONDUIT SIZES USE THE FOLLOWING CONVERSION:
 1/2" = 16 mm
 3/4" = 21 mm
 1" = 27 mm
 1/4" = 35 mm
 1 1/2" = 41 mm
 2" = 53 mm

JACOBS

GENERAL
ELECTRICAL
LEGEND SHEET 2

ANTIOCH ROAD COMPOSITE WATER TOWER
PUBLIC SERVICES
CITY OF CRESTVIEW
CRESTVIEW, FLORIDA

DR G. MESSER
CHK K. HORTON
APVD G. YARBERRY

NO.	DATE	REVISION

JACOBS

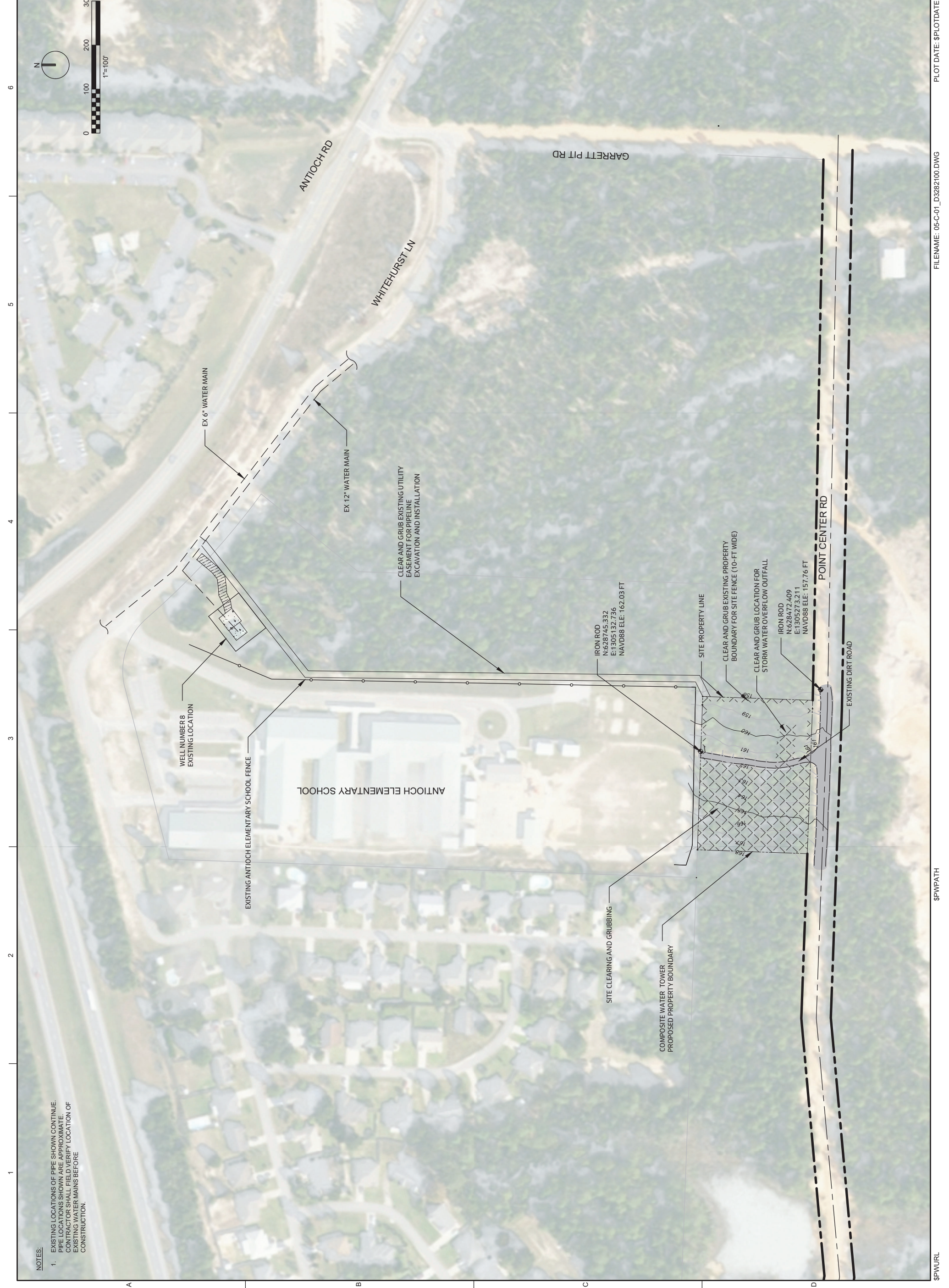
GENERAL
ELECTRICAL
LEGEND SHEET 2

ANTIOCH ROAD COMPOSITE WATER TOWER
PUBLIC SERVICES
CITY OF CRESTVIEW
CRESTVIEW, FLORIDA

DR G. MESSER
CHK K. HORTON
APVD G. YARBERRY

NO.	DATE	REVISION

NOTES:
 1. EXISTING LOCATIONS OF PIPE SHOWN CONTINUE.
 PIPE LOCATIONS SHOWN ARE APPROXIMATE.
 CONTRACTOR SHALL FIELD VERIFY LOCATION OF
 EXISTING WATER MAINS BEFORE
 CONSTRUCTION.



NO.	DATE	REVISION	BY	APVD

DSGN	S. TATMAN
DR	S. TATMAN
CHK	J. NESSL
APVD	S. JERNIGAN

ANTIOCH ROAD COMPOSITE WATER TOWER
 PUBLIC SERVICES
 CITY OF CRESTVIEW
 CRESTVIEW, FLORIDA

JACOBS
 CIVIL
 ANTIOCH WATER TOWER
 EXISTING CONDITIONS

VERIFY SCALE	BAR IS ONE INCH ON ORIGINAL DRAWING 1"
DATE	MARCH 2021
PROJ	D3282100
DWG	C-01
SHEET	10 of 21
PLOT TIME:	\$PLOTTIME

NOTES:

1. PROPOSED EROSION CONTROL IS THE MINIMUM REQUIRED. CONTRACTOR SHALL BE RESPONSIBLE FOR ANY ADDITIONAL EROSION CONTROL NEEDED TO ASSURE COMPLIANCE WITH REGULATIONS.
2. FOR CONCRETE TRUCK AND CHEMICAL WASH OUT AREAS AND VEHICLE AND TEMPORARY FUELING, COORDINATE WITH CONSTRUCTOR AND ENVIRONMENTAL INSPECTOR TO DETERMINE THE LOCATION OF THESE FACILITIES.
3. IMPLEMENT THE FOLLOWING BEST MANAGEMENT PRACTICES TO PREVENT POLLUTION ASSOCIATED WITH SOLID, LIQUID, AND HAZARDOUS CONSTRUCTION RELATED MATERIALS AND WASTES INCLUDING THESE GOOD HOUSE KEEPING PRACTICES:
 - PROVIDE FOR WASTE MANAGEMENT AND SITE LOGISTICS
 - ESTABLISH PROPER BUILDING MATERIALS STAGING AREA
 - DEVELOP A SPILL PREVENTION AND RESPONSE PLAN

COMPOSITE WATER TOWER
SITE PROPERTY LINE

ANTIOCH ELEMENTARY
SCHOOL

COMPOSITE WATER TOWER
PROPOSED LOCATION

MAINTAIN VEGETATIVE BUFFER
BETWEEN SCHOOL FENCING
AND PROJECT LIMITS

NEW PERIMETER FENCING,
DETAIL 3231-410

ALL DISTURBED AREA TO BE
SODDED AT COMPLETION
OF CONSTRUCTION

CONTRACTOR STAGING
AREA, SEE GENERAL SITE
NOTE 3 ON DRAWING G-02

GENERAL SITE FLOW

SEDIMENTATION FENCE (TYP)
LOCATED ALONG GRADING LIMITS,
DETAIL 3125-165

SITE STORMWATER POND

CONTINUE SILT FENCE ALONG
THE PIPELINE ROUTE, SEE
DRAWING C-03 FOR LIMITS

SEDIMENTATION FENCE ALONG
DOWNHILL PORTION OF
EXCAVATION ROUTE OF PIPELINE

15-FOOT WIDE
UTILITY EASEMENT

NEW PERIMETER FENCING,
DETAIL 3231-410

EXISTING TREE LINE, SEE
CLEARING AND GRUBBING
LIMITS ON C-01

MAINTAIN EXISTING ACCESS
ROAD DURING CONSTRUCTION

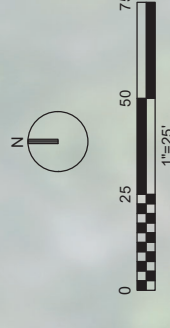
SITE GRADING TO MATCH EXISTING
ELEVATION OF DIRT ROAD

CONSTRUCTION ENTRANCE/EXIT
DETAIL 3125-130

PROJECT BENCHMARKS
SEE C-01, TYP

Point Center Rd

SILT FENCE OPENING AT SITE
DRIVE, 15-FOOT WIDE



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CIVIL
ANTIOCH WATER TOWER
EROSION CONTROL PLAN

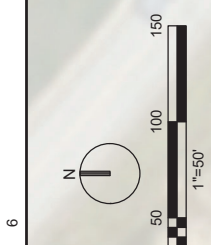
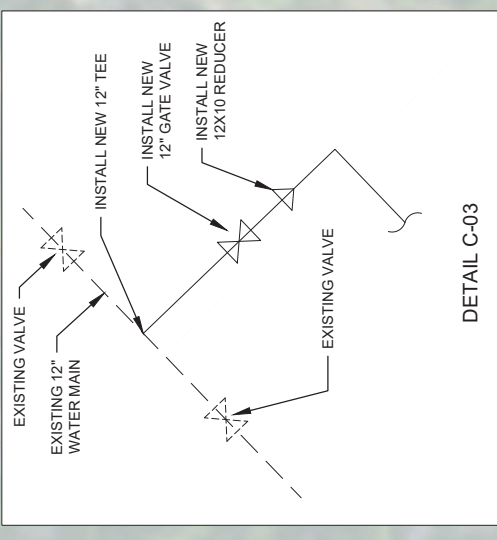
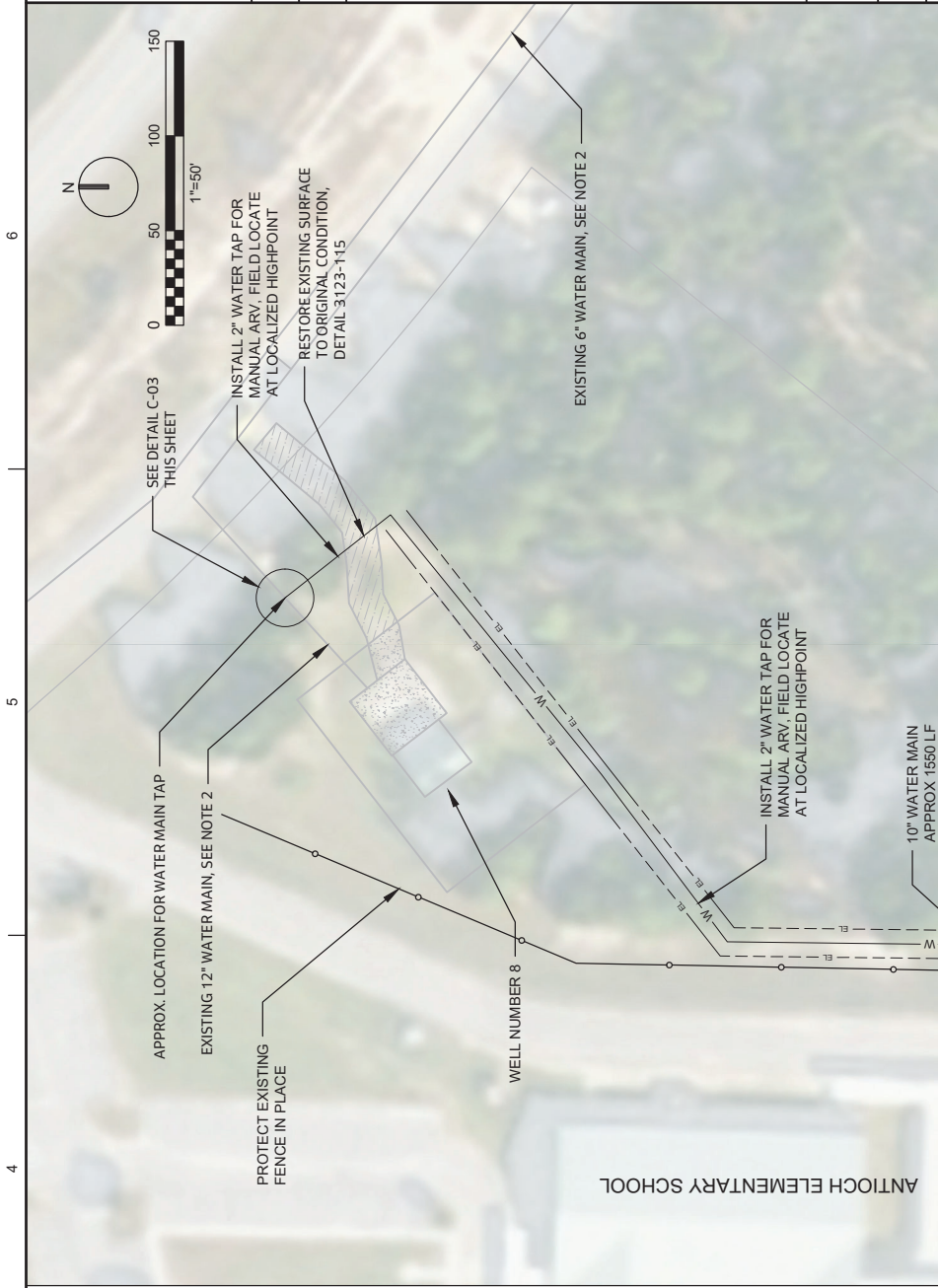
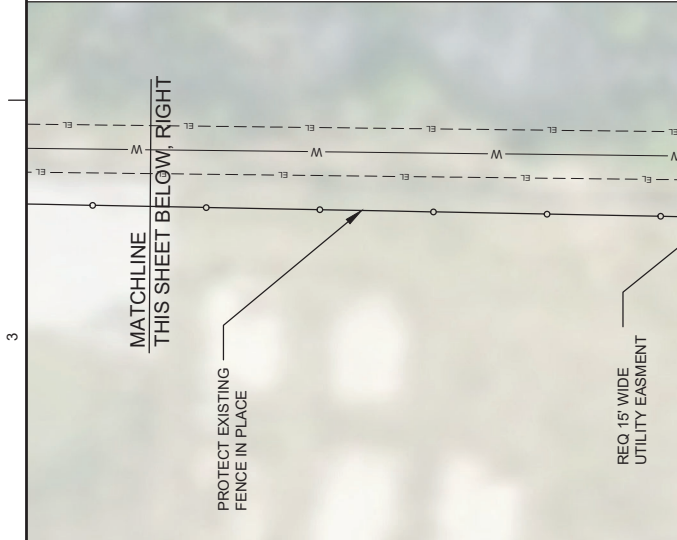
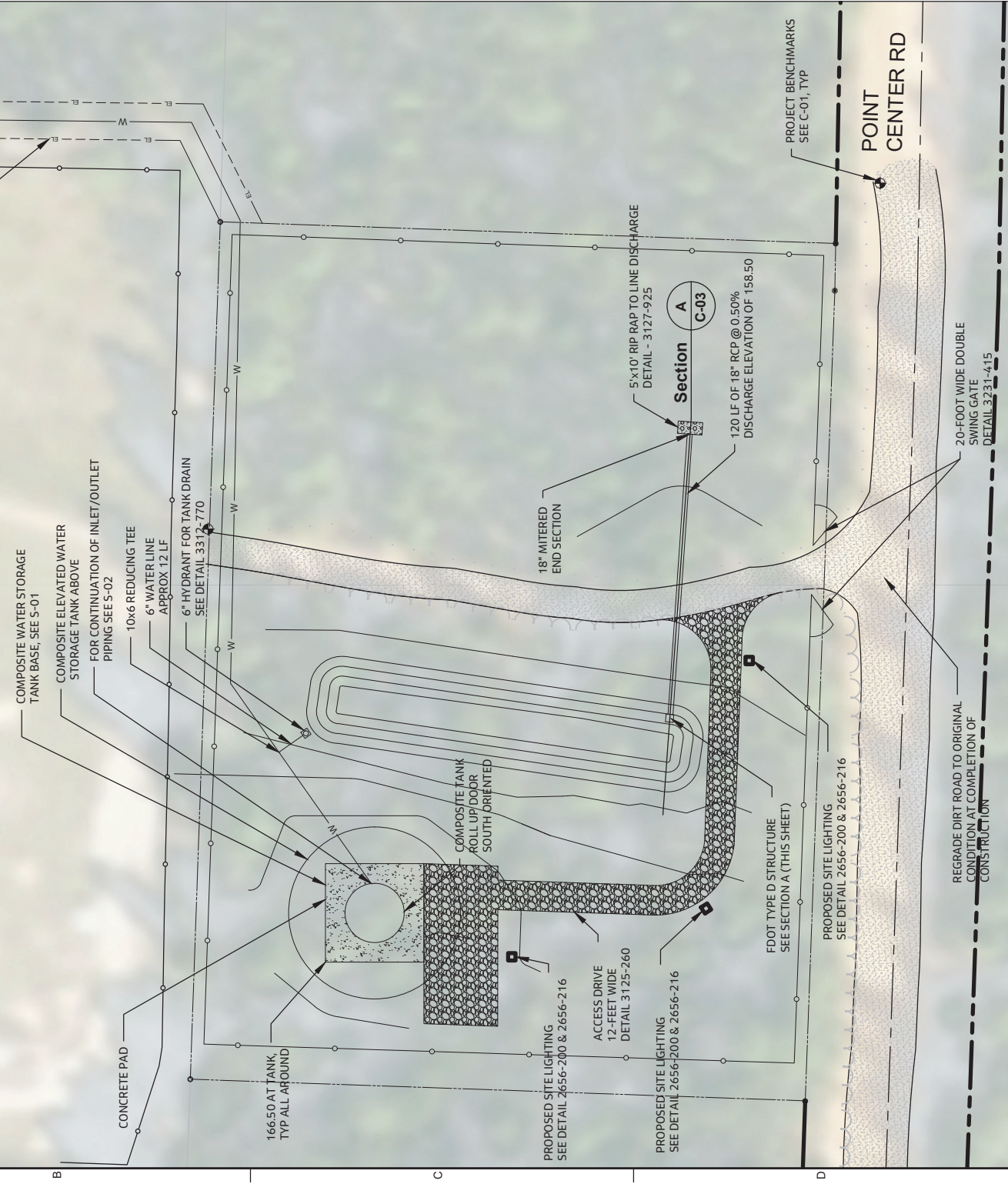
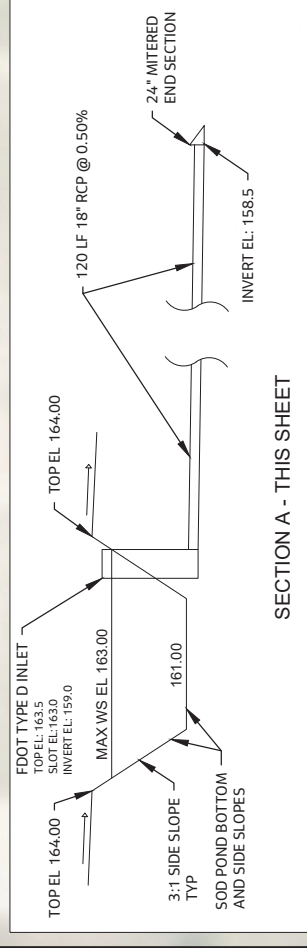
PUBLIC SERVICES
CITY OF CRESTVIEW
CRESTVIEW, FLORIDA

NO.	DATE	REVISION	CHK	DR	DSGN

VERIFY SCALE	
BAR IS ONE INCH ON ORIGINAL DRAWING 1"	
DATE	MARCH 2021
PROJ	D3282100
DWG	C-02
SHEET	11 of 21

- NOTES:**
- CONTRACTOR SHALL LIMIT ALL INTERRUPTION TO EXISTING DISTRIBUTION. CONTRACTOR SHALL NOTIFY PUBLIC SERVICES ONE WEEK BEFORE DISTURBING EXISTING WATER DISTRIBUTION. EXISTING LOCATIONS OF PIPE SHOWN CONTINUE. PIPE LOCATIONS SHOWN ARE APPROXIMATE. CONTRACTOR SHALL FIELD VERIFY LOCATION OF EXISTING WATER MAINS BEFORE CONSTRUCTION.
 - FOR SITE GRADING, REFER TO SHEET C-02.
 - INSTALL MANUAL ARV AT ANY LOCALIZED HIGH POINTS.

ANTIOCH ELEMENTARY SCHOOL



NO.	DATE	REVISION	CHK	APVD

JACOBS

ANTIOCH ROAD COMPOSITE WATER TOWER
PUBLIC SERVICES
CITY OF CRESTVIEW
CRESTVIEW, FLORIDA

ANTIOCH WATER TOWER
PROPOSED SITE IMPROVEMENTS

CIVIL

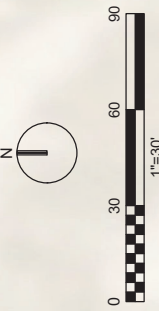
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING @ 1"

DATE: MARCH 2021
PROJ: D3282100
DWG: C-03
SHEET: 12 of 21

PLOT TIME: \$PLOTTIME

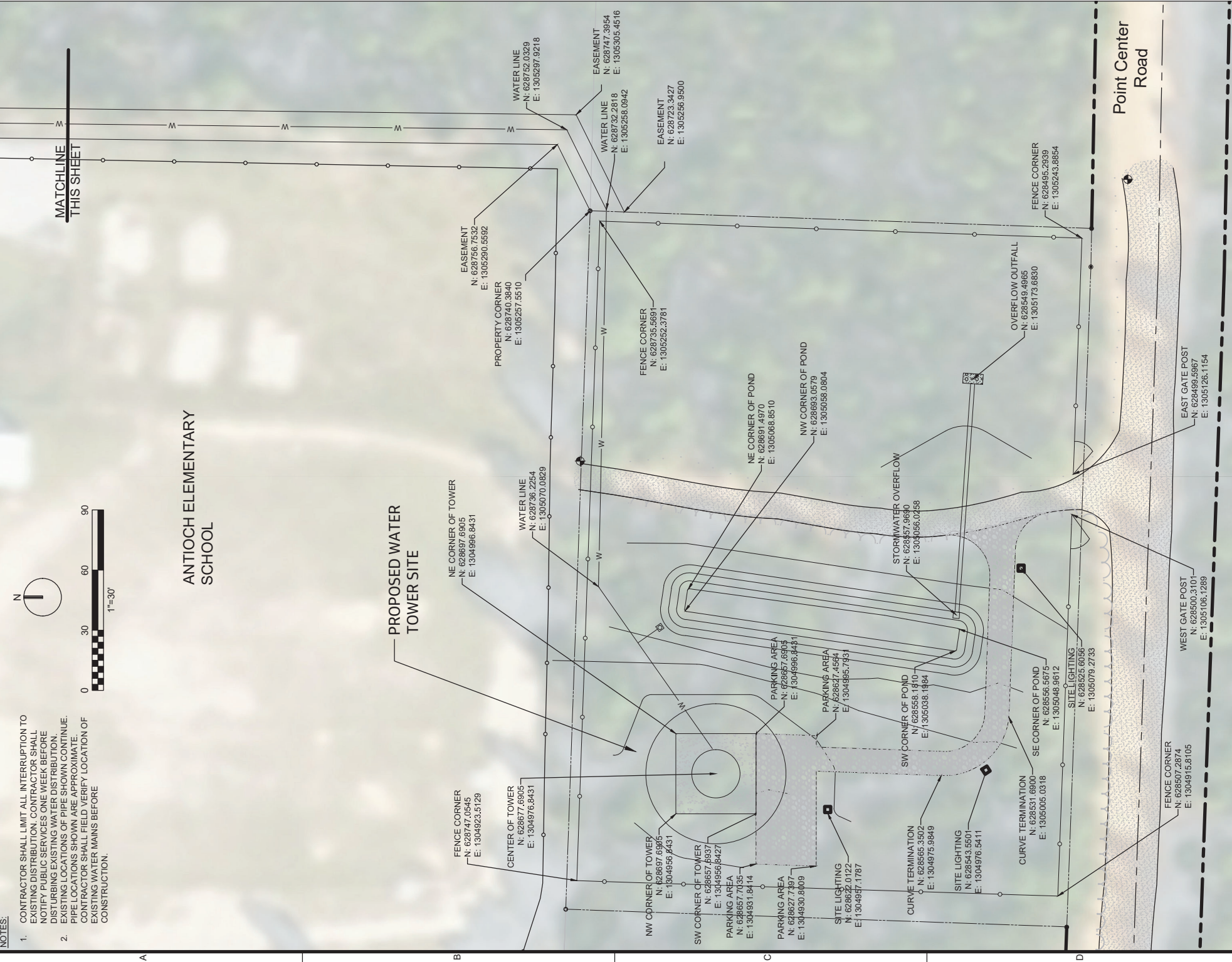
NOTES:

1. CONTRACTOR SHALL LIMIT ALL INTERRUPTION TO EXISTING DISTRIBUTION. CONTRACTOR SHALL NOTIFY PUBLIC SERVICES ONE WEEK BEFORE DISTURBING EXISTING WATER DISTRIBUTION. EXISTING LOCATIONS OF PIPE SHOWN CONTINUE. PIPE LOCATIONS SHOWN ARE APPROXIMATE. CONTRACTOR SHALL FIELD VERIFY LOCATION OF EXISTING WATER MAINS BEFORE CONSTRUCTION.



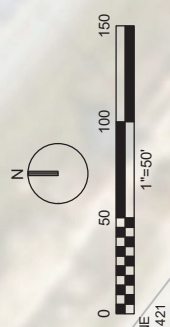
ANTIOCH ELEMENTARY SCHOOL

PROPOSED WATER TOWER SITE



MATCHLINE THIS SHEET

SCHOOL
ANTIOCH ELEMENTARY



WELL NUMBER 8

MATCHLINE THIS SHEET

NO.	DATE	REVISION	BY	APVD

ANTIOCH ROAD COMPOSITE WATER TOWER
PUBLIC SERVICES
CITY OF CRESTVIEW
CRESTVIEW, FLORIDA

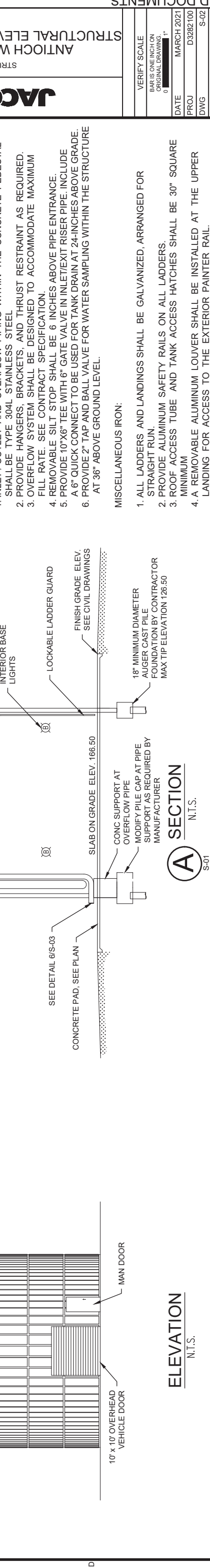
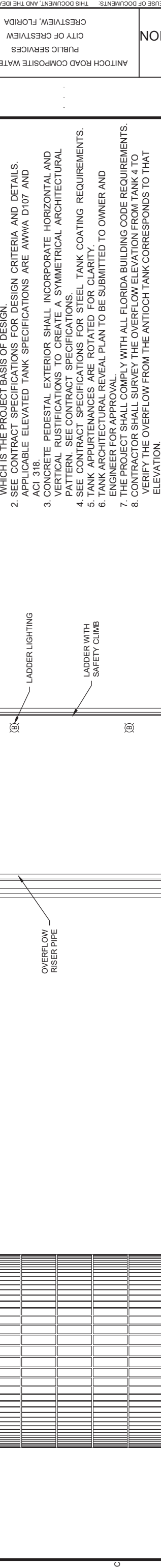
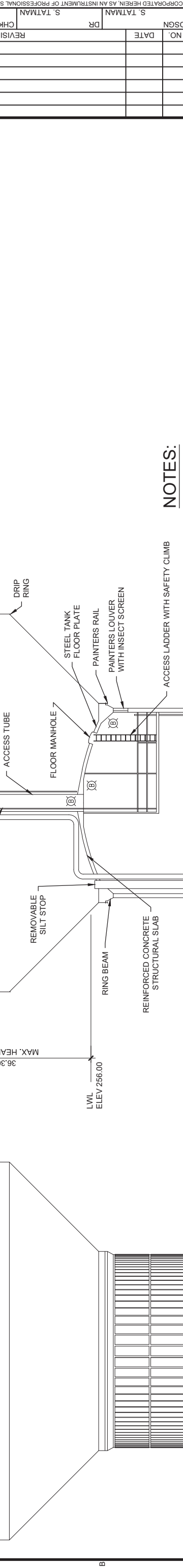
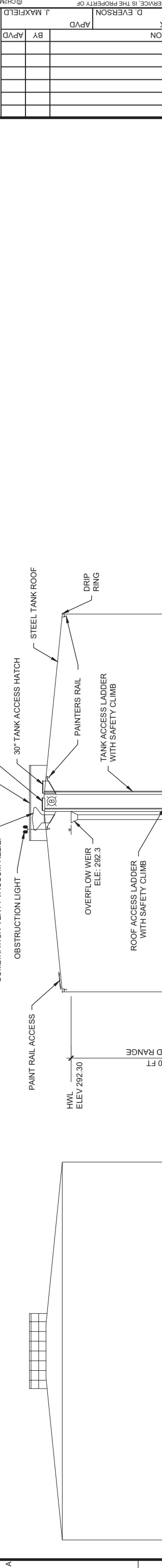
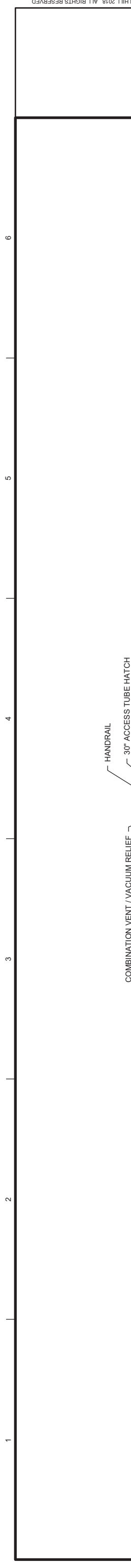
JACOBS

CIVIL
ANTIOCH WATER TOWER CONTROL PLAN

VERIFY SCALE: BAR IS ONE INCH ON ORIGINAL DRAWING 1"

DATE	MARCH 2021
PROJ	D3291200
DWG	C-04
SHEET	13 of 21

PLOT TIME: \$PLOTTIME



ELEVATION
N.T.S.

A SECTION
N.T.S.

NOTES:

GENERAL:

1. ELEVATION, SECTION, AND NOTES SHOWN ARE BASED ON LANDMARK TANKS WHICH IS THE PROJECT BASIS OF DESIGN.
2. SEE CONTRACT SPECIFICATIONS FOR DESIGN CRITERIA AND DETAILS. APPLICABLE ELEVATED TANK SPECIFICATIONS ARE AWWA D107 AND ACI 318.
3. CONCRETE PEDESTAL EXTERIOR SHALL INCORPORATE HORIZONTAL AND VERTICAL RUSTIFICATIONS TO CREATE A SYMMETRICAL ARCHITECTURAL PATTERN. SEE CONTRACT SPECIFICATIONS.
4. SEE CONTRACT SPECIFICATIONS FOR STEEL TANK COATING REQUIREMENTS.
5. TANK APPURTENANCES ARE ROTATED FOR CLARITY.
6. TANK ARCHITECTURAL REVEAL PLAN TO BE SUBMITTED TO OWNER AND ENGINEER FOR APPROVAL.
7. THE PROJECT SHALL COMPLY WITH ALL FLORIDA BUILDING CODE REQUIREMENTS.
8. CONTRACTOR SHALL SURVEY THE OVERFLOW ELEVATION FROM TANK 4 TO VERIFY THE OVERFLOW FROM THE ANTIOCH TANK CORRESPONDS TO THAT ELEVATION.

FOUNDATION:

1. REFER TO THE GEOTECHNICAL REPORT FOR RECOMMENDATIONS REGARDING DEEP FOUNDATION REQUIREMENTS.
2. DESIGN LOADS IN ACCORDANCE WITH AWWA D107.
3. DESIGN CONCRETE FOUNDATION IN ACCORDANCE WITH ACI 318.

MECHANICAL:

1. INLET / OUTLET AND OVERFLOW PIPING WITHIN THE CONCRETE PEDESTAL SHALL BE TYPE 304L STAINLESS STEEL
2. PROVIDE HANGERS, BRACKETS, AND THRUST RESTRAINT AS REQUIRED.
3. OVERFLOW SYSTEM SHALL BE DESIGNED TO ACCOMMODATE MAXIMUM FILL RATE. SEE CONTRACT SPECIFICATION.
4. REMOVABLE SILT STOP SHALL BE 6 INCHES ABOVE PIPE ENTRANCE.
5. PROVIDE 10"x6" TEE WITH 6" GATE VALVE IN INLET/EXIT RISER PIPE. INCLUDE A 6" QUICK CONNECT TO BE USED FOR TANK DRAIN AT 24-INCHES ABOVE GRADE.
6. PROVIDE 2" TAP AND BALL VALVE FOR WATER SAMPLING WITHIN THE STRUCTURE AT 36" ABOVE GROUND LEVEL.

MISCELLANEOUS IRON:

1. ALL LADDERS AND LANDINGS SHALL BE GALVANIZED, ARRANGED FOR STRAIGHT RUN.
2. PROVIDE ALUMINUM SAFETY RAILS ON ALL LADDERS.
3. ROOF ACCESS TUBE AND TANK ACCESS HATCHES SHALL BE 30" SQUARE MINIMUM
4. A REMOVABLE ALUMINUM LOUVER SHALL BE INSTALLED AT THE UPPER LANDING FOR ACCESS TO THE EXTERIOR PAINTER RAIL.

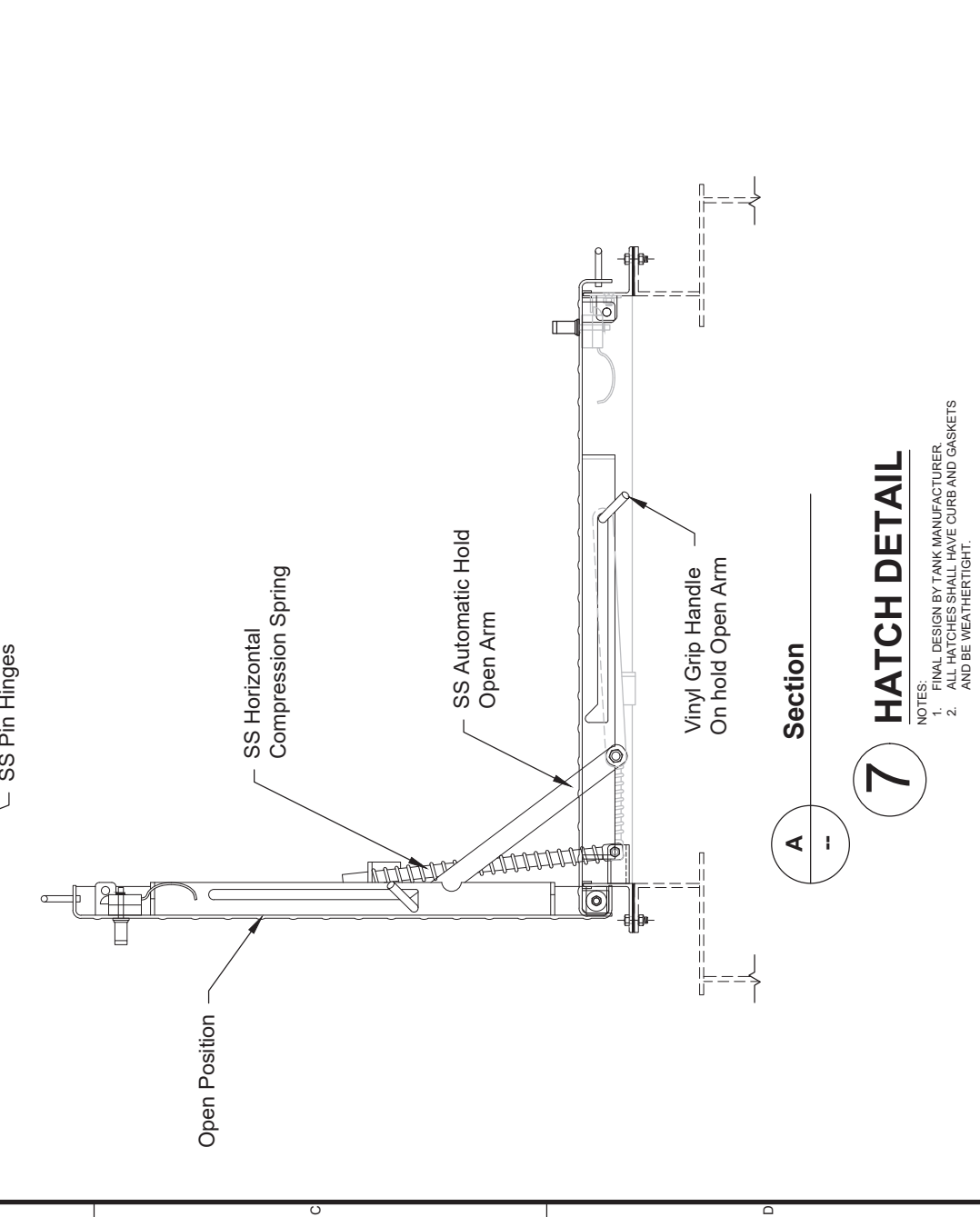
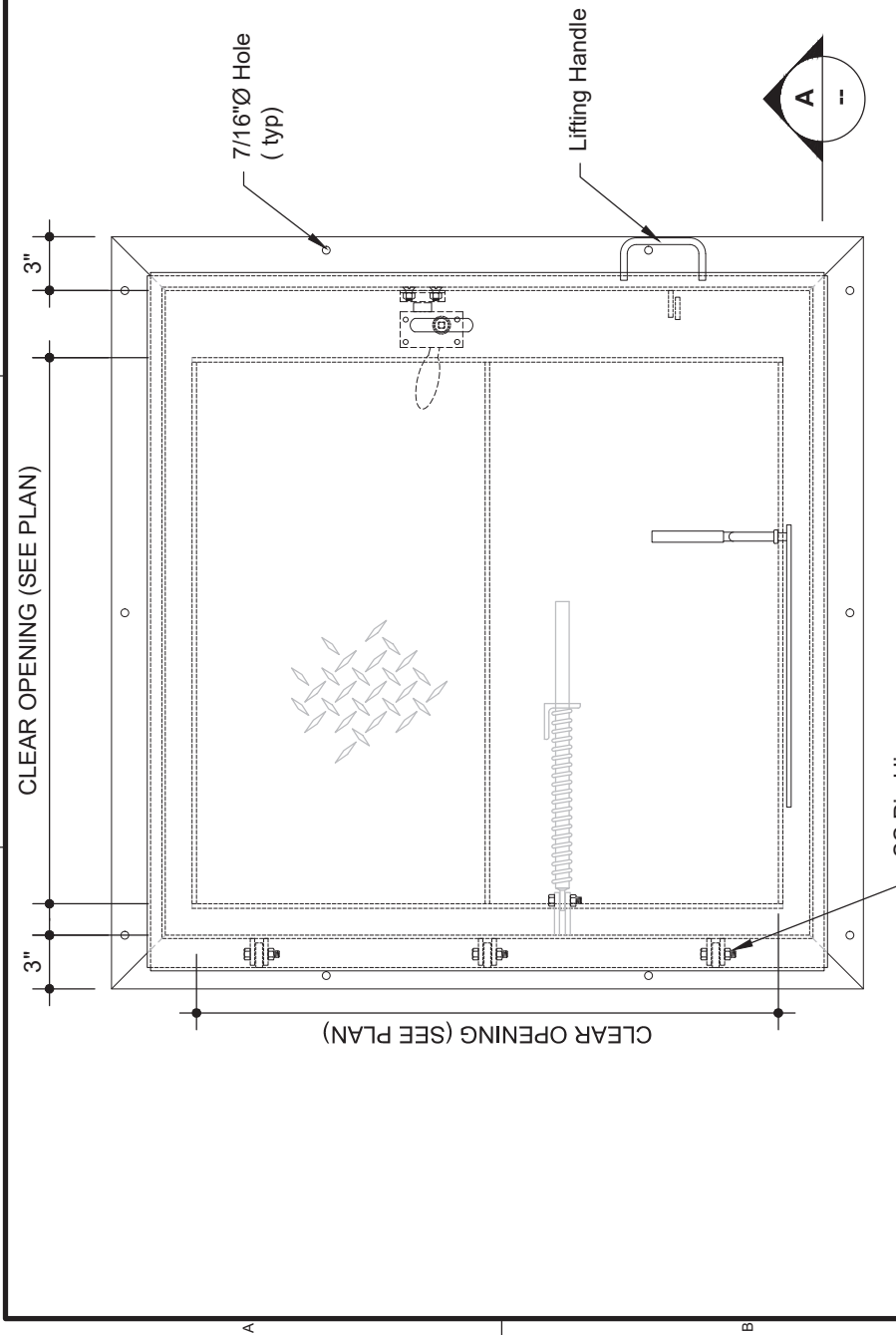
NO.	DATE	REVISION	BY	APVD

ANTIOCH ROAD COMPOSITE WATER TOWER
PUBLIC SERVICES
CITY OF CRESTVIEW
CRESTVIEW, FLORIDA

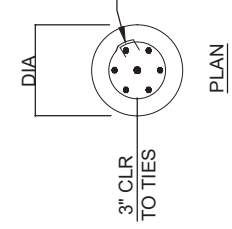
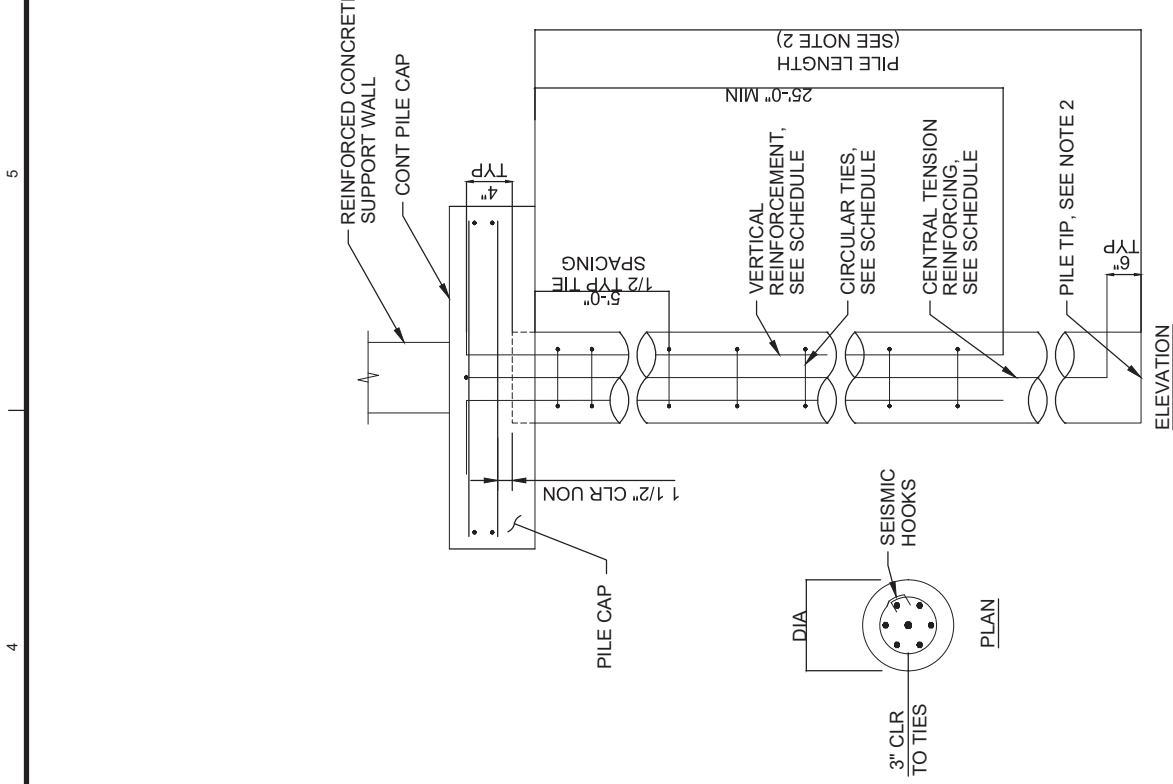
STRUCTURAL
ANTIOCH WATER TOWER AND SECTION



VERIFY SCALE
BAR IS ONE INCH ON
ORIGINAL DRAWING
DATE: MARCH 2021
PROJ: D3282100
DWG: S-02
SHEET: 15 of 21
PLOT TIME: \$PLOTTIME



7 HATCH DETAIL



AUGER CAST GROUT PILE SCHEDULE					
PILE DIA	MAX PILE LENGTH	VERT REINF	CIRCULAR TIES	TENSION REINF	
NOTE 1	NOTE 2	NOTE 3	NOTE 3	NOTE 3	NOTE 3
14"/16"/18"	40'-0"	(6) #7	#4@12"	#4@12"	#11

- NOTE:**
- TANK MANUFACTURER SHALL SELECT FINAL DIAMETER, COORDINATE WITH GEOTECHNICAL REPORT WHICH PROVIDES CAPACITIES FOR 14", 16" AND 18" DIA AUGER CAST PILES.
 - GEOTECHNICAL REPORT NOTES A MINIMUM PILE DEPTH OF 40'-0". FINAL DEPTH TO BE DETERMINED BY TANK MANUFACTURER.
 - REINFORCEMENT SHOWN IS MINIMUM, FINAL PILE DESIGN BY TANK MANUFACTURER.
 - SEE DRAWINGS AND SPECIFICATION FOR ADDITIONAL REQUIREMENTS

8 AUGER CAST GROUT PILE DETAIL AND SCHEDULE

- NOTES:**
- FINAL DESIGN BY TANK MANUFACTURER.

JACOBS

STRUCTURAL
ANTIOCH WATER TOWER

ANTIOCH ROAD COMPOSITE WATER TOWER

PUBLIC SERVICES
CITY OF CRESTVIEW
CRESTVIEW, FLORIDA

NO.	DATE	REVISION	BY	APVD

DSGN S. TATMAN
 DR S. TATMAN
 CHK D. EVERSON
 APVD J. MAXFIELD

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING

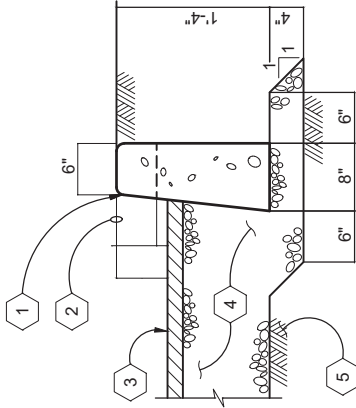
DATE MARCH 2021

PROJ D3282100

DWG S-04

SHEET 17 of 21

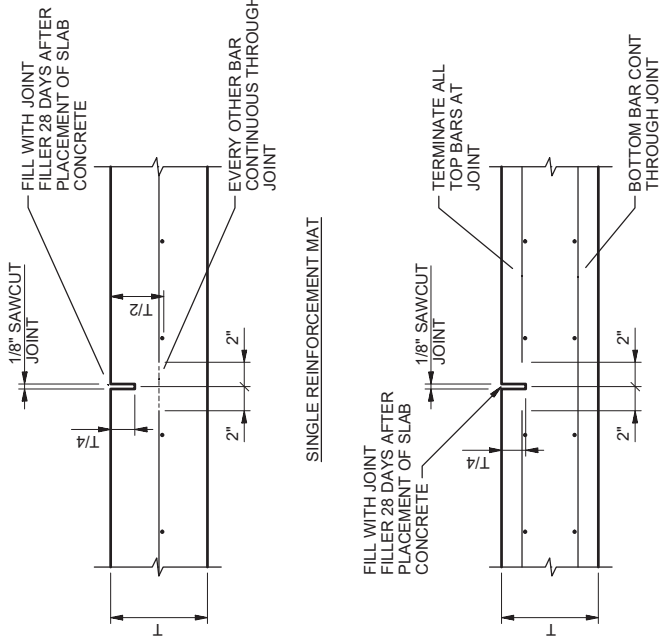
PLOT TIME: \$PLOTTIME



1. 3/4" RADIUS, TYP
2. TOP OF CURB AT APPROACH
3. PAVEMENT SURFACE
4. BASE COURSE
5. PREPARED SUBGRADE

9 CONCRETE CURB

NOTES:
1. FINAL DESIGN BY TANK MANUFACTURER.

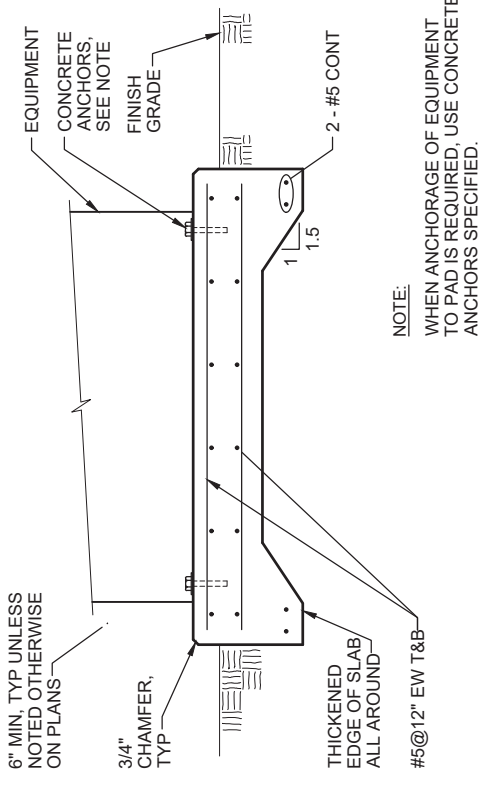


NOTES:

1. CONTRACTOR SHALL USE STRING LINE OR OTHER POSITIVE MEANS TO PLACE REINFORCEMENT AND LOCATE SAWCUT.

10 BUILDING SLAB ON GRADE SAWN CONTROL JOINT

NOTES:
1. FINAL DESIGN BY TANK MANUFACTURER.



TYPE 'H'

11 CONCRETE EQUIPMENT PAD TYPE 'H'

NOTES:
1. FINAL DESIGN BY TANK MANUFACTURER.

STRUCTURAL
ANTIOCH WATER TOWER

JACOBS

ANTIOCH ROAD COMPOSITE WATER TOWER
PUBLIC SERVICES
CITY OF CRESTVIEW
CRESTVIEW, FLORIDA

NO.	DATE	REVISION	BY	APVD

VERIFY SCALE	
BAR IS ONE INCH ON ORIGINAL DRAWING	1"
DATE	MARCH 2021
PROJ	D3282100
DWG	S-05
SHEET	18 of 21
PLOT TIME:	\$PLOTTIME

1 2 3 4 5 6

A

B

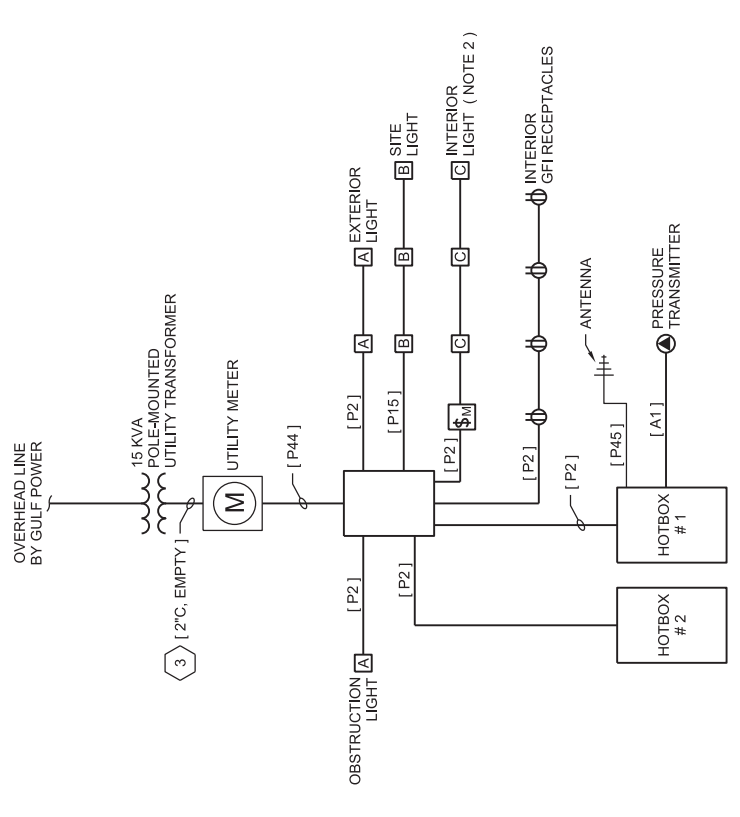
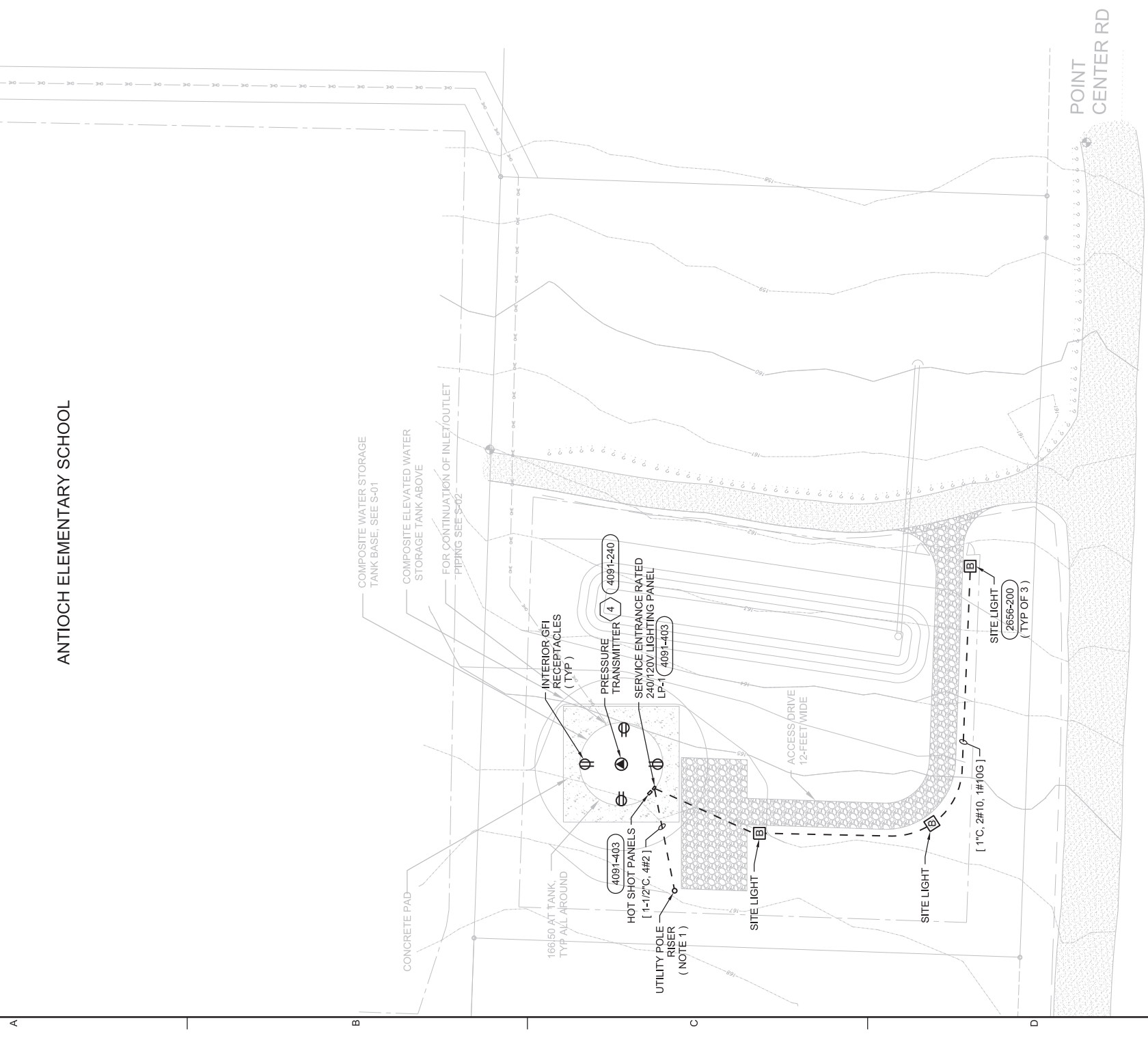
C

D

1 2 3 4 5 6



ANTIOCH ELEMENTARY SCHOOL



ONE LINE DIAGRAM

GENERAL NOTES

1. GULF POWER SHALL PROVIDE AND INSTALL A NEW OVERHEAD POWER LINE TO POWER THE PANELBOARD LP-1. ALL POLES SHALL BE INCLUDED IN THEIR SCOPE. CONTRACTOR SHALL PROVIDE AND INSTALL [2\"/>

ELECTRICAL
ANTIOCH WATER TOWER
PARTIAL ELECTRICAL SITE PLAN
 AND ONE LINE DIAGRAM

ANTIOCH ROAD COMPOSITE WATER TOWER
 PUBLIC SERVICES
 CITY OF CRESTVIEW
 CRESTVIEW, FLORIDA

NO.	DATE	REVISION	BY	APVD

DATE	NOVEMBER 2020
PROJ	D3282100
DWG	E-01
SHEET	19 of 21

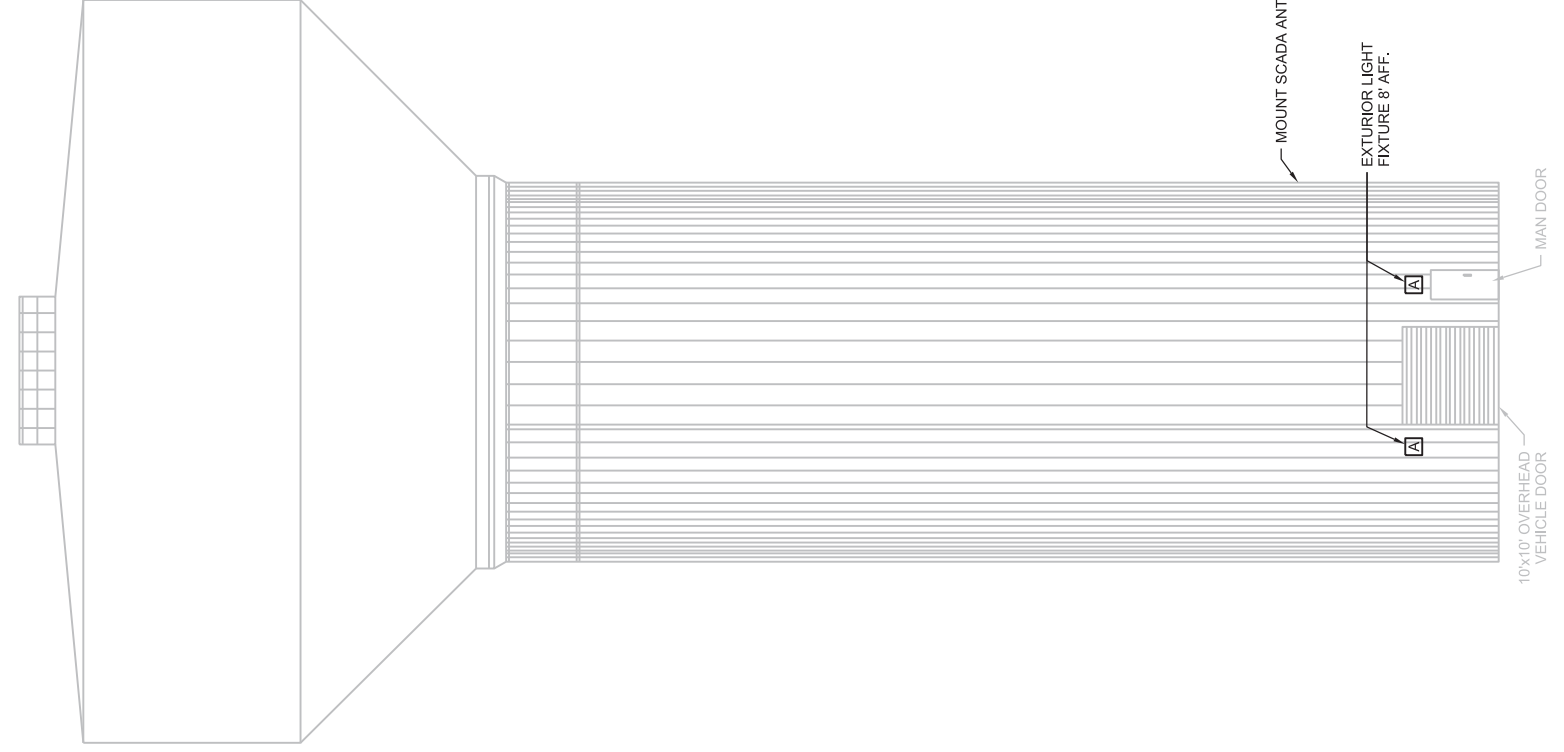
1 2 3 4 5 6

A

B

C

D



ELEVATION
NTS

LOAD IN KVA		CIRCUIT DESCRIPTION	BKR A/P	CKT NO.	CKT BKR	CIRCUIT DESCRIPTION	LOAD IN KVA	
A	B						A	B
0.3		Site Lights	20/1	1	2 20/1	Interior Storage Tank Lights		1.0
	0.6	0.6 Exterior Lights	20/1	3	4 20/1	HOT SHOT # 1		0.5
0.8		Interior GFI Receptacles	20/1 *	5	6 20/1	Obstruction Light		0.2
	0.5	HOT SHOT # 2	20/1	7	8 20/1	SPARE		
		SPARE	20/1	9	10 20/1	SPARE		
		SPARE	20/1	11	12 20/1	SPARE		
		SPARE	20/1 *	13	14 20/1 *	SPARE		
		SPARE	20/1 *	15	16 20/1 *	SPARE		
		BLANK		17	18	BLANK		
		BLANK		19	20	BLANK		
		BLANK		21	22	BLANK		
		BLANK		23	24	BLANK		
		BLANK		25	26	BLANK		
		BLANK		27	28	BLANK		
		BLANK		29	30	BLANK		
1.1	1.1	TOTAL					1.2	0.5

* = ALL BREAKERS WITH A * * * SHALL BE EGFI RATED.

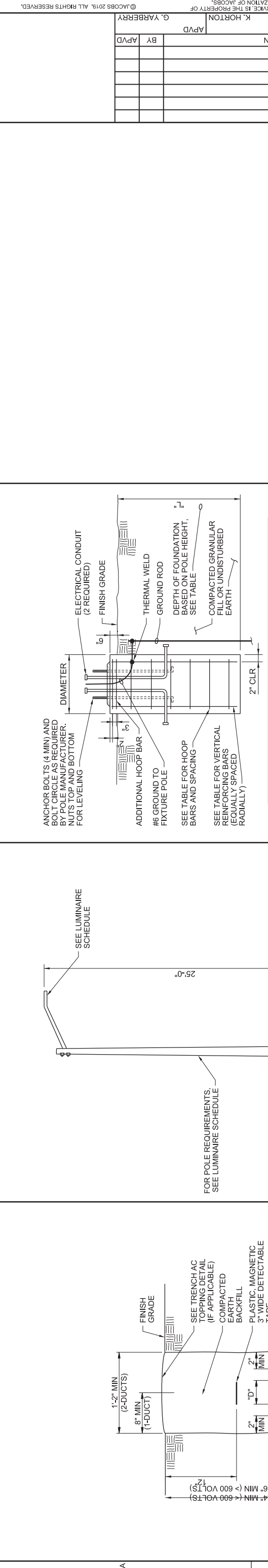


ANTIOCH ROAD COMPOSITE WATER TOWER
PUBLIC SERVICES
CITY OF CRESTVIEW
CRESTVIEW, FLORIDA

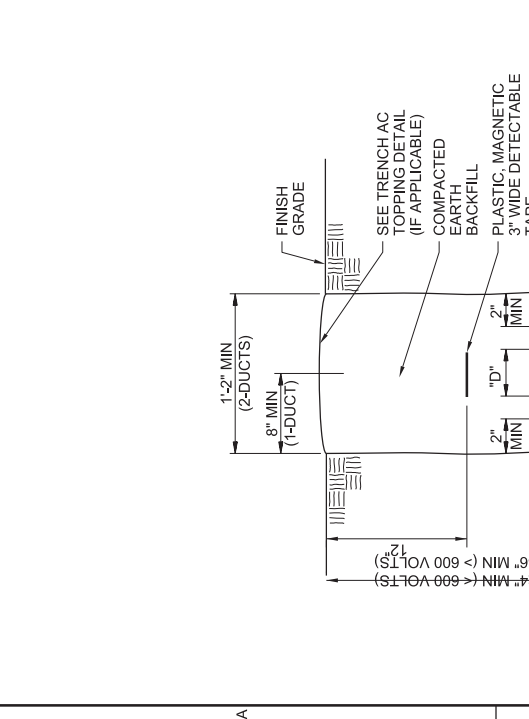
ELECTRICAL
ANTIOCH WATER TOWER
PANEL AND LUMINAIRE SCHEDULES,
AND WATER TOWER ELEVATION

NO.	DATE	REVISION	BY	APVD

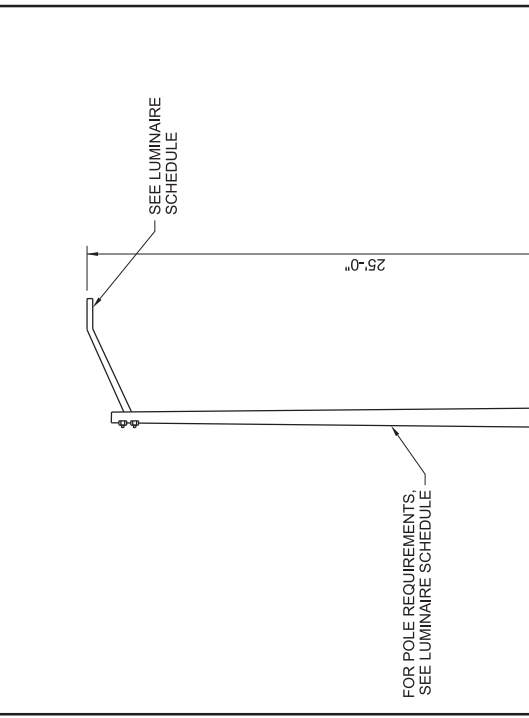
VERIFY SCALE	
BAR IS ONE INCH ON ORIGINAL DRAWING.	
DATE	NOVEMBER 2020
PROJ	D3282100
DWG	E-02
SHEET	20 of 21
PLOT TIME:	5:02:16 PM



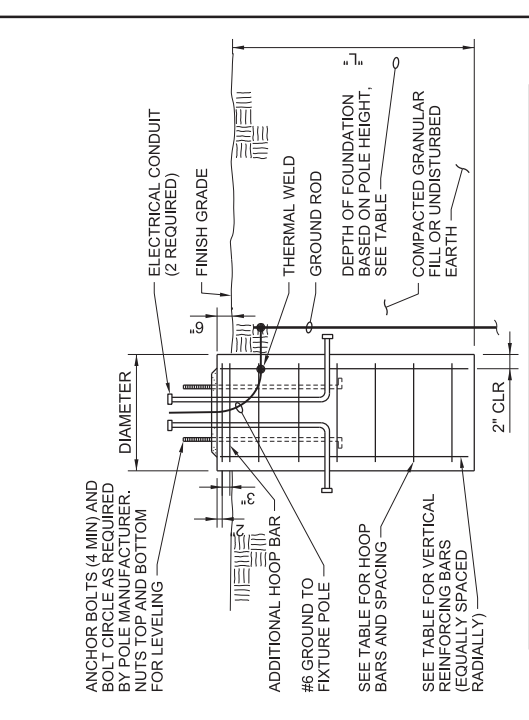
A TRENCH AND CONDUIT PLACEMENT



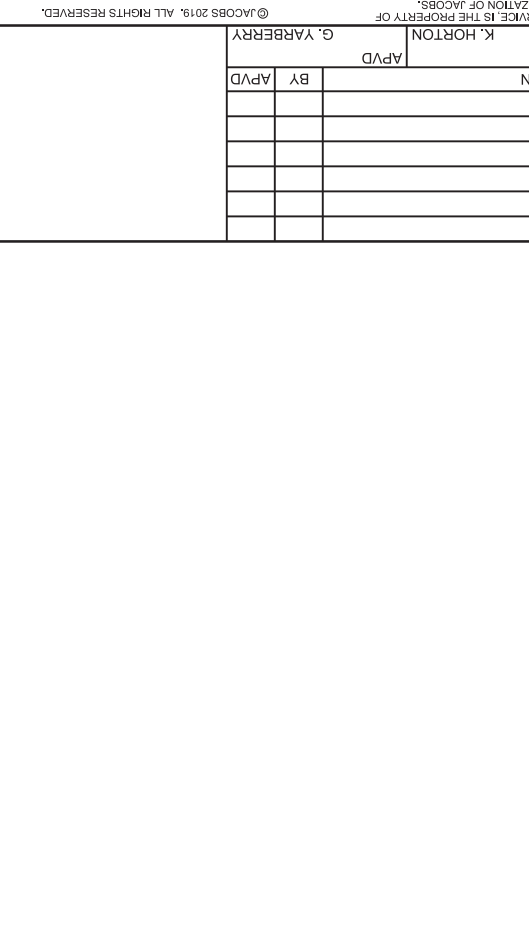
B POST LIGHT FOUNDATION



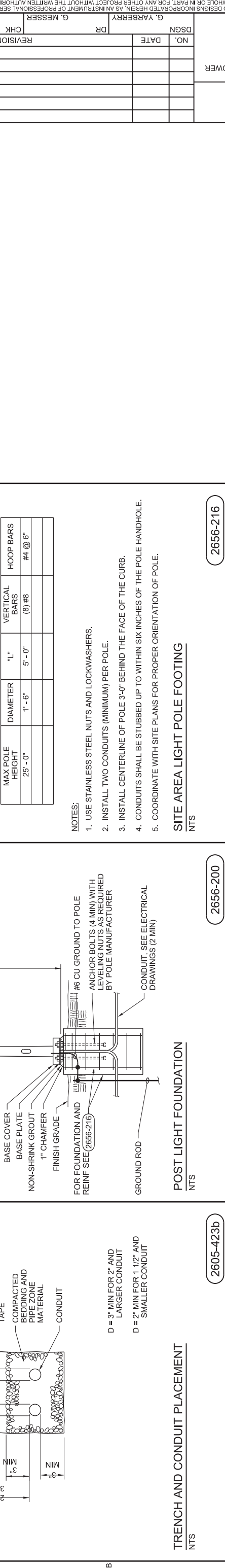
C PANELBOARD AND SCADA PANEL RACK



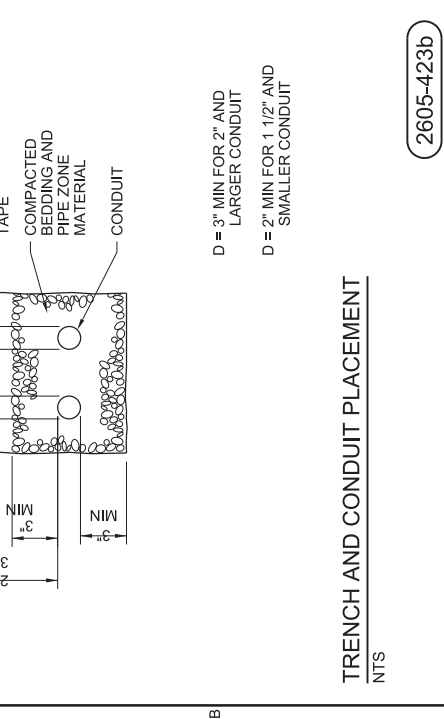
D SITE AREA LIGHT POLE FOOTING



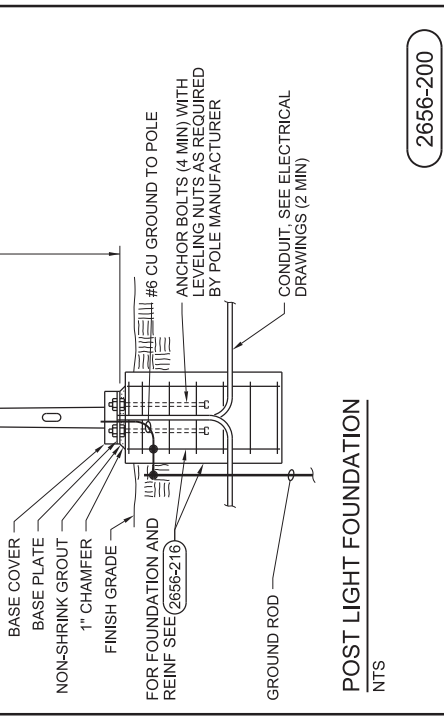
E PANEL MOUNTING RACK



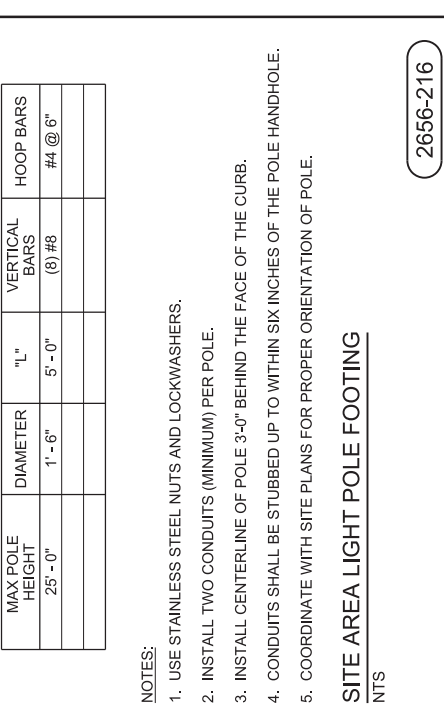
F PDT INSTALLATION FOR TANK LEVEL MEASUREMENT



G PANEL MOUNTING RACK



H POST LIGHT FOUNDATION



I SITE AREA LIGHT POLE FOOTING



J PANEL MOUNTING RACK

