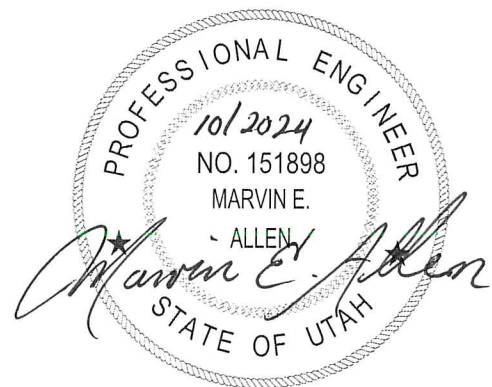




JORDAN VALLEY WATER
CONSERVANCY DISTRICT

WELL PUMP STATION CONSTRUCTION

**700 EAST (7618 S 700 E, SANDY CITY)
1000 EAST (7750 S 1000 E, MIDVALE CITY)**



BIDDING DOCUMENTS

OCTOBER 2024

CONTRACT DOCUMENTS FOR THE
700 E & 1000 E WELL PUMP STATION CONSTRUCTION
AT
7618 SOUTH 700 EAST
7750 SOUTH 1000 EAST

PROJECT #: 4280

NOVEMBER 2024

BID DOCUMENTS & SPECIFICATIONS

OWNER

Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, Utah
(801) 565-4300

ENGINEER

Hansen, Allen & Luce
859 W. South Jordan Pkwy. Ste. 200
South Jordan, UT 84095
(801) 566-5599

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NOTICE INVITING BIDS

PROJECT NAME: 700 E & 1000 E Well Pump Station Construction

DESCRIPTION OF WORK: This project will include the construction of two deep well pump stations at two separate sites. The wells were drilled in a previous project and are now ready to be equipped. The work comprises furnishing and installing all equipment for construction of pumping facilities including pump house buildings with associated mechanical, electrical and instrumentation equipment, fencing, site work, utility trenching, pipelines, pump-to-waste discharge pipeline, surge tanks, surge tank vaults, and associated surge tank equipment, fluoride and chlorine tanks and associated chemical feed systems, landscaping and landscaping irrigation systems, concrete sidewalks, driveways, parking and concrete curbing, and other appurtenant work for complete and operable facilities as specified and shown.

DISTRICT WEB SITE AND PLANHOLDERS LIST: Prospective bidders must register at the District's web site (www.jvwcd.org) under "Engineering Projects". Prospective bidders are required to check the District's web site for any addenda prior to submitting a responsive bid. The District's website will be used to publish updated information relative to the project, including a plan holders list.

RECEIPT OF BIDS: Sealed bids will be received at the office of the Jordan Valley Water Conservancy District, Owner of the Work, located at 8215 South 1300 West, West Jordan, Utah 84088, until **3:00pm, on Thursday, December 12th, 2024**, for construction of the 700 E & 1000 E Well Pump Station Construction. Electronic bids may also be submitted in adobe .pdf format to ellisad@jvwcd.org. **JVWCD suggests that electronic bids be submitted 15 minutes prior to the bid opening deadline, to allow for verification of delivery.** A public bid opening will be held at the bid due time. Attendance is not required. Bid results will be posted to the District's website within 24 hours of the bid opening.

OBTAINING CONTRACT DOCUMENTS: The Contract Documents are entitled "700 E & 1000 E Well Pump Station Construction". All Contract Documents may be obtained online at www.jvwcd.org under "Engineering Projects".

OPENING OF BIDS: The bids will be publicly opened and read at the time and location identified above.

FEDERAL FUNDING: This is a federally funded project. All bidders are required to follow Article 22 – Federal Requirements.

SITES OF WORK:

1. 7618 South 700 East, Sandy City, Utah
2. 7750 South 1000 East, Midvale City, Utah

NOTICE INVITING BIDS

PRE-BID MEETING: A non-mandatory pre-bid meeting will be held at **1:00pm, on Thursday, November 21st, 2024**, at the office of the Owner. Prospective bidders with questions regarding the project are encouraged to attend.

COMPLETION OF WORK: All work shall be completed within 750 calendar days from the date of the Notice to Proceed. Work shall be sequenced and scheduled as listed Section 01 11 00 - Summary of Work.

AWARD OF CONTRACT: An Award of Contract, if it were awarded, will be made within 60 calendar days of the opening of bids.

NOTICE TO PROCEED: A Notice to Proceed, if it were issued, will be made within 60 calendar days of the Notice of Award.

BID SECURITY: Each bid shall be accompanied by a certified or cashier's check, money order or bid bond in the amount of five percent of the total bid price payable to the Jordan Valley Water Conservancy District as a guarantee that the bidder, if its bid is accepted, will promptly execute the contract, provide evidence of worker's compensation insurance, and furnish a satisfactory faithful performance bond in the amount of 100 percent of the total bid price and a payment bond in the amount of 100 percent of the total bid price.

ADDRESS AND MARKING OF BID: The envelope enclosing the bid shall be sealed and addressed to the Jordan Valley Water Conservancy District and delivered or mailed to 8215 South 1300 West, West Jordan, Utah 84088. The envelope shall be plainly marked in the upper left-hand corner with the name and address of the bidder and shall bear the words "Bid for," followed by the title of the Contract Documents for the work and the date and hour of opening of bids. The certified or cashier's check, money order, or bidder's bond shall be enclosed in the same envelope with the bid. Electronic bids shall be submitted to the engineering administrative assistant, ellisad@jvwcd.org as an email attachment with the words "Bid for," followed by the title of the Contract Documents for the work and the date and hour of opening of bids in the subject line of the email.

NOTICE INVITING BIDS

PROJECT ADMINISTRATION: All questions relative to this project prior to the opening of bids shall be directed to the Engineer for the project. It shall be understood, however, that no interpretations of the specifications will be made by telephone, nor will any "or equal" products be considered for approval prior to award of contract.

ENGINEER

Hansen, Allen & Luce
859 W. South Jordan Pkwy. Ste 200
South Jordan, Utah 84095
Telephone: (801) 566-5599
Contact: Marv Allen, PE
Email: mallen@halengineers.com

OWNER

Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, Utah 84088
Telephone: (801) 565-4300
Project Manager: Kevin Rubow, PE
Email: KevinR@jvwcd.org

OWNER'S RIGHTS RESERVED: The Owner reserves the right to reject any or all bids, to waive any informality in a bid, and to make awards in the interest of the Owner.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

INSTRUCTIONS TO BIDDERS

FORM OF BID: The bid shall be made on the bidding schedule(s) bound herein. The bid shall be enclosed in a sealed envelope bearing the name of the bidder and name of the project. In the event there is more than one bidding schedule, the bidder may bid on any individual schedule or on any combination of schedules.

DELIVERY OF BID: The bid shall be delivered by the time and to the place stipulated in the Notice Inviting Bids. It is the bidder's sole responsibility to see that his bid is received at the proper time.

WITHDRAWAL OF BIDS: Bids shall be unconditionally accepted without alteration or correction, excepting that bidder may by means of written request, signed by the bidder or his properly authorized representative withdraw his bid. Such written request must be delivered to the place stipulated in the Notice Inviting Bids for receipt of bids prior to the scheduled closing time for receipt of bids.

OPENING OF BIDS: The bids will be publicly opened and read at the time and place stipulated in the Notice Inviting Bids.

MODIFICATIONS AND ALTERNATIVE BIDS: Unauthorized conditions, limitations, or provisions attached to a bid may render it non-responsive and may cause its rejection. The completed bid forms shall be without interlineations, alterations, or erasures. Alternative bids will not be considered unless called for. Oral, telegraphic, or telephonic bids or modifications will not be considered.

DISCREPANCIES IN BIDS: In the event there is more than one bid item in a bidding schedule, the bidder shall furnish a price for all bid items in the schedule; failure to do so may render the bid non-responsive and subject to rejection. In the event there are unit price bid items in a bidding schedule and the "amount" indicated for a unit price bid item does not equal the product of the unit price and quantity, the unit price shall govern and the "amount" will be corrected accordingly, and the Contractor shall be bound by said Correction. In the event there is more than one bid item in a bidding schedule and the total indicated for the schedule does not agree with the sum of the prices bid on the individual items, the prices bid on the individual items shall govern and the total for the schedule will be corrected accordingly, and the Contractor shall be bound by said correction.

INSTRUCTIONS TO BIDDERS

BID SECURITY: Each bid shall be accompanied by a certified or cashier's check or approved bid bond in the amount stated in the Notice Inviting Bids. Said check or bond shall be made payable to the Owner and shall be given as a guarantee that the bidder, if awarded the work, will enter into a contract within 10 calendar days after receipt of the contract from the Owner, and will furnish the necessary insurance certificates, Payment Bond, and Performance Bond; each of said bonds to be in the amount stated in the Notice Inviting Bids. In case the apparent low bidder refuses or fails to enter into such contract or fails to provide the required insurance and insurance certificates, the check or bid bond, as the case may be, shall be forfeited to the Owner. If the bidder elects to furnish a bid bond as his bid guarantee, he shall use the bid bond bound herein, or one conforming substantially to it in form.

BIDDER'S EXAMINATION OF CONTRACT DOCUMENTS AND SITE

It is the responsibility of each Bidder before submitting a Bid to:

1. Examine Contract Documents thoroughly.
2. Visit the site to become familiar with local conditions that may affect cost, progress, performance, or furnishing of the work.
3. Consider federal, state and local laws and regulations that may affect cost, progress, and performance of furnishing of the work.
4. Study and carefully correlate the Bidder's observations with the Contract Documents.
5. Notify the Engineer of all conflicts, errors, or discrepancies in the Contract Documents.

Reference is made to the Supplemental General Conditions for identification of:

1. Those reports of exploration and tests of subsurface conditions at the site, which have been utilized by the Engineer in the preparation of the Contract Documents.
2. Those drawings of physical conditions in or relating to existing surface and subsurface conditions (except underground utilities as defined in Article 1 of the General Conditions) which are at or contiguous to the site and which were utilized by the Engineer in the preparation of the Contract Documents. Copies of such reports and drawings are available for inspection at the office of the Owner.

INSTRUCTIONS TO BIDDERS

Information and data reflected in the Contract Documents with respect to underground facilities at/or contiguous to the site are based upon information and data furnished to the Owner and the Engineer by the owners of such underground facilities or others, and the Owner does not assume any responsibility for the accuracy or completeness thereof including any damages whatsoever that may be incurred by the Bidder or the Contractor through his reliance thereon unless it is expressly provided otherwise in the Supplemental General Conditions and/or the Technical Specifications.

Before submitting a bid, the bidder shall conduct such examination, investigations, studies and tests as are necessary to satisfy himself as to: the nature and location of the physical conditions (surface, subsurface and underground facilities), the general and local conditions particularly those bearing upon transportation, disposal, handling and storage of materials, availability of labor, availability of utilities, local weather conditions, the character of equipment and facilities required preliminary to and during the prosecution of the work; any and all other conditions that may in any way affect the cost, progress, performance or furnishing of materials in accordance with the Contract Documents. All such examination, investigation, studies, tests and the like shall be at the Bidder's expense.

Upon reasonable request in advance, the Owner shall provide each Bidder access to the site to conduct such explorations, examination, investigation and tests as each Bidder may determine necessary for the submission of a Bid. The Bidder shall fill all holes, clean and restore the site to its former condition upon the completion of such activities.

The submission of a bid hereunder shall be considered prima facie evidence that the Bidder has made such examination as is set forth in the above paragraph and is knowledgeable as to the location and site conditions surrounding the work and the conditions to be encountered in performing the work and as to the requirements, conditions and terms of the Contract and Contract Documents.

The Owner assumes no responsibility for any understanding or representations made by any of its officers or agents during or prior to the execution of this Contract, for information contained in any reports, subsurface studies, or other information which may be made available for the Contractor's information and which are not included as Contract Documents, for any understanding or representations by the Owner or by others which are not expressly stated in the Contract Documents which liability is not expressly assumed by the Owner or its representatives or Engineer in the Contract Documents. Such information shall be deemed to be for the information of the Contractor and the Contractor shall have the obligation of evaluating any such information as to its accuracy and effect the Owner will not be liable or responsible for any such information or any conclusions that may be drawn there from by the Contractor.

The lands upon which the work is to be performed, right-of-ways and easements for access thereto together with other lands designated for use by the Contractor in performing the work are identified in the Contract Documents. All additional lands and access thereto that are required for temporary construction facilities or storage of materials and equipment are to be provided by the Contractor. Easements for permanent structures or permanent changes in existing structures are to be obtained and paid for by the Owner unless

INSTRUCTIONS TO BIDDERS

otherwise provided in the Contract Documents.

The submission of a Bid shall constitute an incontrovertible representation by the Bidder that the Bidder has complied with every requirement of this Article, and that without exception the Bid is premised upon performing and furnishing the work required by the Contract Documents in compliance with such means, methods, techniques, sequences, or procedures of construction as may be indicated in or required by the Contract Documents; and that such means, methods, techniques, sequences or procedures described in the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance and furnishing the work.

QUANTITIES OF WORK: The quantities of work or material stated in the Bid Schedule are supplied only to give an indication of the general scope of the work; the Owner does not expressly or by implication agree that the actual amount of work or material will correspond therewith. The Owner reserves the right after award of the Contract to increase or decrease the quantities of any unit price item of the work by an amount up to and including 25 percent of the quantity of any bid item, or to omit portions of such work as may be deemed necessary or expedient by the Engineer or Owner, without a change in the unit price. Such right to revise and omit shall include the right to delete any bid item in its entirety, or to add additional bid items in quantities up to and including an aggregate total amount not to exceed 25 percent of the total amount of the Contract.

The Bidders nor the ultimate Contractor on the Project shall at any time after the submittal of a bid make or have any claim for damages or anticipated profits or loss of profit or otherwise because of any difference between the quantities of work actually done and material furnished and those stated in said unit price items of the Bid.

COMPETENCY OF BIDDERS: In selecting the lowest responsible Bidder, consideration will be given to the general competency of the Bidder for the performance of the work covered by the Bid. To this end, each bid shall be supported by a statement of the bidder's experience as of recent date on the form entitled "Information Required of Bidder," bound herein. No bid for the work will be accepted from a contractor who does not hold an active Contractor's license in good standing applicable to the type of work bid upon at the time of opening bids.

After an award of the contract no substitution of the Project Manager or Project Superintendent will be allowed without the written approval by the Owner.

DISQUALIFICATION OF BIDDERS: More than one bid from an individual, firm partnership, corporation, or association under the same or different names will not be considered. Reasonable grounds for believing that any bidder is interested in more than one bid for the work contemplated will cause the rejection of all bids in which such bidder is interested. If there is reason for believing that collusion exists among the bidders, all bids will be rejected.

RETURN OF BID GUARANTEE: Within 10 calendar days after award of the contract, the Owner will return the bid guarantees accompanying such of the bids as are not considered

INSTRUCTIONS TO BIDDERS

in making the award. All other bid guarantees will be held until a Notice to Proceed has been issued and accepted. They will then be returned to the respective bidders whose bids they accompany.

AWARD OF CONTRACT: Award of the Contract, if it be awarded, will be based primarily on the lowest overall cost to the Owner, and will be made to a responsive and responsible bidder whose bid complies with all the requirements prescribed. Any such award will be made by written notice and within 60 calendar days after opening of the bids, unless a different waiting period is expressly allowed in the Notice Inviting Bids. Unless otherwise indicated, an award will not be made for less than all the bid items in an individual bidding schedule. In the event the entire work is contained in more than one bidding schedule, the Owner may award schedules individually or in combination. In the case of two bidding schedules which are alternate to each other, only one of such alternate schedules will be awarded.

EXECUTION OF CONTRACT: The Bidder to whom the award is made shall secure all insurance and shall furnish all certificates and bonds required by the specifications within ten calendar days after receipt of the Notice of Award from the Owner. The Bidder to whom the award is made shall execute a written contract with the Owner on the form of agreement provided within ten calendar days after receipt of the Agreement from the Owner. Failure or refusal to enter into a contract as herein provided or to conform to any of the stipulated requirements in connection therewith shall be just cause for annulment of the award and forfeiture of the bid guarantee. If the successful bidder refuses or fails to execute the contract, the Owner may award the contract to the second lowest responsible bidder, or reject all bids and re-advertise the project for rebidding. If the second lowest responsible bidder refuses or fails to execute the contract, the Owner may award the contract to the third lowest responsible bidder. On the failure or refusal of such second or third lowest bidder to execute the contract, each such bidder's guarantees shall be likewise forfeited to the Owner.

ISSUANCE OF NOTICE TO PROCEED: The Owner intends to execute the Agreement and issue the Notice to Proceed specifying the Project start date within ten calendar days after its receipt of the executed Agreement, Purchase Order Assignment(s), (if applicable), bonds and insurance certificates from the successful bidder. If the Contract Time is expressed as a specific completion date in the Notice Inviting Bids and paragraph 3.1 of the Agreement rather than a specific number of successive days following the start date identified in the Notice to Proceed, then any delay by the Owner beyond the ten days in issuing the Notice to Proceed shall extend the completion date by the number of days of the delay.

LICENSES: Contractor must be licensed as a business qualified to do business within the state of Utah prior to issuance of a Notice of Award. Contractor must hold a current contractor's license with classifications appropriate to the work being contracted.

BID

BID TO: JORDAN VALLEY WATER CONSERVANCY DISTRICT

The undersigned Bidder hereby proposes to furnish all plant machinery, labor, services, materials, equipment, tools, supplies, transportation, utilities, and all other items and facilities necessary to perform all work required under the Bidding Schedule of the Owner's Contract Documents entitled "700 E & 1000 E Well Pump Station Construction" drawings and all addenda issued by said Owner prior to opening of the bids.

Addenda are only notified by e-mail and available to download through the internet.

The undersigned bidder acknowledges receipt of the following addenda:

<u>No.</u>	<u>Date Received</u>	<u>No.</u>	<u>Date Received</u>
_____	_____	_____	_____
_____	_____	_____	_____

Bidder agrees that, within 10 calendar days after receipt of Notice of Award from Owner, he will execute the Agreement in the required form, of which the Notice Inviting Bids, Instructions to Bidders, Bid, Information Required of Bidder, Technical Specifications, Drawings, and all addenda issued by Owner prior to the opening of bids, are a part, and will secure the required insurance and bonds and furnish the required insurance certificates; and that upon failure to do so within said time, then the bid guarantee furnished by Bidder shall be forfeited to Owner as liquidated damages for such failure; provided, that if Bidder shall execute the Agreement, secure the required insurance and bonds, and furnish the required insurance certificates within said time, his check, if furnished, shall be returned to him within five days thereafter, and the bid bond, if furnished, shall become void. It is further understood that this bid may not be withdrawn for a period of 45 days after the date set for the opening thereof, unless otherwise required by law.

Dated: _____

Bidder: _____

By: _____
(Signature)

Title: _____

Bidder further agrees to complete all work required within the time stipulated in the Contract Documents, and to accept in full payment therefore the price(s) named in the above-mentioned Bidding Schedule(s).

BID

Bid Item #1: 7618 South 700 East Well Pump Station and Site Improvements

Item No.	Description	Qty	Unit	Unit Cost	Total Amount
1	Mobilization/Demobilization	1	L.S.		\$
2	Surge Tank, Piping and Vault Complete	1	L.S.		\$
3	Pump House Structure Complete	1	L.S.		\$
4	Furnish and Install 300 HP Pump, Motor, & Discharge Head	1	L.S.		\$
5	Pump House Piping Complete with connection to existing pipelines	1	L.S.		\$
6	Site work including site grading, asphalt parking area and driveway, sidewalks, curb, curb and gutter, etc.	1	L.S.		\$
7	Furnish and install drainage piping, structures and new detention pond	1	L.S.		\$
8	Pump Station Electrical System Complete	1	L.S.		\$
9	Pump Station HVAC System Complete	1	L.S.		\$
10	Chlorine chemical feed & instrumentation system complete	1	L.S.		\$
11	Other instrumentation, including conductivity, pH, and turbidity	1	L.S.		\$
12	Furnish and install new 3' ornamental iron man-gate complete	1	L.S.		\$
13	Furnish and install 6" drain piping to Detention Pond	1	L.S.		\$
14	New gas piping from relocated gas meter on New Pump House to Existing Chemical Building	1	L.S.		\$
15	Construction surveying and control services	1	L.S.		\$
16	Landscaping complete	1	L.S.		\$
17	Irrigation System complete	1	L.S.		\$
18	Remove existing vinyl fence and install new 6-foot Bufftech Allegheny molded vinyl fence, or approved equal	1	L.S.		\$
19	Complete all other appurtenant work for a fully functional system, including but not limited to permits, clean-up, commissioning, and any other items not included in the above bid items, etc.	1	L.S.		\$
20	Replace existing ornamental iron gate on east drive entrance with new ornamental iron gate matching existing gate.	1	L.S.		\$

BID

Item No.	Description	Qty	Unit	Unit Cost	Total Amount
21	Permit allowance. Contractor to submit permit receipts for reimbursement.	1	L.S.		\$10,000.00
Total for Bid Item #1:					\$

Bid Item #2: 7750 South 1000 East Well Pump Station and Site Improvements

Item No.	Description	Qty	Unit	Unit Cost	Total Amount
1	Mobilization/Demobilization	1	L.S.		\$
2	Surge Tank, Piping and Vault Complete	1	L.S.		\$
3	Pump House Structure Complete	1	L.S.		\$
4	Furnish and Install 700 HP Pump, Motor, & Discharge Head	1	L.S.		\$
5	Pump House Piping Complete with connection to existing pipelines	1	L.S.		\$
6	Furnish and install 18" RCP drainage piping and system	1	L.S.		\$
7	Site work including site grading, asphalt and concrete parking area and driveway, sidewalks, curb, etc.	1	L.S.		\$
8	Pump Station Electrical System Complete	1	L.S.		\$
9	Pump Station HVAC System Complete	1	L.S.		\$
10	Chlorine chemical feed & instrumentation system complete, including installation and start-up of Tablet Chlorination unit to be supplied by OWNER.	1	L.S.		\$
11	Fluoride chemical feed & instrumentation system complete	1	L.S.		\$
12	Other instrumentation, including conductivity, pH, and turbidity	1	L.S.		\$
13	Remove existing vinyl fence, and install new vinyl fence (match existing) where indicated)	1	L.S.		\$
14	Remove existing chain link fence and install new 6' vinyl coated chain link fence (where indicated)	1	L.S.		\$
15	Construction surveying and control services	1	L.S.		\$

BID

Item No.	Description	Qty	Unit	Unit Cost	Total Amount
16	Landscaping complete	1	L.S.		\$
17	Irrigation Systems complete	1	L.S.		\$
18	Remove existing fence and install new 6-foot black vinyl coated chain link fence	1	L.S.		\$
19	New seal coat on existing asphalt surface at the site.	8,564	S.F.	\$	\$
20	New gas piping from the meter at the Existing East Building to the New Pump House	1	L.S.		\$
21	Complete all other appurtenant work for a fully functional system, including but not limited to permits, clean-up, commissioning, and any other items not included in the above bid items, etc.	1	L.S.		\$
22	Permit allowance. Contractor to submit permit receipts for reimbursement.	1	L.S.		\$10,000.00
Total for Bid Item #2:					\$

TOTAL BID AMOUNT for BID ITEMS #1 & #2: \$ _____

The BIDDER acknowledges to the OWNER that the BID provided herein includes total cost required to build a fully functioning well house and appurtenances, pipelines and related items as outlined within these specifications and shown in the drawings.

COMPANY: _____

Signed: _____

Title: _____

Date: _____

ATTACHMENTS TO THIS BID

The following documents are attached to and made a condition of this Bid:

1. Required Bid security in the form of Bid Bond.
2. Information Required of Bidder
3. Disadvantaged Business Enterprise - Bidder Good Faith Effort Documentation

BID BOND

KNOW ALL MEN BY THESE PRESENTS,

That _____
as Principal, and _____
as Surety, are held and firmly bound unto the Jordan Valley Water Conservancy District
(hereinafter called "Owner") in the sum of _____
dollars, (not less than five percent of the total amount of the bid) for the payment of which
sum, will and truly to be made, we bind ourselves, our heirs, executors, administrators,
successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, Principal has submitted a bid to Owner to perform all work required under the
bidding Schedule of the Owner's Contract Documents entitled "700 E & 1000 E Well Pump
Station Construction", (hereafter called the "Project").

NOW THEREFORE, if Principal is awarded Contract by Owner for the Construction of the
Project and, within the time and in the manner required under the heading "Instructions to
Bidders" enters into the written contract entitled "Agreement" bound with said Contract
Documents, furnishes the required certificates of insurance, and furnishes the required
Performance Bond and Payment Bond within 10 calendar days after receipt of such
contract from Owner, then this obligation shall be null and void, otherwise it shall remain in
full force and effect. In the event suit is brought upon this bond by Owner and judgment is
recovered, Surety shall pay all costs incurred by Owner in such suit, including a reasonable
attorney's fee to be fixed by the court.

SIGNED AND SEALED, this ___ day of _____, 20__.

By: _____ By: _____

Its: _____ Its: _____

(SEAL)

(SEAL)

INFORMATION REQUIRED OF BIDDER

The Bidder shall furnish the following information. Failure to comply with this requirement may render the Bid non-responsive and subject to rejection. Additional sheets shall be attached as required.

1. Contractor's name: _____

2. Contractor's address: _____

Contractor's Primary Contact: _____

Email address of Contractor's primary contact: _____

Contractor's telephone number: _____

3. **Contractor must be qualified and licensed to do business in Utah.**

Utah Department of Commerce Information

Business Entity Number: _____

Delinquent Date: _____

4. **Contractor must hold a current contractor's license, classification B100 or E100.**

Contractor's Utah License Number: _____

Expiration Date: _____

Primary Classification: _____

Supplemental Classification held, if any: _____

5. **Federal Funding Requirements**

This project is federally funded and requires the submission of additional forms. Requirements are described in Article 22 – Federal Requirements. Bidder must provide required forms, including, but not limited to:

a. Disadvantaged Business Enterprise Bidder Good Faith Effort Documentation (DBE) "CERTIFICATION – SIGNATURE":

i. The DBE "Fair Share Objective" goals are listed on page 3 of Article 22. All bidders must demonstrate compliance with the six DBE Good Faith Efforts and include documentation in the bid that records and certifies DBE solicitation efforts. **All bidders must include this documentation with their sealed bid.** An example of DBE solicitation effort documentation is shown on page 6 of Article 22 in the Supplemental General Conditions.

INFORMATION REQUIRED OF BIDDER

6. Key Personnel Qualifications and Experience

List key personnel here and provide detailed information in Attachments A and B. More than one Project Manager and/or Project Superintendent may be proposed. Only personnel approved by the Owner will be allowed in the key positions.

Project Manager A: _____

Project Manager (Alternate 1): _____

Project Manager (Alternate 2): _____

Project Manager shall have:

- At least five (5) years construction experience.
- Successfully completed one (1) project that included the construction of a pumping facility (well house or booster station) with pumping equipment rated at 200 horsepower or greater.

Project Superintendent A: _____

Project Superintendent (Alternate 1): _____

Project Superintendent (Alternate 2): _____

Project Superintendent shall have:

- At least ten (10) years construction experience.
- Successfully completed two (2) projects that included the construction of a pumping facility (well house or booster station) with pumping equipment rated at 200 horsepower or greater.

6. Previous Contractor Project Experience

Past project experience shall be provided for each requirement. The Owner shall be entitled to contact each and every reference listed by the contractor. The Contractor, by submitting a bid, expressly agrees that any information concerning the CONTRACTORS in possession of said entities and references may be made available to the owner.

Provide the information identified in Attachment C for each project which meets the minimum requirements listed below:

INFORMATION REQUIRED OF BIDDER

Requirements:

Contracting firm shall have successfully completed:

- Two (2) projects that included the construction of a pumping facility (well house or booster station) with pumping equipment rated at 200 horsepower or greater.
- One (1) project with a total value of at least \$2,000,000.

Note: One project may satisfy multiple requirements.

7. Name and title of officers of Contractor's firm:

8. Name of person who inspected site of proposed work for your firm:

Name: _____

Date of Inspection: _____

9. Surety company who will provide the required bonds on this contract:

Agent's Name: _____

Telephone: _____

10. Workers Compensation Insurance Policy #: _____

INFORMATION REQUIRED OF BIDDER

ATTACHMENT A

(Copy as necessary – provide experience that meets the requirements listed above)

Project Manager Data Sheet

Name: _____

Years experienced as Project Manager: _____

Years of prior experience: _____ Positions: _____

Qualifying Project #1 _____

Project Summary: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

Supplemental Qualifying Project _____

Project Summary: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

INFORMATION REQUIRED OF BIDDER

ATTACHMENT B

(Copy as necessary – provide experience that meets the requirements listed above)

Superintendent Data Sheet

Name: _____

Years experienced as Superintendent: _____

Years of prior experience: _____ Positions: _____

Qualifying Project #1 _____

Project Summary: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

Qualifying Project #2 _____

Project Summary: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

INFORMATION REQUIRED OF BIDDER

ATTACHMENT C

(Provide experience that meets the requirements listed above)

Contracting Firm Data Sheet

Name: _____

Qualifying Project #1 _____

Project Summary: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

Qualifying Project #2 _____

Project Summary: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

Qualifying Project #3 _____

Project Summary: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

AGREEMENT

An Agreement made as of the _____ day of _____, 20____, by and between the Jordan Valley Water Conservancy District, a Utah special district (“OWNER”), and _____, a _____ corporation qualified to do business and doing business in the State of Utah (“CONTRACTOR”).

TERMS:

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

ARTICLE I
WORK

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

Furnishing all labor, services, materials, equipment, and supplies except for such materials, equipment, and services as may be stipulated in the Contract Documents to be furnished by the OWNER; furnishing and removing all plant machinery, temporary structures, tools, supplies, transportation, utilities, and all other items, facilities and equipment, and to do everything required by this Agreement and the Contract Documents; accepting all responsibility for and paying for all loss and damage arising out of the nature of the Work aforesaid, or from the action of the elements, or from any unforeseen difficulties which may arise during the prosecution of the Work until its acceptance by OWNER, and for all risks of every description connected with the Work; also for all expenses resulting from the suspension or discontinuance of work, except as in the Contract Documents are expressly stipulated to be borne by OWNER.

ARTICLE II
ENGINEER

The Project has been designed by the OWNER. The OWNER will assume all duties and responsibilities and have the rights and authority assigned to ENGINEER in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

[ALTERNATE PARAGRAPH]The Project has been designed by _____, a _____ corporation qualified to do business and doing business in the State of Utah, who is hereinafter called “ENGINEER” and who is to act as OWNER’s representative, assume all duties and responsibilities and have the rights and

authority assigned to 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 shall be complete, in accordance with paragraphs 14.08 and 14.09 of the General Conditions, on or before _____.
- 3.2 Liquidated Damages: OWNER and CONTRACTOR recognize that time is of the essence of 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. They also recognize the delays, expense and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by OWNER if the Work is not completed on time. Accordingly, instead of requiring any proof of loss, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) CONTRACTOR shall pay OWNER the amount specified in Article 14.07 of the General Conditions and in Article 18.01 of the Supplementary General Conditions for each day that expires after the time specified in paragraph 3.1 for final completion until the Work is substantially complete. And, after Substantial Completion if CONTRACTOR neglects, refuses or fails to complete the remaining Work within forty-five (45) days or any proper extension thereof granted by OWNER, CONTRACTOR shall pay OWNER the amount specified in Article 14.07 of the General Conditions and in Article 18.01 of the Supplemental General Conditions for each day that expires after the forty-five (45) days until readiness for final payment.

ARTICLE IV CONTRACT PRICE

All payments to Contractor shall be made in accordance with the Contract Documents. OWNER shall pay CONTRACTOR for completion of the Work in accordance with the Contract Documents in current funds those prices stated in the approved Bid Schedule as named in the Notice of Award.

ARTICLE V PAYMENT PROCEDURES

CONTRACTOR shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by ENGINEER as provided in the General Conditions.

- 5.1 Progress Payments: OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR's Applications for Payment

as recommended by ENGINEER, on a monthly basis. All progress payments will be on the basis of the progress of the Work measured by the schedule of values established in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Conditions.

- 5.2 Final Payment: Upon final completion and acceptance of the Work in accordance with Article 14 of the General Conditions, OWNER shall pay the remainder of the Contract Price as recommended by ENGINEER as provided in Article 14.

ARTICLE VI INTEREST

All moneys not paid when due as provided in Article 14 of the General Conditions shall bear interest at the rate of twelve percent (12%) per annum.

ARTICLE VII CONTRACTOR'S REPRESENTATION

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

- 7.1 CONTRACTOR has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work.
- 7.2 CONTRACTOR has studied carefully all exploration reports and test of subsurface conditions and drawings of physical conditions which are identified in the Supplementary General Conditions, as provided in paragraph 4.02 of the General Conditions, and accepts the Technical Data contained in such reports and drawings upon which CONTRACTOR is entitled to rely.
- 7.3 CONTRACTOR has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests, reports and studies (in addition to or to supplement those referred to in paragraph 7.2 above) which pertain to the subsurface or physical conditions at or contiguous to the site or otherwise may affect the cost, progress, performance or furnishing of the Work as CONTRACTOR considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of paragraph 4.02 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports,

studies or similar information or data are or will be required by CONTRACTOR for such purposes.

- 7.4 CONTRACTOR has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the accurate location of said Underground Facilities.
- 7.5 CONTRACTOR has correlated the results of all observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.
- 7.6 CONTRACTOR has given ENGINEER written notice of all conflicts, errors or discrepancies that he had discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR.

ARTICLE VIII CONTRACT DOCUMENTS

The Contract Documents for the _____, which comprise the entire agreement between OWNER and CONTRACTOR concerning the Work, consist of the following:

- 8.1 This Agreement;
- 8.2 Performance and Payment Bonds;
- 8.3 Notice of Award;
- 8.4 Notice to Proceed;
- 8.5 General Conditions;
- 8.6 Supplemental General Conditions;
- 8.7 Notice Inviting Bids;
- 8.8 Instructions to Bidders;
- 8.9 Information Required of Bidder;
- 8.10 Technical Specifications;
- 8.11 Drawings - Sheets Number One through _____;
- 8.12 Addendum Number One through _____; and,
- 8.13 CONTRACTOR's Bid, including all schedules and explanatory attachments; attached as Exhibit A.

The CONTRACTOR (1) acknowledges that he has received a copy of each document, specified above, (2) acknowledges that he has read and understands each document specified above and (3) agrees to every term, condition and contract obligation set forth in each document specified above.

There are no Contract Documents other than those listed above in this Article 8. The Contract Documents may only be amended, modified or supplemented as provided in paragraphs 3.03 of the General Conditions.

ARTICLE IX
FEDERAL REQUIREMENTS

The CONTRACTOR shall comply with federal regulations as stated in the Supplemental General Conditions, Article 22.

ARTICLE X
MISCELLANEOUS

- 10.1 Terms used in this Agreement which are defined in Article 1 of the General Conditions will have the meanings indicated in the General Conditions.
- 10.2 No assignment by a party hereto of any rights under or interests 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, moneys that may become due and moneys 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 to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.
- 10.3 In the event any legal action or other proceeding is brought for the enforcement of this Agreement and/or the Contract Documents, or for damages, because of an alleged dispute, breach, default or misrepresentation in connection with any of the provisions thereof, the successful or prevailing party shall be entitled to recover reasonable attorneys' fees and other costs incurred in the action or proceeding, in addition to any other relief to which it may be entitled.
- 10.4 Any notice to be given hereunder shall be deemed given when sent by registered or certified mail, postage prepaid to the parties at their respective addresses stated below or at any other address when notice of such change of address has been given as provided in this Article 10.4.

[SIGNATURE PAGE FOLLOWS]

“OWNER”:

Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, Utah 84088

“CONTRACTOR”:

Utah License No. _____

By: _____
Alan E. Packard
Its General Manager/CEO

By: _____
Its: _____

EXHIBIT A
CONTRACTOR'S BID

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS,

That _____, as Contractor, and _____ as Surety, are held firmly bound unto the Jordan Valley Water Conservancy District hereinafter called "Owner," in the sum of \$_____ for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has been awarded and is about to enter into the annexed Agreement with Owner to perform all work required under the Bidding Schedule(s) of the Owner's Contract Documents entitled "700 E & 1000 E Well Pump Station Construction".

NOW THEREFORE, if Contractor shall perform all the requirements of the Agreement required to be performed on his part, at the times and in the manner specified therein, then this obligation shall be null and void, otherwise it shall remain in full force and effect.

PROVIDED, that any alterations in the work to be done or the materials to be furnished, or changes in the time of completion, which may be made pursuant to the terms of the Agreement, shall not in any way release Contractor or Surety thereunder, nor shall any extensions of the time granted under the provisions of the Agreement release either the Contractor or Surety, and notice of such alterations or extensions of the work, materials or time to complete made under the Agreement is hereby waived by Surety. This Bond is furnished in compliance and in accordance with 14-1-18, Utah Code Ann., as amended, and 63-56-38 Utah Code Ann., as amended.

SIGNED AND SEALED, this _____ day of _____, 20__.

By: _____

By: _____

Its: _____

Its: _____

(SEAL)

(SEAL)

(SEAL AND NOTARIAL ACKNOWLEDGMENT OF SURETY)

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS,

That _____ as Contractor, and _____ as Surety, are held firmly bound unto the Jordan Valley Water Conservancy District hereinafter called "Owner," in the sum of \$_____ for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has been awarded and is about to enter into the annexed Agreement with Owner to perform all work required under the Bidding Schedule(s) of the Owner's Contract Documents entitled, "700 E & 1000 E Well Pump Station Construction".

NOW THEREFORE, if said Contractor, or subcontractor, fails to pay for any materials, equipment, or other supplies, or for rental of same, used in connection with the performance of work contracted to be done, or for amounts due under applicable State law for any work or labor thereon, said Surety will pay for the same in an amount not exceeding the sum specified above, and, in the event suit is brought upon this bond, a reasonable attorney's fee to be fixed by the court. This bond shall inure to the benefit of any persons, companies, or corporations entitled to file claims under applicable State law.

PROVIDED, that any alterations in the work to be done or the materials to be furnished, or changes in the time of completion, which may be made pursuant to the terms of the Agreement, shall not in any way release Contractor or Surety thereunder, nor shall any extensions of time granted under the provisions of said contract release either Contractor or the Surety, and notice of such alterations or extensions of the work, materials or time to complete made under the Agreement is hereby waived by Surety. This bond is furnished in compliance and in accordance with 14-1-18 and 19 Utah Code Ann., as amended, and 63-56-38 Utah Code Ann., as amended.

SIGNED AND SEALED, this _____ day of _____, 20____.

By: _____

By: _____

Its: _____

Its: _____

(SEAL)

(SEAL)

(SEAL AND NOTARIAL ACKNOWLEDGMENT OF SURETY)

NOTICE OF AWARD

To:

Re: 700 E & 1000 E Well Pump Station Construction

You are hereby notified that the OWNER has accepted your bid for the above referenced project in the amount of \$_____.

Furnish the required Contractor's Performance Bond, Payment Bond and Certificates of Insurance within ten calendar days from the date of this notice to you. An acknowledged copy of this Notice of Award, together with all future correspondence regarding this project, shall be sent to the District's Project Manager: Kevin Rubow.

When the Agreement is provided, sign and return it within ten calendar days from receipt of the agreement.

Dated this ____ day of _____, 20__.

Shane Swensen, PE
Chief Engineer

ACCEPTANCE OF NOTICE

Receipt of the above Notice of Award is hereby acknowledged by:

This _____ day of _____, 20__.

Signature: _____

Printed Name: _____

Title: _____

NOTICE TO PROCEED

To:

Re: 700 E & 1000 E Well Pump Station Construction

You are hereby notified to commence work in accordance with the Agreement dated _____, and you are to complete the work within ____ calendar days.

An acknowledged copy of this Notice to Proceed should be returned to the Owner, Attention: Kevin Rubow, Staff Engineer.

Dated this _____ day of _____.

Travis P Christensen, P.E.
Engineering Group Leader

ACCEPTANCE OF NOTICE

Receipt of the above Notice to Proceed is hereby acknowledged by:

This _____ day of _____, 20____.

Signature: _____

Printed Name: _____

Title: _____

JORDAN VALLEY WATER CONSERVANCY DISTRICT

PAYMENT APPLICATION AND CERTIFICATE No. _____ DATE: _____

SHEET _____ OF _____

PERIOD FROM _____ TO _____, 20__

PROJECT: 700 E & 1000 E Well Pump Station Construction

JVWCD PROJECT NO.: 4280

CONTRACTOR: _____

ADDRESS: _____

ENGINEER: _____

1. ORIGINAL CONTRACT PRICE:..... \$ _____
2. NET CHANGE ORDERS APPROVED TO DATE: \$ _____
(Attach Summary Sheet)
3. REVISED CONTRACT AMOUNT: \$ _____
(Sum of Lines 1 & 2)
4. TOTAL VALUE OF WORK COMPLETED TO DATE \$ _____
(Attached Payment Breakdown)
5. PERCENT PROJECT COMPLETE: %
(Divide Line 4 by 3 and multiply by 100)
6. LESS AMOUNT RETAINED (5%) \$ _____
7. MATERIALS ON HAND..... \$ _____
(95% of Value, Listing Attached)
8. SUBTOTAL (Sum of Lines 4, Line 6 and Line 7) \$ _____
9. LESS PREVIOUS PAYMENTS \$ _____
10. CURRENT PAYMENT DUE: \$ _____
(Line 8 & 9)

JORDAN VALLEY WATER CONSERVANCY DISTRICT

Payment Application and Certificate No _____

SHEET _____ OF _____

CONTRACTOR'S Certification:

The undersigned CONTRACTOR certifies that: (1) all previous progress payments received from OWNER on account of work done under the Contract referred to herein have been applied to discharge in full all obligations of CONTRACTOR incurred in connection with work covered by prior Applications for Payment numbered 1 through _____ inclusive; and, (2) title to all materials and equipment incorporated in said Work or otherwise listed in or covered by this Application for Payment will pass to OWNER at time of payment free and clear of all liens, claims, security interests and encumbrances (except such as covered by bond acceptable to OWNER).

Dated: _____ CONTRACTOR: _____

By: _____

Engineer's Recommendation:

This Application (with accompanying documentation) meets the requirements of the Contract Documents and payment of the amount due this application is recommended.

ENGINEER

Dated _____ _____
Project Representative

Dated _____ _____
Project Manager

JORDAN VALLEY WATER CONSERVANCY DISTRICT

CHANGE ORDER

Change Order No. _____

Date: _____

Page ___ of ___

NAME OF PROJECT: 700 E & 1000 E Well Pump Station Construction

PROJECT NUMBER: 4280

CONTRACTOR: _____

CONTRACT DATE: _____

The following changes are hereby made to the CONTRACT DOCUMENTS:

- 1)
- 2)
- 3)

Total Change to CONTRACT PRICE: \$

Original CONTRACT PRICE: \$

Current CONTRACT PRICE adjusted by previous CHANGE ORDER(S)..... \$

The new CONTRACT PRICE including this CHANGE ORDER will be \$

The CONTRACT TIME will be increased by _____ calendar days.

The date for Substantial Completion will be _____, 20__.

The Contractor agrees to furnish all labor and materials and perform all work as necessary to complete the change order items for the price named herein, which includes all supervision and miscellaneous costs. This change order constitutes full and mutual accord and satisfaction for all time and all costs related to this change. By acceptance of this change order the Contractor agrees that the change order represents an equitable adjustment to the Contract, and further agrees to waive all right to file a claim arising out of or as a result of this change. This document will become a supplement to the Contract, and all provisions will apply hereto, upon approval by the Owner.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

**CHANGE ORDER
(CONTINUED)**

Change Order No. _____

Date: _____

Page ___ of ___

Recommended: _____
Engineer – Hansen, Allen & Luce Date

Accepted: _____
Contractor - Date

Approved: _____
Owner - Jordan Valley Water Conservancy District Date

JORDAN VALLEY WATER CONSERVANCY DISTRICT

**CONTRACTOR'S CERTIFICATE
OF
SUBSTANTIAL COMPLETION**

OWNER

TO: Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, Utah 84088

PROJECT: 700 E & 1000 E Well Pump Station Construction

ATTENTION: _____

FROM: _____
Firm or Corporation

This is to certify that I, _____ am an authorized official of
_____ working in the capacity of _____
_____ and have been properly authorized by said
firm or corporation to sign the following statements pertaining to the subject contract:

I know of my own personal knowledge, and do hereby certify, that the work of the contract described above has been substantially performed and all materials used and installed to date are in accordance with, and in conformity to, the contract drawings and specifications. A list of all incomplete work is attached.

The Contractor hereby releases the Owner and its agents from all claims of and liability to the Contractor for anything done or furnished for or relating to the work, as further provided in Article 14.08B of the General Conditions, except demands against the Owner for the remainder of progress payments retained to date, and unresolved written claims prior to this date.

The contract work is now substantially complete, ready for its intended use, and ready for your inspection. You are requested to issue a Certificate of Substantial Completion.

SIGNATURE: _____

DATE: _____

JORDAN VALLEY WATER CONSERVANCY DISTRICT

**CONTRACTOR'S CERTIFICATE
OF
FINAL COMPLETION**

OWNER

TO: Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, Utah 84088

PROJECT: 700 E & 1000 E Well Pump Station Construction

ATTENTION: Project Representative: _____

FROM: _____
Firm or Corporation

This is to certify that I, _____ am an authorized official of
_____ working in the capacity of _____
_____ and have been properly authorized
by said firm or corporation to sign the following statements pertaining to the subject
contract:

I know of my own personal knowledge, and do hereby certify, that the work of the contract described above has been performed and all materials used and installed to date are in accordance with, and in conformity to, the contract drawings and specifications.

The Contract work is now complete in all parts and requirements, excepting the attached list of minor deficiencies and the reasons for each being incomplete to date, for which exemption from final payment requirements is requested in conformance to Article 14.09A of the General Conditions of our Contract (if no exemptions requested, write "none") _____. The work is now ready for your final inspection. The following items required from the Contractor prior to application for final payment (such as O & M Manuals, guarantees, record drawings, etc.) are submitted herewith, if any:

JORDAN VALLEY WATER CONSERVANCY DISTRICT

I understand that neither the issuance by the Engineer of a Notice of Completion, nor the acceptance thereof by the Owner, shall operate as a bar or claim against the Contractor under the terms of the guarantee provisions of the Contract Documents.

SIGNATURE: _____

DATE: _____

JORDAN VALLEY WATER CONSERVANCY DISTRICT

CONSENT OF SURETY FOR FINAL PAYMENT

PROJECT NAME: 700 E & 1000 E Well Pump Station Construction

LOCATION: _____

TYPE OF CONTRACT: _____

AMOUNT OF CONTRACT: _____

In accordance with the provisions of the above-named contract between the Owner and the Contractor, the following named surety:

on the Payment Bond of the following named Contractor:

hereby approves of final payment to the Contractor, and further agrees that said final payment to the Contractor shall not relieve the Surety Company named herein of any of its obligations to the following named Owner (as set forth in said Surety company's bond):

IN WITNESS WHEREOF, the Surety Company has hereunto set its hand and seal this _____ day of _____, 20____.

(Name of Surety Company)

(Signature of Authorized Representative)

(Name of Authorized Representatives)

(Title)

JORDAN VALLEY WATER CONSERVANCY DISTRICT

AFFIDAVIT OF PAYMENT

To All Whom It May Concern:

WHEREAS, the undersigned has been employed by the Jordan Valley Water Conservancy District to furnish labor and materials under a contract dated _____ for the project entitled "700 E & 1000 E Well Pump Station Construction", in the County of Salt Lake, State of Utah, of which Jordan Valley Water Conservancy District is the Owner.

NOW, THEREFORE, this _____ day of _____, 20__, the undersigned, as the Contractor for the above-named Contract pursuant to the Conditions of the Contract hereby certifies that, except as listed below, he has paid in full or has otherwise satisfied all obligations for all materials and equipment furnished, for all work, labor, and services performed, and for all known indebtedness and claims against the Contractor for damages arising in any manner in connection with the performance of the Contract referenced above for which the Owner or his property might in any way be held responsible.

EXCEPTIONS: (If none, write "None". If required by the Owner, the Contractor shall furnish bond satisfactory to the Owner for each Exception.)

Contractor (Name of sole ownership,
corporation or partnership)

(affix corporate seal here)

(Signature of Authorized Representative)

Title: _____

GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS

Wherever used in these General Conditions or in the other Contract Documents the following terms have the meanings indicated:

Addenda - Written or graphic instruments issued prior to the opening of Bids which make additions, deletions, or revisions to the Contract Documents.

Agreement - The written contract between the OWNER and the CONTRACTOR for the performance of the WORK pursuant to the Contract Documents. Documents incorporated into the contract by reference become part of the contract and of the Agreement.

Application for Payment - The form furnished by the ENGINEER and completed by the CONTRACTOR to request progress or final payment including supporting documentation to substantiate the amounts for which payment is requested.

Bonds - Performance, and Payment Bonds and other instruments which protect against loss due to inability or refusal of the CONTRACTOR to perform pursuant to the Contract Documents.

Change Order - A document recommended by the ENGINEER, which is signed by the CONTRACTOR and the OWNER and authorizes an addition, deletion, or revision in the WORK, or an adjustment in the Contract Price or the Contract Time, issued on or after the Effective Date of the Agreement.

Contract Documents - Information and Instructions, forms (including the Schedule of Prices and all required certificates and affidavits), Agreement, Performance Bond, Payment Bond, General Conditions, Supplemental General Conditions, Technical Specifications, Drawings and all Addenda and Change Orders executed pursuant to the provisions of the Contract Documents.

Contract Price - The total monies payable by the OWNER to the CONTRACTOR under the terms and conditions of the Contract Documents.

Contract Time - The number of successive Days stated in the Contract Documents for the completion of the WORK. The Contract Time begins to run on the date specified in the Notice to Proceed.

CONTRACTOR - The person, firm, or corporation with whom the OWNER has executed the Agreement.

Cost Proposal - The offer or proposal of the pipeline installation subcontractor to the CONTRACTOR to provide the work required under these Contract Documents.

Day - A calendar day of 24 hours measured from midnight to the next midnight.

Defective Work - Work that: is unsatisfactory, faulty, or deficient; does not conform to the Contract Documents; does not meet the requirements of any inspection, reference standard, test, or approval referred to in the Contract Documents; has been damaged prior to the ENGINEERS's recommendation of final payment.

Drawings - The drawings, plans, maps, profiles, diagrams, and other graphic representations which show the character, location, nature, extent, and scope of the WORK.

Effective date of the Agreement - The date indicated in the Agreement on which it was executed, 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.

ENGINEER - The person, firm, or corporation named as such in the Contract Documents.

Field Order - A written order issued by the ENGINEER which may or may not involve a change in the WORK.

Laws and Regulations; Laws or Regulations - Laws, rules, regulations, ordinances, codes, and/or orders promulgated by a lawfully constituted body authorized to issue such Laws and Regulations.

Notice of Award - The OWNER's written notice to the apparent successful Bidder stating that upon compliance with the conditions precedent enumerated therein by the apparent successful Bidder within the time specified, the OWNER will enter into the Agreement.

Notice to Proceed - The OWNER's written notice to the CONTRACTOR authorizing the CONTRACTOR to proceed with the work and establishing the date of commencement of the Contract Time.

OWNER - The Jordan Valley Water Conservancy District.

Partial Utilization - Placing a portion of the WORK in service for the purpose for which it is intended (or a related purpose) before reaching Substantial Completion of the WORK.

Project - A unit of total construction of which the WORK to be provided under the Contract Documents, may be the whole, or a part thereof.

Project Representative - The authorized representative of the ENGINEER who is assigned to the site or any part thereof.

Proposer - Any person, firm or corporation submitting a proposal for the work.

Schedule of Prices - The offer or proposal of the CONTRACTOR setting forth the price or prices for the work to be performed.

Shop Drawings - All drawings, diagrams, illustrations, schedules and other data which are specifically prepared by or for the CONTRACTOR to illustrate some portion of WORK and all illustrations, brochures, standard schedules, performance charts, instruction, and diagrams to illustrate material or equipment for some portion of the WORK.

Specifications - (Same definition as for Technical Specifications hereinafter).

Subcontractor - An individual, firm, or corporation having a direct contract with the CONTRACTOR or with any other Subcontractor for the performance of a part of the WORK at the site.

Substantial Completion - That state of construction when the WORK has progressed to the point where, in the opinion of the ENGINEER as evidenced by the Certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the WORK 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.

Supplementary General Conditions - The part of the Contract Documents which make additions, deletions, or revisions to these General Conditions.

Supplier - A manufacturer, fabricator, supplier, distributor, materialman, or vendor.

Technical Data - The factual information contained in reports describing physical conditions, including exploration method, plans, logs, laboratory test methods and factual data. Technical Data does not include conclusions, interpretations, interpolations, extrapolations or opinions contained in reports or reached by the CONTRACTOR.

Technical Specifications - Those portions of the Contact Documents consisting of the written technical descriptions of products and execution of the WORK.

Underground Utilities - All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments and any encasements containing such facilities which have been installed under ground to furnish any of the following services or

materials: water, sewage and drainage removal, electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, traffic, or other control systems.

WORK - The entire construction required to be furnished under the Contract Documents. WORK is the result of performing services, furnishing labor and furnishing and incorporating materials and equipment into the construction, all as required by the Contract Documents.

GENERAL CONDITIONS

ARTICLE 2 - PRELIMINARY MATTERS

2.01 DELIVERY OF BONDS/INSURANCE CERTIFICATES

- A. The CONTRACTOR shall deliver to the OWNER the Agreement, Bonds, Insurance Policies and Certificates required by the Contract Documents within ten (10) days after receiving the Notice of Award from the OWNER.

2.02 COPIES OF DOCUMENTS

- A. The OWNER shall furnish the CONTRACTOR 5 copies of the Contract Documents, together with 5 sets of full-scale Drawings. Additional quantities of the Contract Documents will be furnished at reproduction cost.

2.03 STARTING THE PROJECT

- A. The CONTRACTOR shall begin construction of the WORK within 10 days after the commencement date stated in the Notice to Proceed, but shall not commence construction prior to the commencement date.

2.04 BEFORE STARTING CONSTRUCTION

- A. Before undertaking each part of the WORK, the CONTRACTOR shall carefully study and compare the Contract Documents to check and verify pertinent figures and dimensions shown thereon with all applicable field measurements. The CONTRACTOR shall promptly report in writing to the ENGINEER any conflict, error, or discrepancy which the CONTRACTOR may discover and shall obtain a written interpretation or clarification from the ENGINEER before proceeding with any work affected thereby.
- B. The CONTRACTOR shall submit to the ENGINEER for review those documents called for in each section of the Technical Specifications.

2.05 PRECONSTRUCTION CONFERENCE

- A. The CONTRACTOR shall attend a preconstruction conference with the OWNER, the ENGINEER and others as appropriate to discuss the construction of the WORK in accordance with the Contract Documents.

GENERAL CONDITIONS

2.06 FINALIZING SCHEDULES

- A. At least 7 days before the CONTRACTOR's submittal of its first Application for Payment, the CONTRACTOR, the ENGINEER, and others as appropriate will meet to finalize the schedules submitted in accordance with the Technical Specifications.

GENERAL CONDITIONS

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 INTENT

- A. The Contract Documents comprise the entire agreement between OWNER and CONTRACTOR concerning the WORK. The Contract Documents are complementary, what is called for by one is as binding as if called for by all. The Contract Documents will be construed in accordance with the law of the place of the Project.
- B. It is the intent of the Contract Documents to describe the WORK, functionally complete, to be constructed in accordance with the Contract Documents. All work, materials, or equipment that may be reasonably inferred from the Contract Documents as being required to produce the completed work shall be supplied whether or not specifically called for. When words which have a well-known technical or trade meaning are used to describe work, materials, or equipment such words shall be interpreted in accordance with that meaning. Reference to standard specifications, manuals, or codes or any technical society, organization, or association, or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids, except as may be otherwise specifically stated. However, no provision of any referenced standard specification, manual, or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change the duties and responsibilities of the OWNER, the CONTRACTOR, or the ENGINEER or any of their consultants, agents, or employees from those set forth in the Contract Documents.
- C. If, during the performance of the WORK, the CONTRACTOR finds a conflict, error or discrepancy in the Contract Documents, the CONTRACTOR shall immediately report it to the ENGINEER in writing and before proceeding with the work affected thereby. The ENGINEER shall then make a written interpretation, clarification, or correction from the ENGINEER.

GENERAL CONDITIONS

3.02 ORDER OF PRECEDENCE OF CONTRACT DOCUMENTS

- A. In resolving conflicts resulting from conflicts, errors, or discrepancies in any of the Contract Documents, the order of precedence shall be as follows:
 - 1. Change Orders
 - 2. Agreement
 - 3. Addenda
 - 4. Contractor's Bid (Bid Form)
 - 5. Supplemental General Conditions
 - 6. Notice Inviting Bids
 - 7. Instructions to Bidders
 - 8. General Conditions
 - 9. Technical Specifications
 - 10. Referenced Standard Specifications
 - 11. Drawings

- B. With reference to the Drawings the order of precedence is as follows:
 - 1. Figures govern over scaled dimensions
 - 2. Detail drawings govern over general drawings
 - 3. Addenda/change order drawings govern over general drawings
 - 4. Contract Drawings govern over standard drawings

3.03 AMENDING AND SUPPLEMENTING CONTRACT DOCUMENTS

- A. The Contract Documents may be amended by a Change Order (pursuant to Article 10) to provide for additions, deletions or revisions in the WORK or to modify terms and conditions.

GENERAL CONDITIONS

3.04 REUSE OF DOCUMENTS

- A. Neither the CONTRACTOR, Subcontractor, Supplier, nor any other person or organization performing any of the WORK under a contract with the OWNER shall have or acquire any title to or ownership rights in any of the Drawings, Technical Specifications, or other documents used on the WORK, and they shall not reuse any of them on the extensions of the Project or any other project without written consent.

GENERAL CONDITIONS

ARTICLE 4 - AVAILABILITY OF LANDS; PHYSICAL CONDITIONS: REFERENCE POINTS

4.01 AVAILABILITY OF LANDS

- A. The OWNER shall furnish the lands, rights-of-way and easements upon which the WORK is to be performed and for access thereto, together with other lands designated for the use of the CONTRACTOR in the Contract Documents. Easements for permanent structures or permanent changes in existing major facilities will be obtained and paid for by the OWNER, unless otherwise provided in the Contract Documents. Nothing contained in the Contract Documents shall be interpreted as giving the CONTRACTOR exclusive occupancy of the lands or rights-of-way provided. The CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment. The CONTRACTOR shall not enter upon nor use any property not under the control of the OWNER until a written temporary construction easement agreement has been executed by the CONTRACTOR and the property owner, and a copy of the easement furnished to the ENGINEER prior to its use. Neither the OWNER nor the ENGINEER shall be liable for any claims or damages resulting from the CONTRACTOR's unauthorized trespass or use of any properties.

4.02 PHYSICAL CONDITIONS - SUBSURFACE AND EXISTING STRUCTURES

- A. Explorations and Reports: The paragraph entitled "Physical Conditions" of the Supplementary General Conditions identifies exploration reports and subsurface conditions tests at the site that have been utilized by the ENGINEER in the preparation of the Contract Documents. The CONTRACTOR may rely upon the accuracy of the Technical Data contained in these reports. The CONTRACTOR is responsible for the interpretation, extrapolation or interpolation of all technical as well as nontechnical data and its reliance on the completeness, opinions and interpretation of the reports.
- B. Existing Structures: The paragraph entitled "Physical Conditions" of the Supplementary General Conditions identifies the drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Utilities referred to in Paragraph 4.04 herein) which are at or contiguous to the site that have been utilized by the ENGINEER in the preparation of the Contract Documents. The CONTRACTOR is responsible for the interpretation, extrapolation or interpolation of all technical as well as nontechnical data and its reliance on the completeness, opinions and interpretation of the reports.

GENERAL CONDITIONS

4.03 DIFFERING SITE CONDITIONS

- A. The CONTRACTOR shall notify the ENGINEER upon encountering any of the following unforeseen conditions, hereinafter called "differing site conditions," during the prosecution of the WORK. The CONTRACTOR's notice to the ENGINEER shall be in writing and delivered before the differing site conditions are disturbed, but in no event later than 14 days after their discovery.
 - 1. Subsurface or latent physical conditions at the site of the WORK differing materially from those indicated, described, or delineated in the Contract Documents including those reports and documents discussed in Paragraph 4.02; and
 - 2. Physical conditions at the site of the WORK of an unusual nature differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents including those reports and documents discussed in Paragraph 4.02.
- B. The ENGINEER will review the alleged differing site conditions, determine the necessity of obtaining additional explorations or tests with respect to verifying their existence and extent and advise the OWNER in writing of the ENGINEER's findings and conclusions.
- C. If the OWNER concludes that because of newly discovered conditions a change in the Contract Documents is required, a Change Order will be issued as provided in Article 10 to reflect and document the consequences of the differing site conditions.
- D. In each such case, an increase or decrease in the Contract Price or an extension or shortening of the Contract Time, or any combination thereof, will be allowable to the extent that they are attributable to the differing site conditions. If the OWNER and the CONTRACTOR are unable to agree as to the amount or length of the Change Order, a claim may be made as provided in Articles 11 and 12.
- E. The CONTRACTOR's failure to give written notice of differing site conditions within 14 days of their discovery and before they are disturbed shall constitute a waiver of all claims in connection therewith, whether direct or consequential in nature.

GENERAL CONDITIONS

4.04 PHYSICAL CONDITIONS - UNDERGROUND UTILITIES

- A. Shown or Indicated: The information and data shown or indicated in the Contract Documents with respect to existing Underground Utilities at or contiguous to the site are based on information and data furnished to the OWNER or the ENGINEER by the owners of Underground Utilities or by others. Unless it is expressly provided in the Supplementary General Conditions and/or the Section entitled "Protection and Restoration of Existing Facilities" of the Technical Specifications, the OWNER and the ENGINEER shall not be responsible for the accuracy or completeness of any Underground Utilities information or data. The CONTRACTOR's responsibility relating to underground utilities are: review and check all information and data, locate all Underground Utilities shown or indicated in the Contract Documents, coordinate the WORK with the owners of Underground Utilities during construction, the safeguard and protect the of Underground Utilities, and repair any damage to Underground Utilities resulting from the WORK. The cost of all these activities will be considered as having been included in the Contact Price.
- B. Not Shown or Indicated: If an Underground Utility not shown or indicated in the Contract Documents is uncovered or revealed at or contiguous to the site and which the CONTRACTOR could not reasonably have been expected to be aware of, the CONTRACTOR shall give written notice to the OWNER of that utility and the ENGINEER, specifying the location of the utility in question.

4.05 REFERENCE POINTS

- A. The ENGINEER will provide one bench mark, near or on the site of the WORK, and will provide two points near or on the site to establish a base line for use by the ENGINEER for alignment control. Unless otherwise specified in the Technical Specifications, the CONTRACTOR shall furnish all other lines, grades, and bench marks required for proper execution of the WORK.
- B. The CONTRACTOR shall preserve all bench marks, stakes, and other survey marks. In case of their removal or destruction by its own employees or by its subcontractor's employees, the CONTRACTOR shall be responsible for the accurate replacement of reference points by professionally qualified personnel at no additional cost to the OWNER.

GENERAL CONDITIONS

ARTICLE 5 - BONDS AND INSURANCE

5.01 PERFORMANCE AND OTHER BONDS

- A. The CONTRACTOR shall furnish Performance and Payment Bonds, each in the amount set forth in the Supplementary General Conditions as security for the faithful performance and payment of all the CONTRACTOR's obligations under the Contract Documents. All insurance companies, sureties, and bond companies shall have an AM Best rating of A- or better, with a Financial Size Category of XII or better. Sureties shall also be listed on the Department of the Treasury's Circular 570, with an acceptable underwriting limitation limit. The Performance Bond shall remain in effect at least until one year after the date of Notice of Completion, except as otherwise provided by Law or Regulation or by the Contract Documents. After the ENGINEER issues the Notice of Completion, the amount of the Performance Bond may be reduced to 10 percent of the Contract Price, or \$1,000, whichever is greater. The CONTRACTOR shall also furnish such other Bonds as are required by the Supplementary General Conditions.
- B. If the surety on any Bond furnished by the CONTRACTOR is declared a bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the WORK is located, the CONTRACTOR shall within 7 days after written approval by the OWNER of a substitute Bond and Surety substitute the approved Bond and Surety.

5.02 INSURANCE

- A. The CONTRACTOR shall purchase and maintain the insurance required under this paragraph. All insurance companies, sureties, and bond companies shall have an AM Best rating of A- or better, with a Financial Size Category of XII or better. Sureties shall also be listed on the Department of the Treasury's Circular 570, with an acceptable underwriting limitation limit. This insurance shall include the specific coverages set out herein and be written for not less than the limits of liability and coverages provided in the Supplementary General Conditions, or required by law, whichever is greater. The CONTRACTOR's liabilities under the Agreement shall not be deemed limited in any way to the insurance coverage required.
- B. The CONTRACTOR shall furnish the OWNER and ENGINEER with certificates indicating the type, amount, class of operations covered, effective dates and expiration dates of all policies. All insurance policies purchased and maintained (or the certificates or other evidence thereof) shall 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

GENERAL CONDITIONS

notice has been given to the OWNER by certified mail. All insurance shall remain in effect until the ENGINEER issues the Notice of Completion and at all times thereafter when the CONTRACTOR may be correcting, removing, or replacing defective work in accordance with Paragraph 13.06 or completing punch list items required by the Notice of Completion. In addition, the insurance required herein (except for Worker's Compensation and Employer's Liability) shall name the OWNER, the ENGINEER, and their officers, agents, and employees as "additional insured" under the policies.

1. Workers' Compensation and Employer's Liability: This insurance shall protect the CONTRACTOR against all claims under applicable state workers' compensation laws. The CONTRACTOR shall also be protected against claims for injury, disease, or death of employees which, for any reason, may not fall within the provisions of a workers' compensation law. This policy shall include an "all states" endorsement. The CONTRACTOR shall require each subcontractor similarly to provide Workers' Compensation Insurance for all of the latter's employees to be engaged in the WORK unless its employees are covered by the protection afforded by the CONTRACTOR's Workers' Compensation Insurance. In the event a class of employees is not protected under the Workers' Compensation Statute, the CONTRACTOR or Subcontractor, as the case may be, shall provide adequate employer's liability insurance for the protection of its employees not protected under the statute.
2. Comprehensive General Liability: This insurance shall be written in comprehensive form and shall protect the CONTRACTOR against all claims arising from injuries to persons other than its employees and damage to property of the OWNER or others arising out of any act or omission of the CONTRACTOR or its agents, employees or subcontractors. The policy shall include the following endorsements: (1) Protective Liability endorsement to insure the contractual liability assumed by the CONTRACTOR under the indemnification provisions in these General Conditions; (2) Broad Form Property Damage endorsement; (3) Personal Injury endorsement to cover personal injury liability for intangible harm. The Comprehensive General Liability coverage shall contain no exclusion relative to blasting, explosion, collapse of building, or damage to underground structures.
3. Comprehensive Automobile Liability: This insurance shall be written in comprehensive form. The policy shall protect the CONTRACTOR against all claims for injuries to employees, members of the public and

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damage to property of others arising from the use of CONTRACTOR's motor vehicles, whether they are owned, non-owned, or hired, and whether used or operated on or off the site. The motor vehicle insurance required under this paragraph shall include: (a) motor vehicle liability coverage; (b) personal injury protection coverage and benefits; and (c) uninsured motor vehicle coverage.

4. Subcontractor's Insurance: The CONTRACTOR shall require each of its subcontractors to procure and to maintain Comprehensive General Liability Insurance and Comprehensive Automobile Liability Insurance of the type and in the amounts specified in the Supplementary General Conditions or insure the activities of its subcontractors in the CONTRACTOR's own policy, in like amount.
5. Builder's Risk: This insurance shall be of the "all risk" type, shall be written in completed value form, and shall protect the CONTRACTOR, the OWNER, and the ENGINEER against damage to buildings, structures, materials and equipment. The amount of this insurance shall not be less than the insurable value of the WORK at completion. Builder's risk insurance shall provide for losses to be payable to the CONTRACTOR, the OWNER, and the ENGINEER as their interests may appear. The policy shall contain a provision that in the event of payment for any loss under the coverage provided, the insurance company shall have no rights of recovery against the CONTRACTOR, the OWNER, and the ENGINEER. The Builder's Risk policy shall insure against all risks of direct physical loss or damage to property from any external cause including flood and earthquake. Allowable exclusions, if any, shall be as specified in the Supplementary General Conditions.

GENERAL CONDITIONS

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.01 SUPERVISION AND SUPERINTENDENCE

- A. The CONTRACTOR shall supervise and direct the WORK competently and efficiently, devoting the attention and applying the skills and expertise necessary to perform the WORK in accordance with the Contract Documents. The CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction and safety precautions and programs incidental thereto. The CONTRACTOR shall be responsible to see that the finished WORK complies accurately with the Contract Documents.
- B. The CONTRACTOR shall employ the Superintendent named in "Information Required of Bidder" on the work site at all times during the progress of the WORK. The superintendent shall not be replaced without the OWNER's written consent. The superintendent will be the CONTRACTOR's representative at the site and shall have authority to act on behalf of the CONTRACTOR. All communications given to the superintendent shall be as binding as if given to the CONTRACTOR. The CONTRACTOR shall issue all its communications to the OWNER through the ENGINEER.
- C. The CONTRACTOR's superintendent shall be present at the site of the WORK at all times while work is in progress. Failure to observe this requirement shall be considered suspension of the WORK by the CONTRACTOR until the superintendent is again present at the site.

6.02 LABOR, MATERIALS, AND EQUIPMENT

- A. The CONTRACTOR shall provide skilled, competent and suitably qualified personnel to survey and lay out the WORK and perform construction as required by the Contract Documents. When required in writing by the OWNER or ENGINEER, the CONTRACTOR or any subcontractor shall discharge any person who is, in the opinion of the OWNER or ENGINEER, incompetent, disorderly, or otherwise unsatisfactory and shall not again employ the discharged person on the WORK without the consent of the OWNER or ENGINEER. The CONTRACTOR shall at all times maintain good discipline and order at the site.
- B. Except in connection with the safety or protection of persons the WORK, or property at the site or adjacent thereto, all work at the site shall be performed during regular working hours, and the CONTRACTOR will not permit overtime work or the performance of work on Saturday, Sunday or any legal holiday without the OWNER's written consent given after prior written notice

GENERAL CONDITIONS

to the ENGINEER. Except as otherwise provided in this Paragraph, the CONTRACTOR shall receive no additional compensation for overtime work, i.e., work in excess of 8 hours in any one calendar day or 40 hours in any one calendar week, even though such overtime work may be required under emergency conditions and may be ordered by the ENGINEER in writing. Additional compensation will be paid the CONTRACTOR for overtime work in the event extra work is ordered by the ENGINEER and the Change Order specifically authorizes the use of overtime work, but only to the extent that the CONTRACTOR pays overtime wages on a regular basis being paid by for overtime work of a similar nature in the same locality.

- C. All costs of inspection and testing performed during overtime work approved solely for the convenience of the CONTRACTOR shall be borne by the CONTRACTOR. The OWNER shall have the authority to deduct the costs of all inspection and testing from any partial payments otherwise due to the CONTRACTOR.
- D. Unless otherwise specified in the Contract Documents, the CONTRACTOR shall furnish, erect, maintain and remove the construction plant, and temporary works and assume full responsibility for all materials, equipment, labor, transportation, construction equipment, machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities and all other facilities and incidentals necessary for the furnishing, performance testing, start-up and completion of the WORK.
- E. All materials and equipment incorporated into the WORK shall be of new and good quality, except as otherwise provided in the Contract Documents. If required by the ENGINEER, the CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of materials and equipment. The CONTRACTOR shall apply, install, connect, erect, use, clean, and condition all material and equipment in accordance with the instructions of the manufacturer and Supplier except as otherwise provided in the Contract Documents.

6.03 ADJUSTING PROGRESS SCHEDULE

- A. The CONTRACTOR shall submit any adjustments in the progress schedule to the ENGINEER for acceptance in accordance with the provisions for "Contractor Submittals" in the Technical Specifications.

GENERAL CONDITIONS

6.04 SUBSTITUTES OR "OR-EQUAL" ITEMS

- 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 6.04.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: (i) it is a least equal in quality, durability, appearance, strength, and design characteristics; (ii) it will reliably perform at least equally well the function imposed by the design concept of the completed Project as a functioning whole, and;
 - b. CONTRACTOR certifies that: (i) there is no increase in cost to the OWNER; and (ii) it will conform substantially, even with deviations, to the detailed requirements of the item named in the Contract Document.
 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 6.04.A.1, it will be considered a proposed substitute item.
 - b. CONTRACTOR shall submit sufficient information as provided below to allow ENGINEER to determine that the item of material or

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equipment proposed is essentially equivalent to that named and an acceptable substitute therefore. Requests for review of proposed substitute items of material or equipment will not be accepted by ENGINEER from anyone other than CONTRACTOR.

- c. The procedure for review by ENGINEER will be as set forth in paragraph 6.04.A.2.d, as supplemented in the Technical Specifications and as ENGINEER may decide is appropriate under the circumstances.
 - d. CONTRACTOR shall first 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 shall certify that the proposed substitute item will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified, and be suited to the same use as that specified. The application will state the extent, if any, to which the use of the proposed substitute item will prejudice CONTRACTOR's achievement of Substantial Completion on time, whether or not use of the proposed substitute item will require a change in any of the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) to adapt the design to the proposed substitute item, and whether or not incorporation or use of the substitute item is subject to payment of any license fee or royalty. All variations of the proposed substitute item from that specified will be identified in the application, and available engineering, sales, maintenance, repair, and replacement services will be indicated. The application will also contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including 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, all of which will be considered by ENGINEER in evaluating the proposed substitute item. ENGINEER may require CONTRACTOR to furnish additional data about the proposed substitute item.
- B. Substitute Construction Methods or Procedures: If a specific means, method, technique, sequence, or procedure of construction is shown or indicated in and 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

GENERAL CONDITIONS

ENGINEER's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The procedure for review by ENGINEER will be similar to that provided in subparagraph 6.04.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 6.04.A and 6.04.B. 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 either a Change Order for a substitute or 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 time required by ENGINEER and ENGINEER's Consultants in evaluating substitute proposed or submitted by CONTRACTOR pursuant to paragraphs 6.04.A.2 and 6.04.B and in making changes in the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) occasioned thereby. Whether or not ENGINEER approves a substitute item so proposed or submitted by CONTRACTOR, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER's Consultants for evaluation each such proposed substitute.
- F. CONTRACTOR's EXPENSE: CONTRACTOR shall provide all data in support of any proposed substitute or "or-equal" at CONTRACTOR's expense.

6.05 CONCERNING SUBCONTRACTORS, SUPPLIERS, AND OTHERS

- A. The CONTRACTOR shall be responsible to the OWNER and the ENGINEER for the acts and omissions of its subcontractors and their employees to the same extent as the CONTRACTOR is responsible for the acts and omissions of its own employees. Nothing contained in this paragraph shall create any contractual relationship between any subcontractor and the OWNER or the ENGINEER nor relieve the CONTRACTOR of any liability or obligation under the Agreement.

6.06 PERMITS

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- A. Unless otherwise provided in the Supplementary General Conditions, the CONTRACTOR shall obtain and pay for all construction permits and licenses from the agencies having jurisdiction, including furnishing the insurance and bonds required by such agencies. The costs incurred by the CONTRACTOR in compliance with this paragraph shall not be made the basis for claims for additional compensation. The OWNER shall assist the CONTRACTOR, when necessary, in obtaining such permits and licenses. The 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, including all utility connection charges for utilities required by the WORK.

- B. The CONTRACTOR shall pay all license fees and royalties and assume all costs when any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others when issued in the construction of the WORK or incorporated into the WORK. If a particular invention, design, process, product, or device is specified in the Contract Documents for incorporation into or use in the construction of the WORK and if to the actual knowledge of the OWNER or the 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 these rights shall be disclosed by the OWNER in the Contract Documents. The CONTRACTOR shall indemnify, defend and hold harmless the OWNER and the ENGINEER and anyone directly or indirectly employed by either of them from and against all claims, damages, losses, and expenses (including attorneys' fees and court costs) arising out of 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.

6.07 LAWS AND REGULATIONS

- A. The CONTRACTOR shall observe and comply with all federal, state, and local laws, ordinances, codes, orders, and regulations which in any manner affect those engaged or employed on the WORK, the materials used in the WORK, or the conduct of the WORK. If any discrepancy or inconsistency should be discovered in the Contract Documents in relation to any law, ordinance, code, order, or regulations, the CONTRACTOR shall report the same in writing to the ENGINEER. The CONTRACTOR shall indemnify, defend and hold harmless the OWNER, the ENGINEER and their officers, agents, and employees against all claims and from violation of any law, ordinance, code, order, or regulation, whether by CONTRACTOR or by its employees or subcontractors. Any particular law or regulation specified or

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referred to elsewhere in the Contract Documents shall not in any way limit the obligation of the CONTRACTOR to comply with all other provisions of federal, state, and local laws and regulations. Where an individual State act on occupational safety and health standards has been approved by Federal authority, then the provision of said State act shall control.

6.08 EQUAL OPPORTUNITY

- A. The Contractor agrees to abide by: the provisions of Title VII of the Civil Rights Act of 1964 (42USC § § 2000e et seq.), which prohibits discrimination against any employee or applicant for employment on the basis of race, religion, color, or national origin; Executive Order No. 11246, as amended, which prohibits discrimination on the basis of sex; 45 CFR 90, which prohibits discrimination on the basis of age; Section 504 of the Rehabilitation Act of 1973, (42 USC § 794), which prohibits discrimination on the basis of handicap; Utah Executive Order dated June 30, 1989, which prohibits sexual harassment in the workplace; and the Americans with Disabilities Act (42 USC § § 12111 et seq.), which prohibits discrimination against qualified employees and applicants with a disability.

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6.09 TAXES

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

6.10 USE OF PREMISES

- A. The CONTRACTOR shall confine construction equipment, stored materials and equipment, and other operations of workers to (1) the Project site, (2) the land and areas identified for the CONTRACTOR's use in the Contract Documents, and (3) other lands whose use is acquired by Laws and Regulations, rights-of-way, permits, and easements. The CONTRACTOR shall be fully responsible to the owner and occupant of such lands for any damage to the lands or areas contiguous thereto, resulting from the performance of the WORK or otherwise. Should any claim be made against the OWNER or the ENGINEER by owner or occupant of lands because of the performance of the WORK, the CONTRACTOR shall promptly settle the claim by agreement, or resolve the claim through litigation. The CONTRACTOR shall, to the fullest extent permitted by Laws and Regulations, indemnify, defend, and hold the OWNER and the ENGINEER harmless from and against all claims, damages, losses, and expenses (including, but not limited to, fees of engineers, architects, attorneys, and other professionals and court costs) arising directly, indirectly, or consequentially out of any action, legal or equitable, brought by any owner or occupant of land against the OWNER or the ENGINEER to the extent the claim is based or arises out of the CONTRACTOR's performance of the WORK.

6.11 SAFETY AND PROTECTION

- A. The CONTRACTOR shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the WORK. The CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:
 - 1. All employees on the WORK and other persons and organizations who may be affected thereby.
 - 2. All the WORK and materials and equipment to be incorporated therein, whether in storage on or off the site; and

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3. Other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.
- B. The CONTRACTOR shall comply with all applicable Laws and Regulations (whether referred to herein or not) of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury, or loss and shall erect and maintain all necessary safeguards for such safety and protection. The CONTRACTOR shall notify owners of adjacent property and utilities when prosecution of the WORK may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.
- C. Unless the CONTRACTOR otherwise designates in writing a different individual as the responsible individual, the CONTRACTOR's superintendent shall be CONTRACTOR's representative at the site whose duty shall be the prevention of accidents.

6.12 SHOP DRAWINGS AND SAMPLES

- A. After checking and verifying all field measurements and after complying with the applicable procedures specified in the Technical Specifications, the CONTRACTOR shall submit all shop drawings to the ENGINEER for review and approval in accordance with the approved schedule for shop drawings submittals specified in the Technical Specifications.
- B. The CONTRACTOR shall also submit to the ENGINEER for review and approval all samples in accordance with the approved schedule of sample submittals specified in the Technical Specifications.
- C. Before submitting shop drawings or samples, the CONTRACTOR shall determine and verify all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers, and similar data with respect thereto and review or coordinate each shop drawing or sample with other shop drawings and samples and with the requirements of the WORK and the Contract Documents.

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6.13 CONTINUING THE WORK

- A. The CONTRACTOR shall carry on the WORK and adhere to the progress schedule during all disputes or disagreements with the OWNER. No work shall be delayed or postponed pending resolution of any dispute or disagreement, except as the CONTRACTOR and the OWNER may otherwise mutually agree in writing.

6.14 INDEMNIFICATION

- A. To the fullest extent permitted by Laws and Regulations, the CONTRACTOR shall indemnify, defend, and hold harmless the OWNER, the ENGINEER, and their officers, agents, and employees, against and from all claims and liability arising under or by reason of the Agreement or any performance of the WORK, but not from the sole negligence or willful misconduct of the OWNER and/or the ENGINEER. Such indemnification by the CONTRACTOR shall include but not be limited to the following:
1. Liability or claims resulting directly or indirectly from the negligence or carelessness of the CONTRACTOR or its agents in the performance of the WORK, or in guarding or maintaining the same, or from any improper materials, implements, or appliances used in its construction, or by or on account of any act or omission of the CONTRACTOR or its agents;
 2. Liability or claims arising directly or indirectly from or based on the violation of any law, ordinance, regulation, order, or decree, whether by the CONTRACTOR or its agents;
 3. Liability or claims arising directly or indirectly from the use or manufacture by the CONTRACTOR, its agents, or the OWNER in the performance of this Agreement of any copyrighted or uncopyrighted composition, secret process, patented or unpatented invention, article, or appliance, unless otherwise specifically stipulated in this Agreement.
 4. Liability or claims arising directly or indirectly from the breach of any warranties, whether express or implied, made to the OWNER or any other parties by the CONTRACTOR or its agents;
 5. Liabilities or claims arising directly or indirectly from the willful misconduct of the CONTRACTOR or its agents; and,

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6. Liabilities or claims arising directly or indirectly from any breach of the obligations assumed herein by the CONTRACTOR.
 - B. The CONTRACTOR shall reimburse the OWNER, and the ENGINEER for all costs and expense, (including but not limited to fees and charges of engineers, architects, attorneys, and other professional and court costs) incurred by the OWNER, and the ENGINEER in enforcing the provisions of this Paragraph.
 - C. The indemnification obligation under this Paragraph shall not be limited in any way by any limitation of the amount or type of damages, compensation, or benefits payable by or for the CONTRACTOR or any such subcontractor or other person or organization under workers' compensation acts, disability benefit acts, or other employee benefit acts.

6.15 CONTRACTOR'S DAILY REPORTS

- A. The CONTRACTOR shall complete a daily report indicating manpower, major equipment, subcontractors, weather conditions, etc., involved in the performance of the WORK. The daily report shall be completed on forms prepared by the CONTRACTOR and acceptable to the ENGINEER, and shall be submitted to the ENGINEER at the conclusion of each work day.

6.16 ASSIGNMENT OF CONTRACT

- A. The CONTRACTOR shall not assign, sublet, sell, transfer, or otherwise dispose of the Agreement or any portion thereof, or its right, title, or interest therein, or obligations thereunder, without the written consent of the OWNER except as imposed by law. If the CONTRACTOR violates this provision, the Agreement may be terminated at the option of the OWNER. In such event, the OWNER shall be relieved of all liability and obligations to the CONTRACTOR and to its assignee or transferee, growing out of such termination.

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ARTICLE 7 - OTHER WORK

7.01 RELATED WORK

- A. The OWNER may perform other work related to the Project at the site by the OWNER's own forces, have other work performed by utility owners, or let other direct contracts for the performance of the other work which may contain General Conditions similar to these. If the fact that such other work is to be performed was not noted in the Contract Documents, written notice thereof will be given to the CONTRACTOR prior to commencing any other work.
- B. The CONTRACTOR shall afford each utility owner and other contractor who is a party to a direct contract (or the OWNER, if the OWNER is performing the additional work with the OWNER's employees) proper and safe access to the site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of the other work. The CONTRACTOR shall properly connect and coordinate the WORK with the other work. The CONTRACTOR shall do all cutting, fitting, and patching of the WORK that may be required to make its several parts come together properly and integrate with the other work. The CONTRACTOR shall not endanger any work of others by cutting, excavating, or otherwise altering their work and shall only cut or alter their work with the written consent of the ENGINEER and the others whose work will be affected.
- C. If the proper execution or results of any part of the CONTRACTOR's work depends upon the integration of work with the completion of other work by any other contractor or utility owner (or the OWNER), the CONTRACTOR shall inspect and report to the ENGINEER in writing all delays, defects, or deficiencies in the other work that renders it unavailable or unsuitable for proper integration with the CONTRACTOR's work. Except for the results or effects of latent or nonapparent defects and deficiencies in the other work, the CONTRACTOR's failure to report will constitute an acceptance of the other work as fit and proper for integration with the CONTRACTOR's work and as a waiver of any claim for additional time or compensation associated with the integration of the CONTRACTOR's work with the other work.

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7.02 COORDINATION

- A. If the OWNER contracts with others for the performance of other work on the Project at the site, a coordinator will be identified to the extent that the coordinator can be identified at this time, in the Supplementary General Conditions and delegated the authority and responsibility for coordination of the activities among the various contractors. The specific matters over which the coordinator has authority and the extent of the coordinator's authority and responsibility will be itemized in the Supplementary General Conditions or in a notice to the CONTRACTOR at such time as the identity of the coordinator is determined.

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ARTICLE 8 - OWNER'S RESPONSIBILITIES

8.01 COMMUNICATIONS

- A. The OWNER shall issue all its communications to the CONTRACTOR through the ENGINEER.

8.02 PAYMENTS

- A. The OWNER shall make payments to the CONTRACTOR as provided in Paragraphs 14.05 and 14.09.

8.03 LANDS, EASEMENTS, AND SURVEYS

- A. The 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. The OWNER shall identify and make available to the CONTRACTOR copies of exploration reports and subsurface conditions tests at the site and in existing structures which have been utilized by the ENGINEER in preparing the Drawings and Technical Specifications as set forth in Paragraph 4.02

8.04 CHANGE ORDERS

- A. The OWNER shall execute approved Change Orders for the conditions described in Paragraph 10.01D.

8.05 INSPECTIONS AND TESTS

- A. The OWNER's responsibility with respect to inspection, tests, and approvals is set forth in Paragraph 13.03B.

8.06 SUSPENSION OF WORK

- A. In connection with the OWNER's right to stop work or suspend work, see Paragraphs 13.04 and 15.01. Paragraphs 15.02 and 15.03 deal with the OWNER's right to terminate services of the CONTRACTOR under certain circumstances.

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ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.01 OWNER'S REPRESENTATIVE

- A. The ENGINEER will be the OWNER's representative during the construction period. The duties, responsibilities and the limitations of authority of the ENGINEER as the OWNER's representative during construction are set forth in a separate agreement with the OWNER and are summarized hereafter.

9.02 VISITS TO SITE

- A. The ENGINEER will make visits to the site during construction to observe and inspect the progress and quality of the WORK and to determine, in general if the WORK is proceeding in accordance with the Contract Documents.

9.03 PROJECT REPRESENTATION

- A. The ENGINEER will furnish a Project Representative to observe and inspect the performance of the WORK. The Project Representative and/or other authorized agents of the Engineer shall serve as the chief Owner/Engineer contact(s) with the Contractor during the construction phase. All submittals shall be delivered to and communications between the Engineer and the Contractor shall be handled by the Project Representative and/or other authorized agents. The Project Representative shall be the chief authorized representative of the Owner and the Engineer at the site of the work in all on-site relations with the Contractor.

9.04 CLARIFICATIONS AND INTERPRETATIONS

- A. The ENGINEER will issue with reasonable promptness written clarifications or interpretations of the requirements of the Contract Documents (in the form of Drawings or otherwise) as the ENGINEER may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents.

9.05 AUTHORIZED VARIATIONS IN WORK

- A. The ENGINEER may authorize minor variation in the WORK as described in the Contract Documents when such variations do not involve an adjustment in the Contract Price or the Contract Time and are consistent with the overall intent of the Contract Documents. These variations shall be accomplished by issuing a Field Order. The issuance of a Field Order requires the CONTRACTOR to perform the work described in the order promptly. If the

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CONTRACTOR believes that a Field Order justifies an increase in the Contract Price or an extension of the Contract Time and parties are unable to agree as the amount or extent thereof, the CONTRACTOR may make a claim therefor as provided in Article 11 or 12.

9.06 REJECTION OF DEFECTIVE WORK

- A. The ENGINEER is authorized to reject work which the ENGINEER believes to be defective and require special inspection or testing of the WORK as provided in Paragraph 13.03G, whether or not the WORK is fabricated, installed, or completed.

9.07 CONTRACTOR SUBMITTALS, CHANGE ORDERS, AND PAYMENTS

- A. The ENGINEER will review for approval all Contractor submittals, including shop drawings, samples, substitutes, and "or equal" items, etc., in accordance with the procedures set forth in the Technical Specifications.
- B. In connection with the ENGINEER's responsibilities as to Change Orders, see Articles 10, 11, and 12.
- C. In connection with the ENGINEER's responsibilities with respect to Applications for Payment, see Article 14.

9.08 DECISIONS ON DISPUTES

- A. All claims, disputes, and other matters concerning the acceptability of the WORK, the interpretation of the requirements of the Contract Documents pertaining to the performance of the WORK, and claims for changes in the Contract Price or Contract Time under Articles 11 and 12 will be referred to the ENGINEER in writing with a request for formal decision in accordance with this paragraph. The ENGINEER will render a decision in writing within 30 days of receipt of the request. Written notice of each claim, dispute, or other matter will be delivered by the CONTRACTOR to the ENGINEER promptly (but in no event later than 30 days) after the occurrence of the event. Written supporting data will be submitted to the ENGINEER with the written claim unless the ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim.
- B. When reviewing the claim or dispute, the ENGINEER will not show partiality to the OWNER or the CONTRACTOR and will incur no liability in connection with any interpretation or decision rendered in good faith. The ENGINEER's rendering of a decision with respect to any claim, dispute, or other matter (except any which have been waived by the making or acceptance of final

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payment as provided in Paragraph 14.12) shall be a condition precedent to the OWNER's or the CONTRACTOR's exercise of their rights or remedies under the Contract Documents or by Law or Regulations with respect to the claim, dispute, or other matter.

9.09 LIMITATION ON ENGINEER'S RESPONSIBILITIES

- A. Neither the ENGINEER's authority to act pursuant to its agreement with the OWNER, nor the description of that authority under this Article 9, nor any other description of the ENGINEER's responsibility in the Contract Documents, nor any decision made by the ENGINEER in good faith either to exercise or not exercise its authority, shall give rise to any duty or responsibility on the part of the ENGINEER to the CONTRACTOR, any Subcontractor, any Supplier, any surety or any other person or organization performing any part of the WORK.
- B. Whenever in the Contract Documents the terms "as ordered," "as directed," "as required," "as allowed," "as reviewed," "as approved," or terms of like effect or import are used, or the adjectives "reasonable," "suitable," "acceptable," "proper," or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review, or judgement of the ENGINEER as to the WORK, it is intended that such requirement, direction, review, or judgment will be solely to evaluate the WORK for compliance with the Contract Documents, unless there is a specific statement indicating otherwise. The use of any such term or adjective shall not be effective to assign to the 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 its agreement with the OWNER.
- C. The ENGINEER will not be responsible for the CONTRACTOR's means, methods, techniques, sequences, or procedures of construction not specified in the Contract Documents or the safety precautions and programs incident thereto.
- D. The ENGINEER will not be responsible for the acts or omissions of the CONTRACTOR nor of any subcontractor, supplier, or any other person or organization performing any of the WORK to the extent that such acts or omissions are not reasonably discoverable considering the level of observation and inspection required by the ENGINEER's agreement with the OWNER.

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ARTICLE 10 - CHANGES IN THE WORK

10.01 GENERAL

- A. Without invalidating the Agreement and without notice to any surety, the OWNER may at any time or from time to time, order additions, deletions, or revisions in the WORK; these will be authorized by a written Field Order and/or a Change Order issued by the ENGINEER. Upon receipt of any of these documents, the CONTRACTOR shall promptly proceed with the work involved pursuant to the applicable conditions of the Contract Documents.
- B. If the OWNER and the CONTRACTOR are unable to agree upon the increase or decrease in the Contract Price or an extension or shortening of the Contract Time, if any, that should be allowed as a result of a Field Order, a claim may be made therefor as provided in Articles 11 or 12.
- C. The CONTRACTOR shall not be entitled to an increase in the Contract Price nor an extension of the Contract Time with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented by Change Order, except in the case of an emergency and except in the case of uncovering work provided in the Paragraph 13.03G.
- D. The OWNER and the CONTRACTOR shall execute appropriate Change Orders covering:
 - 1. Changes in the WORK which are ordered by the OWNER pursuant to Paragraph 10.01A;
 - 2. Changes required because of acceptance of defective work under Paragraph 13.06;
 - 3. Changes in the Contract Price or Contract Time which are agreed to by the parties; or
 - 4. Any other changes agreed to by the parties.
- E. If the provisions of any Bond require notice of any change to be given to a surety, the giving of these notices will be the CONTRACTOR's responsibility. The CONTRACTOR shall provide for the amount of each applicable Bond to be adjusted accordingly.

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10.02 ALLOWABLE QUANTITY VARIATIONS

- A. Whenever a unit price and quantity have been established for a bid item in the Contract Documents, the quantity stated may be increased or decreased to a maximum of 25 percent with no change in the unit price. An adjustment in the quantity in excess of 25 percent will be sufficient to justify a change in the unit price. Changes in the quantity of all bid items established in the Contract Documents, regardless of whether the changes are more or less than 25 percent and at the unit price established in the Contract Documents or adjusted otherwise, shall be documented by Change Orders.

- B. In the event a part of the WORK is to be entirely eliminated and no lump sum or unit price is named in the Contract Documents to cover the eliminated work, the price of the eliminated work shall be agreed upon in writing by the OWNER and the CONTRACTOR. If the OWNER and the CONTRACTOR fail to agree upon the price of the eliminated work, the price shall be determined in accordance with the provisions of Article 11.

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ARTICLE 11 - CHANGE OF CONTRACT PRICE

11.01 GENERAL

- A. The Contract Price constitutes the total compensation payable to the CONTRACTOR for performing the WORK. Except as directed by Change Orders, all duties, responsibilities, and obligations assigned to or undertaken by the CONTRACTOR shall be at its expense without change in the Contract Price.

- B. The Contract Price may only be changed by a Change Order. Any claim for an increase in the Contract Price shall be based on written notice delivered by the CONTRACTOR to the ENGINEER promptly (but in no event later than 30 days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the amount of the claim with supporting data shall be delivered with the claim, unless the ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim, and shall be accompanied by the CONTRACTOR's written statement that the amount claimed covers all known amounts (direct, indirect, and consequential) to which the CONTRACTOR is entitled as a result of the occurrence of the event. If the OWNER and the CONTRACTOR cannot otherwise agree on the amount involved, all claims for adjustment in the Contract Price shall be determined by the ENGINEER in accordance with Paragraph 9.08A. No claim for an adjustment in the Contract Price will be valid if not submitted in accordance with this Paragraph 11.01B.

- C. The value of any work covered by a Change Order or of any claim for an increase or decrease in the Contract Price shall be determined in one of the following ways:
 - 1. Where the work involved is covered by unit prices contained in the Contract Documents, by application of unit prices to the quantities of the items involved.
 - 2. By mutual acceptance of a lump sum, which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.
 - 3. On the basis of the cost of work (determined as provided in Paragraphs 11.02 and 11.03) plus a CONTRACTOR's fee for overhead and profit (determined as provided in Paragraph 11.04).

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11.02 COST OF WORK (BASED ON TIME AND MATERIALS)

- A. General: The term "cost of work" means the sum of all costs necessarily incurred and paid by the CONTRACTOR for labor, materials, and equipment in the proper performance of work. Except as otherwise may be agreed to in writing by the OWNER, such costs shall be in amounts no higher than those prevailing in the locality of the Project.
- B. Labor: The cost of labor used in performing work by the CONTRACTOR, a subcontractor, or other forces will be the sum of the following:
1. The actual wages paid plus any employer payments to, or on behalf of workers for fringe benefits including health and welfare, pension, vacation, and similar purposes. The cost of labor may include the rates paid to foremen when determined by the ENGINEER that the services of foremen do not constitute a part of the overhead allowance.
 2. All payments imposed by state and federal laws including, but not limited to, compensation insurance, and social security payments.
 3. The amount paid for subsistence and travel required by collective bargaining agreements, or in accordance with the regular practice of the employer.

At the beginning of the extra work and as later requested by the ENGINEER, the CONTRACTOR shall furnish the ENGINEER proof of labor compensation rates being paid.

- C. Materials: The cost of materials used in performing work will be the cost to the purchaser, whether CONTRACTOR or subcontractor, from the supplier thereof, except as the following are applicable:
1. Trade discounts available to the purchase shall be credited to the OWNER notwithstanding the fact that such discounts may not have been taken by the CONTRACTOR.
 2. For materials secured by other than a direct purchase and direct billing to the purchaser, the cost shall be deemed to be the price paid to the actual supplier as determined by the ENGINEER. Markup except for actual costs incurred in the handling of such materials will not be allowed.

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3. Payment for materials from sources owned wholly or in part by the purchaser shall not exceed the price paid by the purchaser for similar materials from these sources on extra work items or current wholesale price for the materials delivered to the work site, whichever is lower.
 4. If in the opinion of the ENGINEER the cost of material is excessive, or the CONTRACTOR does not furnish satisfactory evidence of the cost of the material, then the cost shall be deemed to be the lowest current wholesale price for the quantity concerned, delivered to the work site less trade discount. The OWNER reserves the right to furnish materials for the extra work and no claim shall be made by the CONTRACTOR for costs and profit on such materials.
- D. Equipment: The CONTRACTOR will be paid for the use of equipment at the rental rate listed for the equipment specified in the Supplementary General Conditions. The rental rate will be used to compute payments for equipment whether the equipment is under the CONTRACTOR's control through direct ownership, leasing, renting, or another method of acquisition. The rental rate to be applied for use of each item of equipment shall be the rate resulting in the least total cost to the Owner for the total period of use. If it is deemed necessary by the CONTRACTOR to use equipment not listed in the Supplementary General Conditions an equitable rental rate for the equipment will be established by the ENGINEER. The CONTRACTOR may furnish cost data which might assist the ENGINEER in the establishing the rental rate.
1. All equipment shall, in the opinion of the ENGINEER, be in good working condition and suitable for the purpose for which the equipment is to be used.
 2. Before construction equipment is used on the extra work, the CONTRACTOR shall plainly stencil or stamp an identifying number thereon at a conspicuous location, and shall furnish to the ENGINEER, in duplicate, a description of the equipment and its identifying number.
 3. Unless otherwise specified, manufacturers' ratings and manufacturer approved modifications shall be used to classify equipment for the determination of applicable rental rates. Equipment which has no direct power unit shall be powered by a unit of at least the minimum rating recommended by the manufacturer.
 4. Individual pieces of equipment or tools having a replacement value of \$100 or less, whether or not consumed by use, shall be considered to be small tools and no payment will be made therefore.

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5. Rental time will not be allowed while equipment is inoperative due to breakdowns.
- E. Equipment on the Work: The rental time to be paid for equipment used on the WORK shall be the time the equipment is in productive operation on the extra work being performed and, in addition, shall include the time required to move the equipment to the location of the extra work and return it to the original location or to another location that requires no more moving time than that required to return it to its original location. Moving time will not be paid if the equipment is used on other than the extra work, even though located at the site of the extra work. Loading and transporting costs will be allowed, in lieu of moving time, when the equipment is moved by means other than its own power. However, no payment will be made for loading and transporting costs when the equipment is used on other than the extra work even though located at the site of the extra work. The following shall be used in computing the rental time of equipment on the WORK.
1. When hourly rates are listed, any part of an hour less than 30 minutes of operation shall be considered to be 1/2-hour of operation, and any part of an hour in excess of 30 minutes will be considered one hour of operation.
 2. When daily rates are listed, any part of a day less than 4 hours operation shall be considered to be 1/2-day of operation. When owner-operated equipment is used to perform extra work to be paid for on a time and materials basis, the CONTRACTOR will be paid for the equipment and operator, as set forth in Paragraph (3), (4), and (5), following.
 3. Payment for the equipment will be made in accordance with the provisions in Paragraph 11.02D, herein.
 4. Payment for the cost of labor and subsistence or travel allowance will be made at the rates paid by the CONTRACTOR to other workers operating similar equipment already on the WORK, or in the absence of such labor, established by collective bargaining agreements for the type of workmen and location of the extra work, whether or not the operator is actually covered by such an agreement. A labor surcharge will be added to the cost of labor described herein in accordance with the provisions of Paragraph 11.02B, herein, which surcharge shall constitute full compensation for payments imposed by state and federal laws and all payments made to on behalf of workers other than actual wages.

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5. To the direct cost of equipment rental and labor, computed as provided herein, will be added the allowances for equipment rental and labor as provided in Paragraph 11.04, herein.

11.03 SPECIAL SERVICES

- A. Special work or services are defined as that work characterized by extraordinary complexity, sophistication, or innovation or a combination of the foregoing attributes which are unique to the construction industry. The following may be considered by the ENGINEER in making estimates for payment for special services:
 1. When the ENGINEER and the CONTRACTOR, by agreement, determine that a special service or work is required which cannot be performed by the forces of the CONTRACTOR or those of any of its subcontractors, the special service or work may be performed by an entity especially skilled in the work to be performed. After validation of invoices and termination of market values by the ENGINEER, invoices for special services or work based upon the current fair market value thereof may be accepted without complete itemization of labor, material, and equipment rental cost.
 2. When the CONTRACTOR is required to perform work necessitating special fabrication or machining process in a fabrication or a machine shop facility away from the job site, the charges for that portion of the work performed at the off-site facility may by agreement, be accepted as a special service and accordingly, the invoices from the work may be accepted without detailed itemization.
 3. All invoices for special services will be adjusted by deducting all trade discounts offered or available, whether the discounts were taken or not. In lieu of the allowances for overhead and profit specified in Paragraph 11.04, herein, an allowance of 5 percent will be added to invoices for special services.
- B. All work performed hereunder shall be subject to all of the provisions of the Contract Documents and the CONTRACTOR's sureties shall be bound with reference hereto as under the original Agreement. Copies of all amendments to surety bonds or supplemental surety bonds shall be submitted to the OWNER for review prior to the performance of any work hereunder.

GENERAL CONDITIONS

11.04 CONTRACTOR'S FEE

- A. WORK ordered on the basis of time and materials will be paid for at the actual necessary cost as determined by the ENGINEER, plus allowances for overhead and profit. For extra work involving a combination of increases and decreases in the WORK the actual necessary cost will be the arithmetic sum of the additive and deductive costs. The allowance for overhead and profit shall include full compensation for superintendence, bond and insurance premiums, taxes, office expenses, and all other items of expense or cost not included in the cost of labor, materials, or equipment provided for under Paragraphs 11.02B, C, and D, herein including extended overhead and home office overhead. The allowance for overhead and profit will be made in accordance with the following schedule:

ACTUAL NECESSARY COST OVERHEAD AND PROFIT ALLOWANCE

Labor	10 percent
Materials	10 percent
Equipment	10 percent

- B. It is understood that labor, materials, and equipment may be furnished by the CONTRACTOR or by the subcontractor, the allowance specified herein shall be applied to the labor, materials, and equipment costs of the subcontractor, to which the CONTRACTOR may add 5 percent of the subcontractor's total cost for the extra work. Regardless of the number of hierarchical tiers of subcontractors, the 5 percent increase above the subcontractor's total cost which includes the allowances for overhead and profit specified herein may be applied one time only for each separate work transaction.

GENERAL CONDITIONS

ARTICLE 12 - CHANGE OF CONTRACT TIME

12.01 GENERAL

- A. The Contract Time may only be changed by a Change Order. Any claim for an extension of the Contract time shall be based on written notice delivered by the CONTRACTOR to the ENGINEER promptly (but in no event later than 30 days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the extent of the claim with supporting data shall be delivered within 30 days after such occurrence (unless the ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by the CONTRACTOR's 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. All claims for adjustment in the Contract Time shall be determined by the ENGINEER in accordance with Paragraph 9.08 if the OWNER and the CONTRACTOR cannot otherwise agree. No claim for an adjustment in the Contract Time will be valid if not submitted in accordance with the requirements of this Paragraph 12.01A.
- B. The Contract Time will be extended in an amount equal to time lost if the CONTRACTOR makes a claim as provided in Paragraph 12.01A and the ENGINEER determines that the delay was caused by events beyond the control of the CONTRACTOR. Examples of events beyond the control of the CONTRACTOR include acts or neglect by the OWNER or others performing additional work as contemplated by Article 7, or by acts of God or of the public enemy, fire, floods, epidemics, quarantine restrictions, strikes, labor disputes, sabotage, or freight embargoes.
- C. All time limits stated in the Contract Documents are of the essence.
- D. None of the aforesaid time extensions shall entitle the CONTRACTOR to any adjustment in the Contract Price or any damages for delay. Furthermore, the CONTRACTOR hereby indemnifies and holds harmless the OWNER and ENGINEER, their officers, agents and employees from and against all claims, damages, losses and expenses (including lost property and attorney's fees) arising out of or resulting from the temporary suspension of work whether for the OWNER's convenience as defined in Article 15.01 (a) or for whatever other reasons including the stoppage of work by the ENGINEER for the CONTRACTOR's failure to comply with any order issued by the ENGINEER.

GENERAL CONDITIONS

12.02 EXTENSIONS OF THE TIME FOR DELAY DUE TO INCLEMENT WEATHER

- A. "Inclement weather" is any weather condition or conditions resulting immediately therefrom, causing the CONTRACTOR to suspend construction operations or preventing the CONTRACTOR from proceeding with at least 75 percent of the normal labor and equipment force engaged on the WORK.
- B. Should the CONTRACTOR prepare to begin work at the regular starting time at the beginning of any regular work shift on any day on which inclement weather, or its effects on the condition of the WORK prevents work from beginning at the usual starting time and the crew is dismissed as a result thereof, the CONTRACTOR will not be charged for a working day whether or not conditions change thereafter during the day and the major portion of the day could be considered to be suitable for construction operations.
- C. The CONTRACTOR shall base its construction schedule upon the inclusion of the number of days of inclement weather specified in the paragraph entitled "Inclement weather delays" of the Supplementary General Conditions. No extension of the Contract Time due to inclement weather will be considered until after the stated number of days of inclement weather has been reached. However, no reduction in Contract Time will be made if the number of inclement weather days is not reached.

12.03 EXTENSIONS OF TIME FOR OTHER DELAYS

- A. If the CONTRACTOR is delayed in completion of the WORK beyond the time named in the Contract Documents for the completion of the WORK, by acts of God or of the public enemy, fire, floods, epidemics, quarantine restrictions, strikes, labor disputes, industry-wide shortage of raw materials, sabotage or freight embargoes, the CONTRACTOR shall be entitled to an adjustment in the Contract Time. No such adjustment will be made unless the CONTRACTOR shall notify the ENGINEER in writing of the causes of delay within 15 calendar days from the beginning of any such delay. The ENGINEER shall ascertain the facts and the extent of the delay. No adjustment in time shall be made for delays resulting from noncompliance with the Contract, accidents, failure on the part of the CONTRACTOR to carry out the provisions of the Contract including failure to provide materials, equipment or workmanship meeting the requirements of the Contract Documents; the occurrence of such events shall not relieve the CONTRACTOR from the necessity of maintaining the required progress.
- B. In the event that Contract completion is delayed beyond the Contract Time named in the Specifications by reason of shortages of raw materials required for CONTRACTOR-furnished items, the CONTRACTOR shall be entitled to

GENERAL CONDITIONS

an adjustment in the Contract Time in like manner as if the WORK had been suspended for the convenience and benefit of the OWNER; provided, however, that the CONTRACTOR shall furnish documentation acceptable to the OWNER and ENGINEER that he placed or attempted to place firm orders with suppliers at a reasonable time in advance of the required date of delivery of the items in question, that such shortages shall have developed following the date such orders were placed or attempts made to place same, that said shortages are general throughout the affected industry, that said shortages are shortages of raw materials required to manufacture CONTRACTOR-furnished items and not simply failure of CONTRACTOR's suppliers to manufacture, assemble or ship items on time, and that the CONTRACTOR shall, to the degree possible, have made revisions in the sequence of his operations, within the terms of the Contract, to offset the expected delay. The CONTRACTOR shall notify the ENGINEER, in writing, concerning the cause of delay, within 15 calendar days of the beginning of such delay. The validity of any claim by the CONTRACTOR to an adjustment in the Contract Time shall be determined by the OWNER acting through the ENGINEER, and his findings thereon shall be based on the ENGINEER's knowledge and observations of the events involved and documentation submitted by the CONTRACTOR, showing all applicable facts relative to the foregoing provisions. Only the physical shortage of raw materials will be considered under these provisions as a cause for adjustment of time and no consideration will be given to any claim that items could not be obtained at a reasonable, practical, or economical cost or price, unless it is shown to the satisfaction of the OWNER that such items could have been obtained only at exorbitant prices entirely out of line with current rates taking into account the quantities involved and the usual practices in obtaining such quantities.

- C. If the CONTRACTOR is delayed in completion of the WORK by reason of changes made under the provisions of Article 10 or changed conditions as provided under Article 4.03, or by failure of the OWNER to acquire or clear right-of-way as provided under Article 15.01, or by any act of the ENGINEER or of the OWNER, not contemplated by the Contract, an adjustment in the Contract time will be made by the OWNER in like manner as if the WORK had been suspended for the convenience and benefit of the OWNER, except, that if the WORK is increased as a result of changes, the OWNER, at his sole discretion, may grant an adjustment in the number of calendar days for completion of the Contract. In the event of such delay, the CONTRACTOR shall notify the ENGINEER in writing of the causes of delay within 15 calendar days from the beginning of any such delay.

GENERAL CONDITIONS

ARTICLE 13 - WARRANTY AND GUARANTEE; TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

13.01 WARRANTY, GUARANTEE AND MAINTENANCE PERIOD

- A. The CONTRACTOR warrants and guarantees to the OWNER and the ENGINEER that all work, equipment, materials and workmanship are in accordance with the Contract Documents and are not defective. Prompt notice of defects discovered by the OWNER or ENGINEER shall be given to the CONTRACTOR. All defective work, whether or not in place, may be rejected, corrected, or accepted as provided in this Article 13.

- B. If within one (1) year after the date of Final Completion, as set by the Engineer's Notice of Completion, or a longer period of time prescribed by Laws or Regulations or by the terms of any applicable special guarantee or specific provisions of the Contract Documents, any work is found to be defective, the OWNER shall notify the CONTRACTOR in writing and the CONTRACTOR shall promptly, without cost to the OWNER and in accordance with the OWNER's written notification, either correct the defective work, or, if it has been rejected by the OWNER, remove it from the site and replace it with non-defective work. In the event the CONTRACTOR does not promptly comply with the notification, or in an emergency where delay would cause serious risk of loss or damage, the OWNER may have the defective work corrected or rejected work removed and replaced. All direct, indirect, and consequential costs of the removal and replacement including but not limited to fees and charges of engineers, architects, attorneys and other professionals will be paid by the CONTRACTOR. This paragraph shall not be construed to limit nor diminish the CONTRACTOR's absolute guarantee to complete the WORK in accordance with the Contract Documents.

13.02 ACCESS TO WORK

- A. The ENGINEER, other representatives of the OWNER, testing agencies, and governmental agencies with jurisdictional interests shall have access to the work at reasonable times for their observation, inspections, and testing. The CONTRACTOR shall provide proper and safe conditions for their access.

GENERAL CONDITIONS

13.03 TESTS AND INSPECTIONS

- A. The CONTRACTOR shall give the ENGINEER timely notice of readiness of the WORK for all required inspections, tests, or approvals.
- B. If Laws or Regulations of any public body other than the OWNER, with jurisdiction over the WORK require any work to be specifically inspected, tested, or approved, the CONTRACTOR shall pay all costs in connection therewith. The CONTRACTOR shall also be responsible for and shall pay all costs in connection with any inspection or testing required in connection with the OWNER's or the ENGINEER's acceptance of a Supplier of materials or equipment proposed as a substitution or-equal to be incorporated in the WORK and of materials or equipment submitted for review prior to the CONTRACTOR's purchase for incorporation in the WORK. The cost of all inspections, tests, and approvals with the exception of the above which are required by the Contract Documents shall be paid by the OWNER (unless otherwise specified).
- C. The ENGINEER will make, or have made, such inspections and test as the ENGINEER deems necessary to see that the WORK is being accomplished in accordance with the requirements of the Contract Documents. The Contractor without additional cost to the OWNER, shall provide the labor and equipment necessary to make the WORK available for inspections. Unless otherwise specified in the Supplementary General Conditions or the OWNER-ENGINEER Agreement, all other costs of inspection and testing will be borne by the OWNER. In the event the inspections or tests reveal non-compliance with the requirements of the Contract Documents, the CONTRACTOR shall bear the cost of corrective measures deemed necessary by the ENGINEER, as well as the cost of subsequent re-inspection and retesting. Neither observations by the ENGINEER nor inspections, tests, or approvals by others shall relieve the CONTRACTOR from the CONTRACTOR's obligation to perform the WORK in accordance with the Contract Documents.
- D. All inspections, tests, or approvals other than those required by Laws or Regulations of any public body having jurisdiction shall be performed by properly licensed organizations selected by the OWNER.

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- E. If any work (including the work of others) that is to be inspected, tested, or approved is covered without the ENGINEER's written authorization, it must, if requested by the ENGINEER, be uncovered for testing, inspection, and observation. The uncovering shall be at the CONTRACTOR's expense unless the CONTRACTOR timely notified the ENGINEER of the CONTRACTOR's intention to cover the same and the ENGINEER failed to act with reasonable promptness in response to the notice.
- F. In any work is covered contrary to the written request of the ENGINEER, it must, if requested by the ENGINEER, be uncovered for the ENGINEER's observation and replaced at the CONTRACTOR's expense.
- G. If the ENGINEER considers it necessary or advisable that covered work be observed, inspected or tested by the ENGINEER or others, the ENGINEER shall direct the CONTRACTOR to uncover, expose, or otherwise make available for observation, inspection, or testing that portion of the work in question. The CONTRACTOR shall comply with the ENGINEER's direction and furnish all necessary labor, material, and equipment. If found the work is defective, the CONTRACTOR shall bear all direct, indirect and consequential costs of uncovering, exposure, observation, inspection, and testing and of satisfactory reconstruction of the work, including but not limited to fees and charges for engineers, architects, attorneys, and other professionals. However, if the work is not defective, the CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both. The increase in Contract Time and Contract Price shall be the CONTRACTOR's actual time and costs directly attributable to uncovering and exposing the work. If the parties are unable to agree as to the amount or extent of the changes, the CONTRACTOR may make a claim therefor as provided in Articles 11 and 12.

13.04 OWNER MAY STOP THE WORK

- A. If the WORK is defective, or the CONTRACTOR fails to perform work in such a way that the completed WORK will conform to the Contract Documents, the OWNER may order the CONTRACTOR to stop the WORK, or any portion thereof, until the cause for the order has been eliminated. This right of the OWNER to stop the WORK shall not give rise to any duty on the part of the OWNER to exercise this right for the benefit of the CONTRACTOR or any other party.

13.05 CORRECTION OR REMOVAL OF DEFECTIVE WORK

- A. When directed by the ENGINEER, the CONTRACTOR shall promptly correct all defective work, whether or not fabricated, installed, or completed, or, if the

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work has been rejected by the ENGINEER, remove it from the site and replace it with non-defective work. The CONTRACTOR shall bear all direct, indirect and consequential costs of correction or removal, including but not limited to fees and charges of engineers, architects, attorneys, and other professionals made necessary thereby.

13.06 ACCEPTANCE OF DEFECTIVE WORK

- A. If, instead of requiring correction or removal and replacement of defective work, the OWNER prefers to accept the work, the OWNER may do so. The CONTRACTOR shall bear all direct, indirect, and consequential costs attributable to the OWNER's evaluation of and determination to accept the defective work. If any acceptance of defective work occurs prior to final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the WORK, and the OWNER shall be entitled to an appropriate decrease in the Contract Price.

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ARTICLE 14 - PAYMENTS TO CONTRACTOR, LIQUIDATED DAMAGES AND COMPLETION

14.01 SCHEDULE OF VALUES (LUMP SUM PRICE BREAKDOWN)

- A. The schedule of values or lump sum price breakdown established as provided in the Technical Specifications shall serve as the basis for progress payments and will be incorporated into the form of Application for Payment included in the Contract Documents.

14.02 UNIT PRICE BID SCHEDULE

- A. Progress payments for unit price work will be based on the number of units completed.

14.03 APPLICATION FOR PROGRESS PAYMENT

- A. Unless otherwise prescribed by the Owner, on the 25th of each month, the CONTRACTOR shall submit to the ENGINEER for review and approval, an Application for Payment completed and signed by the CONTRACTOR covering the WORK completed as of the date of the Application and accompanied by such supporting documentation as required by the Contract Documents.
- B. The Application for Payment shall identify, as a sub-total, the amount of the CONTRACTOR's Total Earnings to Date, plus the Value of Materials at the Site which have not yet been incorporated in the WORK, and less a deductive adjustment for materials installed which were not previously incorporated in the WORK, but for which payment was allowed under the provisions of payment for Materials Stored at the Site but not yet incorporated in the WORK.
- C. The Net Payment Due to the CONTRACTOR shall be the above-mentioned sub-total, from which shall be deducted the retainage amount and the total amount of all previous payments made to the CONTRACTOR.
- D. The OWNER may withhold and retain 5% of each approved progress payment to the CONTRACTOR. The total retention proceeds withheld shall not exceed 5% of the total construction price. All retention proceeds shall be placed by the OWNER in an interest-bearing account. The interest accrued shall be for the benefit of the CONTRACTOR and its subcontractors, and it shall be paid after the WORK has been completed and accepted by the OWNER. CONTRACTOR shall ensure that any interest accrued on the

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retainage is distributed by the CONTRACTOR to its subcontractors on a pro rata basis.

- E. Any retention proceeds withheld, and any accrued interest, shall be released by the OWNER pursuant to an Application for Payment from the CONTRACTOR within 45 days from the later of:
1. the date the OWNER receives the final Application for Payment from the CONTRACTOR;
 2. the date that a certificate of occupancy or final acceptance notice is issued to:
 - (a) the Contractor who obtained the building permit from the building inspector or from a public agency;
 - (b) the OWNER; or
 - (c) the ENGINEER.
 3. the date the CONTRACTOR accepts final payment for the Work; or
 4. the date that a public agency or building inspector having authority to issue its own certificate of occupancy does not issue the certificate but permits partial or complete occupancy of a newly constructed or remodeled building; provided, however, that if only partial occupancy of a building is permitted, any retention proceeds withheld and retained, and any accrued interest, shall be partially released in direct proportion to the value of the part of the building occupied.

Each Application for Payment from the CONTRACTOR shall include documentation of lien releases or waivers.

- F. Notwithstanding any other provision in this Article to the contrary,
1. If the CONTRACTOR is in default or breach of the terms and conditions of the Contract Documents, the OWNER may withhold from payment to the CONTRACTOR for so long as reasonably necessary an amount necessary to cure the breach or default of the CONTRACTOR; or
 2. If the WORK or a portion of the WORK has been substantially completed, the OWNER may retain until completion up to twice the

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fair market value of the WORK of the CONTRACTOR that has not been completed:

- (a) in accordance with the Contract Documents; or
- (b) in the absence of applicable provisions in the Contract Documents to generally accepted craft standards.

- 3. If the OWNER refuses payment under subparagraphs (F)(i) or (ii), it shall describe in writing within 45 days of withholding such amounts what portion of the WORK was not completed according to the standards specified in the Contract Documents.

G. The CONTRACTOR shall distribute retention proceeds as outlined below:

- 1. Except as provided in Paragraph 14.03.G.2, below, if the CONTRACTOR receives retention proceeds, it shall pay each of its subcontractors from whom retention has been withheld each subcontractor's share of the retention received within ten days from the day that all or any portion of the retention proceeds is received from the OWNER.
- 2. Notwithstanding Paragraph 14.03.G.1, above, if a retention payment received by the CONTRACTOR is specifically designated for a particular subcontractor, payment of the retention shall be made to the designated subcontractor.

H. Except as otherwise provided in the Supplementary General Conditions, the value of materials stored at the site shall be valued at 95 percent of the value of the materials. This amount shall be based upon the value of all acceptable materials and equipment stored at the site or at another location agreed to in writing by the OWNER; provided, each individual item has a value of more than \$5,000 and will become a permanent part of the WORK. The Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that the CONTRACTOR has received the materials and equipment free and clear of all liens, charges, security interests, and encumbrances (which are hereinafter in these General Conditions referred to as "Liens") and evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect the OWNER's interest therein, all of which will be satisfactory to the OWNER.

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14.04 CONTRACTOR'S WARRANTY OF TITLE

- A. The CONTRACTOR warrants and guarantees that title to all work, materials, and equipment covered by an Application for Payment, whether incorporated in the WORK or not, will pass to the OWNER no later than the time of final payment free and clear of all liens.

14.05 REVIEW OF APPLICATIONS FOR PROGRESS PAYMENT

- A. The ENGINEER will, within 7 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to the OWNER, or return the Application to the CONTRACTOR indicating in writing the ENGINEER's reasons for refusing to recommend payment. In the later case, the CONTRACTOR may make the necessary corrections and resubmit the Application. Thirty days after presentation of the Application for Payment with the ENGINEER's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.05B) become due and when due will be paid by the OWNER to the CONTRACTOR.
- B. The OWNER may refuse to make payment of the full amount recommended by the ENGINEER to compensate for claims made by the OWNER on account of the CONTRACTOR's performance of the WORK or other items entitling the OWNER to a credit against the amount recommended, but the OWNER must give the CONTRACTOR written notice within 7 days (with a copy to the ENGINEER) stating the reasons for such action.

14.06 PARTIAL UTILIZATION

- A. The OWNER may utilize or place into service any item of equipment or other usable portion of the WORK at any time prior to completion of the WORK. The OWNER shall notify the CONTRACTOR in writing of its intent to exercise this right. The notice will identify the equipment or specific portion or portions of the WORK to be utilized or otherwise placed into service.
- B. It shall be understood by the CONTRACTOR that until such written notification is issued, all responsibility for care and maintenance of all items or portions of the WORK to be partially utilized shall be borne by the CONTRACTOR. Upon the issuance of a notice of partial utilization, the ENGINEER will deliver to the OWNER and the CONTRACTOR a written recommendation as to division of responsibilities between the OWNER and the CONTRACTOR with respect to security, operation, safety, maintenance,

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heat, utilities and insurance. Upon the OWNER's acceptance of these recommendations, the ENGINEER's aforesaid recommendation will be binding on the OWNER and the CONTRACTOR until final payment.

- C. The CONTRACTOR shall retain full responsibility for satisfactory completion of the WORK, regardless of whether a portion thereof has been partially utilized by the OWNER and the CONTRACTOR's one year correction period shall commence only after the date of Final Completion for the WORK.

14.07 LIQUIDATED DAMAGES

- A. The CONTRACTOR shall pay to the OWNER the amount specified in the Supplemental General Conditions, not as a penalty but as liquidated damages, if he fails to complete the WORK or specified parts of the WORK within the time or times agreed upon. The periods for which these damages shall be paid shall be the number of Days from the agreed date or Contract Time as contained in the Agreement, or from the date of termination of any extension of time approved by the OWNER, to the date or dates on which the ENGINEER certifies Substantial Completion of WORK or specified parts of the WORK as provided in Article 14.08, herein. The OWNER may deduct the amount of said damages from any monies due or to become due the CONTRACTOR. After Substantial Completion, if the CONTRACTOR fails to complete the remaining WORK within 45 days or any proper extension thereof granted by OWNER, CONTRACTOR shall pay OWNER the amount stated in the Supplemental General Conditions as liquidated damages for each day that expires after the 45 days until readiness for final payment.
- B. The said amount is fixed and agreed upon by and between the CONTRACTOR and the OWNER because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the OWNER would sustain; and said amount is agreed to be the amount of damages which the OWNER would sustain. Said damages are not in lieu of but in addition to other actual or consequential damages to which the OWNER may be entitled.
- C. All times specified in the Contract Documents are hereby declared to be of the essence.

14.08 SUBSTANTIAL COMPLETION

- A. When the CONTRACTOR considers the WORK ready for its intended use, and the CONTRACTOR has delivered to the ENGINEER all maintenance and operating instructions, schedules, guarantees, bonds, certificates of

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inspection, marked-up record documents and other documents, all as required by the Contract Documents, the CONTRACTOR may notify the OWNER and the ENGINEER in writing that the WORK is substantially complete and request that the ENGINEER prepare a Certificate of Substantial Completion. Within a reasonable time thereafter, the OWNER, the CONTRACTOR, and the ENGINEER shall make an inspection of the WORK to determine the status of completion. If the ENGINEER does not consider the WORK substantially complete, the ENGINEER will notify the OWNER and CONTRACTOR in writing giving the reasons therefor. If the ENGINEER considers the WORK substantially complete, the ENGINEER will prepare and deliver to the OWNER for its execution the Certificate of Substantial Completion signed by the ENGINEER and CONTRACTOR, which shall fix the date of Substantial Completion.

- B. The Certificate of Substantial Completion shall be a release by the CONTRACTOR of the OWNER and its agents from all claims and liability to the CONTRACTOR for anything done or furnished for, or relating to, the WORK or for any act or neglect of the OWNER or of any person relating to or affecting the WORK, to the date of Substantial Completion, except demands against the OWNER for the remainder of the amounts kept or retained from progress payments and excepting pending, unresolved claims filed in writing prior to the date of Substantial Completion. At the time of delivery of the Certificate of Substantial Completion, the ENGINEER will deliver to the OWNER and the CONTRACTOR, if applicable, a written recommendation as to division of responsibilities between the OWNER and the CONTRACTOR with respect to security, operation, safety, maintenance, heat, utilities and insurance. Upon the OWNER's acceptance of these recommendations, the ENGINEER's recommendation will be binding on the OWNER and the CONTRACTOR until final payment.
- C. The OWNER, upon written notice to the CONTRACTOR, shall have the right to exclude the CONTRACTOR from the WORK after the date of Substantial Completion, and complete all or portions of the WORK at the CONTRACTOR's expense.

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14.09 COMPLETION AND FINAL PAYMENT

- A. Upon written certification from the CONTRACTOR that the WORK is complete (if a Certificate of Substantial Completion has been issued this certification must occur within 45 days of that date), the ENGINEER will make a final inspection with the OWNER and the CONTRACTOR. If the OWNER and ENGINEER do not consider the WORK complete, the ENGINEER will notify the OWNER and the CONTRACTOR in writing of all particulars in which this inspection reveals that the WORK is incomplete or defective. The CONTRACTOR shall immediately take the measures necessary to remedy these deficiencies. If the ENGINEER and OWNER consider the WORK complete, the CONTRACTOR may proceed to file its application for final payment pursuant to this Article. At the request of the CONTRACTOR, the ENGINEER may recommend to the OWNER that certain minor deficiencies in the WORK that do not prevent the entire WORK from being used by the OWNER for its intended use, and the completion of which will be unavoidably delayed due to no fault of the CONTRACTOR, be exempted from being completed prerequisite to final payment. These outstanding items of pickup work, or "punch list items", shall be listed on the ENGINEER's Notice of Completion, together with the recommended time limits for their completion, and extended warranty requirements for those items and the value of such items.
- B. After the issuance of the Notice of Completion and after the CONTRACTOR has completed corrections that have not been exempted to the satisfaction of the ENGINEER and delivered to the ENGINEER all required additions and modifications to maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, marked-up record documents and other documents, all as required by the Contract Documents; and after the ENGINEER has indicated that the WORK is acceptable, the CONTRACTOR may make application for final payment following the procedure for progress payments. The final application for payment shall be accompanied by all documentation called for in the Contract Documents and other data and schedules as the OWNER or ENGINEER may reasonably require, including an affidavit of the CONTRACTOR that all labor, services, material, equipment and other indebtedness connected with the WORK for which the OWNER or his property might in any way be responsible, have been paid or otherwise satisfied, and a consent of the payment bond surety to final payment, all in forms approved by the OWNER.

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14.10 FINAL APPLICATION FOR PAYMENT

- A. If, on the basis of the ENGINEER's observation of the WORK during construction and final inspection, and the ENGINEER's review of the final application for payment and accompanying documentation, all as required by the Contract Documents, the ENGINEER is satisfied that the WORK has been completed and the CONTRACTOR has fulfilled all of his obligations under the Contract Documents, the ENGINEER will, within ten days after receipt of the final application for payment, indicate in writing his recommendation of payment and present the application to the OWNER for payment. Thereupon, the ENGINEER will give written notice to the OWNER and the CONTRACTOR that the WORK is acceptable by executing the ENGINEER's Notice of Completion. Otherwise, the ENGINEER will return the application to the CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case the CONTRACTOR shall make the necessary corrections and resubmit the application.
- B. Within 45 calendar days after the ENGINEER's filing of the Notice of Completion, the OWNER will make final payment including all deducted retainage (except as noted below) to the CONTRACTOR. The OWNER's remittance of final payment shall be the OWNER's acceptance of the WORK if formal acceptance of the WORK is not indicated otherwise. The final payment shall be that amount remaining after deducting all prior payments and all amounts to be kept or retained under the provisions of the Contract, including the following items:
1. Liquidated damages, as applicable.
 2. All amounts retained by the OWNER under Paragraph 14.03(F).

14.11 CONTRACTOR'S CONTINUING OBLIGATIONS

- A. The CONTRACTOR's obligation to perform and complete the WORK in accordance with the Contract Documents shall be absolute. Neither recommendation of any progress or final payment by the ENGINEER, nor the issuance of a Certificate of Substantial Completion or Notice of Completion, nor payment by the OWNER to the CONTRACTOR under the Contract Documents, nor any use or occupancy of the WORK or any part thereof by the OWNER, nor any act of acceptance by the OWNER nor any failure to do so, nor any review of a shop drawing or sample submittal, will constitute an acceptance of work or materials not in accordance with the Contract Documents or a release of the CONTRACTOR's obligation to perform the WORK in accordance with the Contract Documents.

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14.12 FINAL PAYMENT TERMINATES LIABILITY OF OWNER

- A. Final payment is defined as the last progress payment made to the CONTRACTOR for earned funds, less deductions listed in Paragraph 14.10B herein. The acceptance by the CONTRACTOR of the final payment referred to in Paragraph 14.10 herein, shall be a release of the OWNER and its agents from all claims of liability to the CONTRACTOR for anything done or furnished for, or relating to, the work or for any act or neglect of the OWNER or of any person relating to or affecting the work, except demands against the OWNER for the remainder, if any, of the amounts kept or retained under the provisions of Paragraph 14.10 herein; and excepting pending, unresolved claims filed prior to the date of the Certificate of Substantial Completion.

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ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

15.01 SUSPENSION OF WORK BY OWNER

- A. The OWNER acting through the ENGINEER may, by written notice to the Contractor, temporarily suspend the WORK, in whole or in part, for a period or periods of time, but not to exceed 90 days, for the convenience and benefit of the OWNER upon the occurrence of any one or more of the following: (1) unsuitable weather; (2) delay in delivery of OWNER- furnished equipment or materials, or such other conditions as are considered unfavorable for prosecution of the work; (3) Shortfall in construction funds; (4) Constraints imposed by public entities, public utilities, property owners or legal proceedings; (5) Failure or delay in acquisition of easements or right-of-way by the OWNER; or (6) Other conditions which, in the opinion of the OWNER, warrant a delay in the WORK. Suspended WORK shall be resumed by the CONTRACTOR within 10 calendar days of receipt from the ENGINEER of written notice to proceed. Whenever the OWNER temporarily suspends work for any conditions enumerated in this Article 15.01 A, the CONTRACTOR shall be entitled to an adjustment in the Contract Time as specified in Article 12.03 C.

- B. The suspension of work shall be effective upon receipt by the Contractor of the written order suspending the work and shall be terminated upon receipt by the Contractor of the written order terminating the suspension.

- C. The CONTRACTOR hereby indemnifies and holds harmless the OWNER and ENGINEER, their officers, agents and employees, from and against all claims, damages, losses and expenses, including lost profits and attorney's fees, arising out of or resulting from the temporary suspension of the WORK, whether for the OWNER's convenience described in this Article or for whatever other reasons, including the stoppage of work by the ENGINEER for the CONTRACTOR's failure to comply with any order issued by the ENGINEER.

15.02 TERMINATION OF AGREEMENT BY OWNER (CONTRACTOR DEFAULT)

- A. In the event of default by the CONTRACTOR, the OWNER may give written notice to the CONTRACTOR of OWNER's intent to terminate the Agreement. The notice shall state the event of default and the time allowed to remedy the default. It shall be considered a default by the CONTRACTOR whenever the CONTRACTOR shall: (1) declare bankruptcy, become insolvent, or assign its assets for the benefit of its creditors; (2) fail to provide materials or workmanship meeting the requirements of the Contract Documents; (3) disregard or violate provisions of the Contract Documents or ENGINEER's

GENERAL CONDITIONS

instructions, (4) fail to prosecute the WORK according to the approved progress schedule; or, (5) fail to provide a qualified superintendent, competent workmen, or materials or equipment meeting the requirements of the Contract Documents. If the CONTRACTOR fails to remedy the conditions constituting default within the time allowed, the OWNER may then issue a Notice of Termination.

- B. In the event the Agreement is terminated in accordance with Paragraph 15.02A, the OWNER may take possession of the WORK and may complete the WORK by whatever method or means the OWNER may select. The cost of completing the WORK shall be deducted from the balance which would have been due the CONTRACTOR had the Agreement not been terminated and the WORK completed in accordance with the Contract Documents. If such cost exceeds the balance which would have been due, the CONTRACTOR shall pay the excess amount to the OWNER. If such cost is less than the balance which would have been due, the CONTRACTOR shall have no claim to the difference.

15.03 TERMINATION OF AGREEMENT BY OWNER (FOR CONVENIENCE)

- A. The OWNER may terminate the Agreement at any time if it is found that reasons beyond the control of either the OWNER or CONTRACTOR make it impossible or against the OWNER's interests to complete the WORK. In such a case, the CONTRACTOR shall have no claims against the OWNER except: (1) for the value of the work, as determined by the engineer, performed by the Contractor up to the date the Agreement is terminated; and, (2) for the cost of materials and equipment on hand, in transit, or on definite commitment, as of the date the Agreement is terminated, which would be needed in the WORK and which meet the requirements of the Contract Documents. The value of work performed and the cost of materials and equipment delivered to the site, as mentioned above, shall be determined by the ENGINEER in accordance with the procedure prescribed from making the final application for payment and final payment under Paragraphs 14.09 and 14.10.

15.04 TERMINATION OF AGREEMENT BY CONTRACTOR

- A. The CONTRACTOR may terminate the Agreement upon 10 days written notice to the OWNER, whenever: (1) the WORK has been suspended under the provisions of Paragraph 15.01, for more than 90 consecutive days through no fault or negligence of the CONTRACTOR, and notice to resume work or to terminate the agreement has not been received from the OWNER within this time period; or, (2) the OWNER should fail to pay the

GENERAL CONDITIONS

CONTRACTOR any monies due him in accordance with the terms or the Contract Documents and within 60 days after presentation to the OWNER by the CONTRACTOR of a request therefor, unless within said 10-day period the OWNER shall have remedied the condition upon which the payment delay was based. In the event of such termination, the CONTRACTOR shall have no claims against the OWNER except for those claims specifically enumerated in Paragraph 15.03, and as determined in Accordance with the requirements of that paragraph.

GENERAL CONDITIONS

ARTICLE 16 - MISCELLANEOUS

16.01 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 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 if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

16.02 TITLE TO MATERIALS FOUND ON THE WORK

- A. The OWNER reserves the right to retain title to all soils, stone, sand, gravel, and other materials developed and obtained from excavations and other operations connected with the WORK. Unless otherwise specified in the Contract Documents, neither the CONTRACTOR nor any subcontractor shall have any right, title, or interest in or to any such materials. The CONTRACTOR will be permitted to use in the WORK, without charge, any such materials which meet the requirements of the Contract Documents.

16.03 RIGHT TO AUDIT

- A. If the CONTRACTOR submits a claim to the OWNER for additional compensation, the OWNER shall have the right, as a condition to considering the claim, and as a basis for evaluation of the claim, and until the claim has been settled, to audit the CONTRACTOR's books. This right shall include the right to examine books, records, documents, and other evidence and accounting procedures and practices, sufficient to discover and verify all direct and indirect costs of whatever nature claimed to have been incurred or anticipated to be incurred and for which the claim has been submitted. The right to audit shall include the right to inspect the CONTRACTOR's plants, or such parts thereof, as may be or have been engaged in the performance of the WORK. The CONTRACTOR further agrees that the right to audit encompasses all subcontracts and is binding upon subcontractors. The right to examine and inspect herein provided for shall be exercisable through such representatives as the OWNER deems desirable during the CONTRACTOR's normal business hours at the office of the CONTRACTOR. The CONTRACTOR shall make available to the OWNER for auditing, all relevant accounting records and documents, and other financial data, and upon request, shall submit true copies of requested records to the OWNER.

16.04 ASBESTOS

- A. If the CONTRACTOR during the course of work observes the existence of asbestos in any structure or building, the CONTRACTOR shall promptly notify the OWNER and the ENGINEER. The OWNER shall consult with the ENGINEER regarding removal or encapsulation of the asbestos material and the CONTRACTOR shall not perform any work pertinent to the asbestos material prior to receipt or special instruction from the OWNER through the ENGINEER.

SUPPLEMENTAL GENERAL CONDITIONS

ARTICLE 17- GENERAL

17.01 GENERAL

1. These Supplemental General Conditions amend or supplement the General Conditions of the Contract and any other provisions of the Contract Documents as indicated herein. All provisions which are not so amended or supplemented remain in full force and effect.
2. The terms used in these Supplemental General Conditions which are defined in the General Conditions of the Contract have the meanings assigned to them in the General Conditions of the Contract herein.

17.02 SUPPLEMENTAL DEFINITIONS

1. ENGINEER

The "Engineer" is

Hansen, Allen & Luce, Inc
859 W. South Jordan Parkway
South Jordan, Utah 84095
(801) 566-5599

17.03 TESTING COSTS

1. Paragraph 13.03 of the General Conditions is amended as follows: the CONTRACTOR shall pay all testing costs. The Owner reserves the right to have additional tests performed by a testing organization selected by the OWNER and at the OWNER's expense.

SUPPLEMENTAL GENERAL CONDITIONS

ARTICLE 18 - AMOUNTS OF LIQUIDATED DAMAGES, BONDS AND INSURANCE

18.01 AMOUNT OF LIQUIDATED DAMAGES

- A. As provided in Article 14.07 of the General Conditions, the Contractor shall pay to the Owner as liquidated damages the amount of \$500 for each calendar day's delay beyond the Contract Time for substantial completion, liquidated damages shall apply to each site stipulated in the Contract Documents. The Contractor shall pay to the Owner as liquidated damages the amount of \$100 for each calendar day's delay beyond 45 calendar days from the date of substantial Completion until the Engineer issues the Notice of Final Completion.

18.02 PERFORMANCE AND OTHER BOND AMOUNTS

- A. The CONTRACTOR shall furnish a satisfactory Performance Bond in the amount of 100 percent of the Contract Price and a satisfactory Payment Bond in the amount of 100 percent of the Contract Price.

18.03 INSURANCE AMOUNTS

The limits of liability for the insurance required by Paragraph 5.02 of the General Conditions shall provide for not less than the following amounts or greater where required by Laws and Regulations:

- A. Workers' Compensation under Paragraph 5.02B.1 of the General Conditions:

- 1. State: Utah Statutory

- B. Comprehensive General Liability: (under Paragraph 5.02B.2 of the General Conditions):

- 1. Bodily Injury (including completed operations and products liability):

<u>\$ 500,000</u>	Each Occurrence
<u>\$ 1,000,000</u>	Annual Aggregate

Property Damage:

<u>\$ 500,000</u>	Each Occurrence
<u>\$ 1,000,000</u>	Annual Aggregate
or a combined single limit of	<u>\$1,000,000</u>

SUPPLEMENTAL GENERAL CONDITIONS

2. Property Damage liability insurance including, Explosion, Collapse and Underground coverages, where applicable.

3. Personal Injury, with employment exclusion deleted

\$ 1,000,000

Annual Aggregate

C. Comprehensive Automobile Liability: (Under Paragraph 5.02B.3 of the General Conditions:)

1. Bodily Injury

\$ 500,000

Each Person

\$ 1,000,000

Each Occurrence

2. Property Damage:

\$ 500,000

Each Occurrence

or combined single limit of

\$1,000,000

D. Builders Risk: Not required.

SUPPLEMENTAL GENERAL CONDITIONS

ARTICLE 19 - PHYSICAL CONDITIONS AND WEATHER DELAYS

19.01 INCLEMENT WEATHER DELAYS

- A. The Contractor's construction schedule shall be based upon the inclusion of at least fifteen (15) day(s) of inclement weather delays. Reference Article 12, paragraph 12.02 of the General Conditions for additional requirements.

SUPPLEMENTAL GENERAL CONDITIONS

ARTICLE 20 - SUBCONTRACT LIMITATIONS

20.01 SUBCONTRACT LIMITATIONS

- A. In addition to the provisions of Paragraph 6.05 of the General Conditions, the CONTRACTOR shall perform not less than 20 percent of the WORK with its own forces (i.e., without subcontracting). The 20 percent requirement shall be understood to refer to the WORK, the value of which totals not less than 20 percent of the Contract Price.

ARTICLE 21 - MISCELLANEOUS

21.01 PATENTS AND COPYRIGHTS

The Contractor shall indemnify and save harmless the Owner, the Engineer, and their officers, agents, and employees, against all claims or liability arising from the use of any patented or copyrighted design, device, material, or process by the Contractor or any of his subcontractors in the performance of the work.

ARTICLE 22 – FEDERAL REQUIREMENTS

22.01 GENERAL

1.01 SUMMARY

- A. This is a federally funded project. All bidders are required to take affirmative steps to assure compliance with special conditions set forth by the Department of the Interior (DOI). These conditions are in addition to all other bid requirements and are outlined in this Section. These regulations include compliance with regulations associated with, but not limited to Disadvantaged Business Enterprise (DBE), Equal Employment Opportunity, Buy America Domestic Procurement preference, and Davis Bacon Prevailing Wage Requirements.
- B. The Bidder shall ensure, to the fullest extent possible, that at least the negotiated "Fair Share" objectives of Federal funds for prime contracts or subcontracts for supplies, construction, equipment, or professional services are made available to minority and women owned or controlled organizations or businesses. The "Fair Share" objectives are as follows for each category of procurement:

Category	MBE	WBE
Professional Services	0.5%	0.5%
Supplies	0.25%	0.25%
Equipment	0.25%	0.25%
Construction	4.0%	2.0%

- C. The BIDDER/CONTRACTOR agrees to include in its bid documents the "Fair Share" objectives and require all of its sub-contractors to include in their bid documents for sub-contracts the "Fair Share" objectives. The Bidder shall be prepared to provide documentation supporting compliance with these requirements. This documentation should include a log that lists dates and times of verbal, written, and faxed correspondence, telephone logs, a list of companies contacted and contact person with that company, notes of to whom bid packages were sent, responses from firms contacted, a list of bids or quotes received and which sub-bidders will be used, etc. If an MBE/WBE, which submitted a bid/quote was not selected, state the reason for not selecting them. Upon request, after the bid opening and before the contract is awarded, the Bidder will provide all relevant information to the Owner [Borrower] who will provide the same information to the Division of Drinking Water, Department of Environmental Quality, and DOI for evaluation.
- D. Every BIDDER must sign the DBE "CERTIFICATION – SIGNATURE" page and SUBMIT said page with his/her BID. If the BIDDER fails to submit the "CERTIFICATION – SIGNATURE" page with his/her bid prior to Award of Contract, the bid will be disqualified. If this occurs the Borrower will be required to select the next low bidder and will require that bidder to provide the above-described documentation.

- E. To evaluate compliance with the "Fair Share" policy, the CONTRACTOR also agrees to comply with the following six affirmative steps:
 - 1. Include all DBEs including: Small, Minority and Women Owned Businesses (MBE/WBE) on solicitation lists.
 - 2. Assure that DBEs are solicited whenever they are potential sources.
 - 3. Divide total requirements, when economically feasible, into small tasks or quantities to permit maximum participation by DBEs.
 - 4. Establish delivery schedules, when the requirements of the work will permit, which will encourage participation by DBEs.
 - 5. Use the services of the Small Business Administration and the Minority Business Development Agency of the United States Department of Commerce, as appropriate.
 - 6. Require the Contractor to make the good faith efforts in subparagraphs "a" through "e" if the Contractor awards sub-agreements.
- F. The Bidder shall submit EPA Form 5700-52A, "MBE/WBE Utilization under Federal Grants, Cooperative Agreements, and Interagency Agreements" on a semi-annual basis based on the Federal Fiscal Year.
- G. The contractor shall not discriminate on the basis of race, color, national origin or sex in the performance of this contract. The contractor shall carry out applicable requirements of 40 CFR Part 33 in the award and administration of contracts awarded under DOI financial assistance agreements. Failure by the contractor to carry out these requirements is a material breach of this contract which may result in the termination of this contract or other legally available remedies.

22.02 DISADVANTAGED BUSINESS ENTERPRISE (DBE) UTILIZATION

2.01 GENERAL

- A. This project includes federal financial assistance. The Contractor/Bidder is required to make good faith efforts with adequate documentation to include disadvantaged business enterprises (DBEs) as subcontractors or suppliers on this project. More detailed regulations are published under 40 CFR Part 33.

2.02 DBE CERTIFICATION

- A. DBEs include minority business enterprises (MBEs) and women's business enterprises (WBEs). MBEs and WBEs must be independently certified as such in order to participate as a DBE. Certification can be obtained through the Utah Department of Transportation (UDOT) or other valid government or private organizations. UDOT maintains their list of certified DBE firms on the internet at the following URL: <https://www.udot.utah.gov/connect/business/civil-rights/>. You should review this internet page to get the most recent list of UDOT certified DBE firms. If a desired DBE is not certified through UDOT, the DBE should submit a copy of their independent certification to UDOT for review. If a desired DBE does not currently have an independent DBE certification, they can contact EPA Region

8's acting DBE coordinator, Jennifer Hale at hale.jennifer@epa.gov or (303) 312.6564 to obtain information on certification through EPA.

2.03 GOOD FAITH EFFORTS

- A. The Contractor/Bidder shall make the following good faith efforts when soliciting contractors, subcontractors, or suppliers to procure construction, equipment, services, and supplies on this project:
1. Ensure DBEs are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities. For Indian Tribal, State, Local, and Government recipients, this will include placing DBEs on solicitation lists and soliciting them whenever they are potential sources.
 2. Make information on forthcoming opportunities available to DBEs and arrange time frames for contracts and establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by DBEs in the competitive process. This includes, whenever possible, posting solicitations for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date.
 3. Consider in the contracting process whether firms competing for large contracts could subcontract with DBEs. For Indian Tribal, State and local Government recipients, this will include dividing total requirements when economically feasible into smaller tasks or quantities to permit maximum participation by DBEs in the competitive process.
 4. Encourage contracting with a consortium of DBEs when a contract is too large for one of these firms to handle individually.
 5. Use the services and assistance of the SBA and the Minority Business Development Agency of the Department of Commerce.
 6. If the prime contractor awards subcontracts, require the prime contractor to take the steps in paragraphs (a) through (e) of this section.
 7. Failure to comply with the six DBE Good Faith Efforts can be considered grounds for determining a bid to be non-responsive.

2.04 FAIR SHARE OBJECTIVE

- A. DBE share objective percentages are set forth below. These are goals, not quotas. The requirement is that the Contractor/Bidder shall show and document good faith efforts to solicit DBE participation. The goals are:

Category	MBE	WBE
Construction	4.0%	2.0%
Equipment	0.25%	0.25%
Services	0.50%	0.50%
Supplies	0.25%	0.25%

2.05 DOCUMENTATION FOR BIDDER TO SUBMIT WITH BID

- A. Contractor/Bidder **shall submit documentation with its bid** to demonstrate compliance with good faith effort requirements. Examples of documentation include copies of advertisements in journals and newspapers, telephone logs,

and/or direct correspondence. The attached "Disadvantaged Business Enterprise Bidder Good Faith Effort Documentation" form may be used as part of the documentation.

- B. Contractor/Bidder shall submit with its bid a "bidders list" of all firms that provided Contractor/Bidder a bid or quote on this project. The bidders list shall include both DBE and non-DBE bidders. Required information for each bidder includes 1) entity's name and point of contact, 2) entity's mailing address, telephone number, and e-mail address, 3) procurement on which entity bid or quoted and when, and 4) entity's status as a MBE/WBE or non-DBE. Solicitations from non-DBEs can be included on the "Disadvantaged Business Enterprise Bidder Good Faith Effort Documentation" form or separately on a similar form.

2.06 DOCUMENTATION FOR BIDDER TO SUBMIT WITH BID OR PROPOSAL PACKAGE

- A. Contractor/Bidder shall have its DBE subcontractors complete The State of Utah—DBE Program Subcontractor Performance Form and shall include all completed forms as part of the bid or proposal package.
- B. Contractor/Bidder shall complete and submit The State of Utah—DBE Program Subcontractor Utilization Form as part of the bid or proposal package.

2.07 OTHER REQUIREMENTS AND INFORMATION

- A. Contractor shall pay its subcontractors for satisfactory performance no more than 30 calendar days from Contractor's receipt of payment from Owner.
- B. The Contractor shall notify the Owner in writing prior to any termination of a DBE subcontractor for Contractor's convenience.
- C. If a DBE subcontractor fails to complete work under the subcontract for any reason, Contractor shall employ the six good faith efforts if soliciting a replacement subcontractor.
- D. Contractor shall employ the six good faith efforts even if Contractor has achieved its fair share objectives.
- E. Contractor shall provide The State of Utah—DBE Program Subcontractor Participation Form to all of its DBE subcontractors. The State of Utah DBE forms gives a DBE subcontractor the opportunity to describe the work the DBE subcontractor received from the prime contractor, how much the DBE subcontractor was paid and any other concerns the DBE subcontractor might have, for example reasons why the DBE subcontractor believes it was terminated by the prime contractor.
- F. Copies of DBE forms are also attached to this specification.
 - 1. If a list of solicitations from non-DBE subcontractors is not included with the bid, it will be required to be submitted prior to the Award of Contract. Additionally, if State of Utah DBE Forms are not completed at the time of

bid for the DBE bids selected by the Contractor for the project, they will be required to be completed prior to the Award of Contract.

- a. DBE Program Subcontractor Performance Form. This form captures an intended subcontractor's description of work to be performed for the prime contractor and the price of the work submitted to the prime. This form is a documents of the Contractor's Good Faith Effort from the DBE's perspective.
 - b. DBE Program Subcontractor Utilization Form. This form captures the prime's intended use of an identified DBE subcontractor, and the estimated dollar amount of the subcontract. This form is a documents of the Contractor's Good Faith Effort from the Contractor's perspective.
- G. Contractor shall not discriminate on the basis of race, color, national origin or sex in the performance of this contract. Contractor shall carry out applicable requirements of 40 CFR part 33 in the award and administration of contracts awarded under DOI financial assistance agreements. Failure by Contractor to carry out these requirements is a material breach of this contract which may result in the termination of this contract or other legally available remedies.

2.08 DISADVANTAGED BUSINESS ENTERPRISE BIDDER GOOD FAITH EFFORT DOCUMENTATION

SUBCONTRACTOR SOLICITATION INFORMATION							
Name, Address & Phone Number of Subcontractor Contacted	Date Request for Quote Sent	Description of Work Offered	Date of Phone Follow-up & Person Contacted	Amount of Quote or Reason for Not Quoting - a	Quote Accepted? If not, List Reason for Rejection	Indicate MBE/WBE or non-DBE	Source of MBE/WBE Independent Certification

a-Use additional sheets if necessary.

The undersigned hereby certifies that the above information is true and correct.

Contractor

By: _____
Signature

Title

Date: _____

22.03 EQUAL EMPLOYMENT OPPORTUNITY AND AFFIRMATIVE ACTION REQUIREMENTS ON FEDERALLY ASSISTED CONSTRUCTION CONTRACTS

3.01 NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY (EXECUTIVE ORDER 11246)

- A. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Specifications" set forth herein.
- B. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:
 - 1. Goal for female participation in each trade: 6.9%
 - 2. Minority participation goals in each trade:
 - a. 12.6% for Beaver, Garifield, Iron, Kane, Washington
 - b. 2.4% for Utah, Provo-Orem
 - c. 10.2% for Grand, San Juan
 - d. 6.0% for Davis, Salt Lake, Tooele, Weber, Salt Lake City - Ogden
 - e. 5.1% for Boz Elder, Cache, Carbon, Daggett, Duchesne, Emery, Juab, Millard, Morgan, Piute, Rich, Sanpete, Sevier, Summit, Uintah, Wasatch, Wayne
 - 3. These goals are applicable to all the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the Contractor also is subject to the goals for both its federally involved and non-federally involved construction.
 - 4. The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from contractor to contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order, and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.
- C. The Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs within 10 working days of award of any construction subcontract in excess of \$10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address and telephone number for the subcontractor; employer identification number of the subcontractor; estimated dollar amount of the

subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed. An example notification letter is available on the next page.

- D. As used in this Notice, and in the contract resulting from this solicitation, the "covered area" is Salt Lake County, Utah.
- E. This notice shall be included in, and shall be a part of, all solicitations for offers and bids on all Federal and federally assisted construction contracts or subcontracts in excess of \$10,000 to be performed in geographical areas designated by the Director pursuant to 41 CFR 60-4.6.

CONTRACTOR'S NAME, ADDRESS & TELEPHONE NUMBER

RETURN TO:
USDOL/OFCCP
Denver District
Office
1244 Speer Blvd.,
Suite 520
Denver CO 80204
FAX: 720-264-3211
ATTN: Jerome Carter

EMPLOYER ID NUMBER OF
CONTRACTOR:

Per our obligation under 41 CFR 60-4.2, we are submitting the following information regarding our subcontractor(s) whose contract is in excess of \$10,000 on our Federal or federally assisted construction project:

CONTRACT INFORMATION

PROJECT AND LOCATION:				
Dollar Amount of Contract	Estimated Start Date	Estimated Completion Date	Contract No.	Geographical Area

NOTIFICATION OF SUBCONTRACTS AWARDED (>\$10,000)

Subcontractor's Name, Address, & Phone Number	Employer ID Number of Subcontractor	Estimated \$ Amount of Subcontract	Estimated Start Date	Estimated Completion Date

22.04 EQUAL OPPORTUNITY CLAUSES

4.01 THE EQUAL OPPORTUNITY CLAUSE PUBLISHED AT 41 CFR 60-1.4(B) IS REQUIRED TO BE INCLUDED IN, AND IS PART OF, ALL NONEXEMPT FEDERALLY ASSISTED CONSTRUCTION CONTRACTS AND SUBCONTRACTS (INCLUDING THIS CONTRACT). THE EQUAL OPPORTUNITY CLAUSE SHALL BE CONSIDERED TO BE A PART OF EVERY CONTRACT AND SUBCONTRACT REQUIRED BY THE REGULATIONS TO INCLUDE SUCH A CLAUSE, WHETHER OR NOT IT IS PHYSICALLY INCORPORATED IN SUCH CONTRACTS. THE NOTICES REQUIRED TO BE POSTED BY PARAGRAPHS (1) AND (3) OF THE EQUAL OPPORTUNITY CLAUSE SHALL BE THE "EQUAL EMPLOYMENT OPPORTUNITY IS THE LAW" POSTER APPROVED BY THE OFFICE OF FEDERAL CONTRACT COMPLIANCE PROGRAMS AND AVAILABLE ON THE INTERNET AT: <HTTPS://WWW1.EEOC.GOV/EMPLOYERS/POSTER.CFM>

4.02 EQUAL OPPORTUNITY CLAUSE (41 CFR 60-1.4(B))

A. During the performance of this contract, the Contractor agrees as follows:

1. The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to the following: Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.
2. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive considerations for employment without regard to race, color, religion, sex, or national origin.
3. The Contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the Contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
4. The Contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.
5. The Contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the

Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

6. In the event of the Contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.
7. The Contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (7) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: Provided, however, that in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

4.03 THE STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY CONSTRUCTION CONTRACT SPECIFICATIONS PUBLISHED AT 41 CFR 60-4.3(A) ARE REQUIRED TO BE INCLUDED IN, AND ARE PART OF, ALL FEDERAL AND FEDERALLY ASSISTED CONSTRUCTION CONTRACTS AND SUBCONTRACTS (INCLUDING THIS CONTRACT) IN EXCESS OF \$10,000 TO BE PERFORMED IN GEOGRAPHICAL AREAS DESIGNATED BY THE DIRECTOR PURSUANT TO 41 CFR 60-4.6 AND IN CONSTRUCTION SUBCONTRACTS IN EXCESS OF \$10,000 NECESSARY IN WHOLE OR IN PART TO THE PERFORMANCE OF NON-CONSTRUCTION FEDERAL CONTRACTS AND SUBCONTRACTS COVERED UNDER EXECUTIVE ORDER 11246. THESE SPECIFICATIONS SHALL BE CONSIDERED TO BE A PART OF EVERY CONTRACT AND SUBCONTRACT REQUIRED BY THE REGULATIONS TO INCLUDE SUCH A CLAUSE, WHETHER OR NOT IT IS PHYSICALLY INCORPORATED IN SUCH CONTRACTS.

- A. STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY CONSTRUCTION CONTRACT SPECIFICATIONS (EXECUTIVE ORDER 11246) as used in these specifications:
 1. "Covered Area" means the geographical area described in the solicitation from which this contract resulted;
 2. "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;

3. "Employer identification number" means the Federal Social Security number used on the employer's quarterly Federal Tax Return, U.S. Treasury Department Form 941.
 4. "Minority" includes:
 - a. Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);
 - b. Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);
 - c. Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands);
 - d. American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).
- B. Whenever the Contractor, or any subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of \$10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.
- C. If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area, (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each contractor or subcontractor participating in an approved Plan is individually required to comply with its obligations under the Equal Opportunity Clause (EEO) clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other contractors or subcontractors toward a goal in an approved Plan does not excuse any covered contractor's or subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.
- D. The Contractor shall implement the specific affirmative action standards provided in paragraphs (7)(a) through (p) of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered Construction Contractors performing construction work in geographical areas where they do not have a Federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the FEDERAL REGISTER in notice form, and such notices may be obtained from any Office of Federal Contract

Compliance Programs office or from Federal procurement contracting officers. The Contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.

- E. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.
- F. In order for the non-working training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.
- G. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:
 - 1. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.
 - 2. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.
 - 3. Maintain a current file of the names, addresses, and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefore, along with whatever additional actions the Contractor may have taken.
 - 4. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union

referral process has impeded the Contractor's efforts to meet its obligations.

5. Develop on-the-job training opportunities and/or participate in training programs for the areas which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under (7)(b) above.
6. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.
7. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with on-site supervisory personnel such as superintendents, general foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.
8. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other contractors and subcontractors with whom the Contractor does or anticipates doing business.
9. Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.
10. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a contractor's workforce.
11. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.
12. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and

- encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.
13. Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.
 14. Ensure that all facilities and company activities are non-segregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.
 15. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.
 16. Conduct a review, at least annually, of all supervisor's adherence to and performance under the Contractor's EEO policies and affirmative action obligations.
- H. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (7)(a) through (p). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the Contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under (7)(a) through (p) of these specifications provided that the Contractor actively participates in the group, makes every effort to assure that the group has positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.
- I. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive order if a specific minority group of women is under-utilized).
- J. The Contractor shall not use the goals and timetables of affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

- K. The Contractor shall not enter into any subcontract with any person or firm debarred from government contracts pursuant to Executive Order 11246.
- L. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.
- M. The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph (7) of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.
- N. The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the government and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.
- O. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

22.05 PROHIBITION AGAINST LISTED VIOLATING FACILITIES

5.01 REQUIREMENTS

- A. To comply with all the requirements of section 114 of the Clean Air Act, as amended (42 U.S.C. 1857, et seq., as amended by Pub. L. 92-604) and section 308 of the Clean Water Act (33 U.S.C. 1251, as amended), respectively, which relate to inspection, monitoring, entry, reports, and information, as well as other requirements specified in section 114 and section 308 of the Air Act and the Water

Act, respectively, and all regulations and guidelines issued thereunder before the award of this contract.

- B. That no portion of the work required by this prime contract will be performed in a facility listed on the Environmental Protection Agency (EPA) list of violating facilities on the date when this contract was awarded unless and until the EPA eliminates the name of such facility or facilities from the listing.
- C. To use his best efforts to comply with clean air and clean water standards at the facilities in which the contract is being performed.
- D. To insert the substance of the provisions of this clause, including this paragraph (4), in any nonexempt subcontract.

5.02 DEFINITIONS

- A. Air Act means the Clean Air Act, as amended (42 U.S.C. 1857 et seq.).
- B. Water Act means the Clean Water Act, as amended (33 U.S.C. 1251 et seq.).
- C. Clean Air Standards means any enforceable rules, regulations, guidelines, standards, limitations, orders, controls, prohibitions, or other requirements which are contained in, issued under, or otherwise adopted under the Air Act or Executive Order 11738, an applicable implementation plan as described in section 110 (d) of the Air Act (42 U.S.C. 1857c-5(d)), an approved implementation procedure or plan under section 111 (c) or section 111(d), or an approved implementation procedure under section 112(d) of the Air Act (42 U.S.C. 1857c-7(d)).
- D. Clean Water Standards means any enforceable limitation, control, condition, prohibition, standard, or other requirement which is promulgated under the Water Act or contained in a permit issued to a discharger by the Environmental Protection Agency or by a State under an approved program, as authorized by section 402 of the Water Act (33 U.S.C. 1342), or by a local government to ensure compliance with pretreatment regulations as required by section 307 of Water Act (33 U.S.C. 1317).
- E. Compliance means compliance with clean air or water standards. Compliance shall also mean compliance with a schedule or plan ordered or approved by a court of competent jurisdiction, the Environmental Protection Agency in accordance with the requirements of the Air Act or Water Act and regulations.
- F. Facility means any building, plant, installation, structure, mine, vessel, or other floating craft, location, or site of operations, owned, leased, or supervised by a contractor or subcontractor, to be used in the performance of a contract or subcontract. Where a location or site of operations contains or includes more than one building, plant, installation, or structure, the entire location or site shall be deemed to be a facility except where the Director, Office of Federal Activities, Environmental Protection Agency, determines that independent facilities are located in one geographical area.

22.06 WILLIAMS-STEIGER OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970

6.01 AUTHORITY

- A. The Contractor is subject to the provisions of the Williams-Steiger Occupational Safety and Health Act of 1970.
- B. These construction documents and the joint and several phases of construction hereby contemplated are to be governed, at all times, by applicable provisions of the Federal law(s), including but not limited to the latest amendment of the following:
 - 1. Williams-Steiger Occupational Safety and Health Act of 1970, Public Law 94-596;
 - 2. Part 1910 - Occupational Safety and Health Standards, Chapter XVII of Title 29, Code of Federal Regulations;
 - 3. Part 1926 - Safety and Health Regulations for Construction, Chapter XVII of Title 29, Code of Federal Regulations.

6.02 SAFETY AND HEALTH PROGRAM REQUIREMENTS

- A. This project, its prime Contractor and its subcontractors, shall at all times be governed by Chapter XVII of Title 29, Code of Federal Regulations, Part 1926 - Safety and Health Regulations for Construction (29 CFR 22801), as amended to date.
- B. To implement the program and to provide safe and healthful working conditions for all persons, general project safety meetings will be conducted at the site at least once each month during the course of construction, by the construction superintendent or his/her designated safety officer. Notice of such meeting shall be issued not less than three (3) days prior, stating the exact time, location, and agenda to be included. Attendance by the Owner, architect, general foreman, shop steward(s), and trades, or their designated representatives, witnessed in writing as such, shall be mandatory.
- C. To further implement the program, each trade shall conduct a short gang meeting, not less than once a week, to review project safety requirements mandatory for all persons during the coming week. The gang foreman shall report the agenda and specific items covered to the project superintendent, who shall incorporate these items in his/her daily log or report.
- D. The prime Contractor and all subcontractors shall immediately report all accidents, injuries, or health hazards to the Owner and architect, or their designated representatives, in writing. This shall not obviate any mandatory reporting under the provisions of the Occupational Safety and Health Act of 1970.
- E. This program shall become a part of the contract documents and the contract between the Owner and prime Contractor, prime Contractor and all subcontractors, as though fully written therein.

6.03 ANTI-KICKBACKS

- A. Contractor shall comply with the Copeland "Anti-Kickback" Act (18 U.S.C. 874) as supplemented in the Department of Labor Regulations (29 CFR, Part 3). This Act provides that Contractor is prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he is otherwise entitled.
- B. Contractor certifies and warrants that no gratuities, kickbacks and contingency fees were paid in connection with this contract, nor were any fees, commissions, gifts, or other considerations made contingent upon the award of this contract.
- C. Contractor certifies that, to Contractor's knowledge, no state employee has any personal or beneficial interest whatsoever in the services described in this Contract.
- D. No staff member of Contractor, compensated either partially or wholly with funds disbursed pursuant to the Contract, shall engage in any Contract or activity which would constitute a conflict of interest as related to this Contract.

22.07 DISCOVERY OF ARCHAEOLOGICAL AND OTHER HISTORICAL ITEMS

7.01 IN THE EVENT OF AN ARCHAEOLOGICAL FIND DURING ANY PHASE OF CONSTRUCTION, THE FOLLOWING PROCEDURE WILL BE FOLLOWED:

- A. Construction shall be halted, with as little disruption to the archaeological site as possible.
- B. Contractor shall notify Owner who shall contact the State Historic Preservation Officer.
- C. The State Historic Preservation Officer may decide to have an archaeologist inspect the site and make recommendations about the steps needed to protect the site, before construction is resumed.
- D. The entire event should be handled as expediently as possible in order to hold the loss in construction time to a minimum while still protecting archaeological finds.

- 7.02 A SIMILAR PROCEDURE SHOULD BE FOLLOWED WITH REGARD TO MORE RECENT HISTORICAL RESOURCES. SHOULD ANY ARTIFACTS, HOUSING SITES, ETC., BE UNCOVERED, THE SAME PROCEDURE SHOULD BE FOLLOWED AS FOR AN ARCHAEOLOGICAL FIND.
- 7.03 IN THE EVENT ARCHAEOLOGICAL/HISTORICAL DATA ARE EVALUATED TO MEET NATIONAL REGISTER CRITERIA, THE ADVISORY COUNCIL ON HISTORIC PRESERVATION MAY BE NOTIFIED AND ASKED TO COMMENT BY THE UTAH STATE REVOLVING FUND PROGRAM.

22.08 ACCESS

- 8.01 CONTRACTOR AND LOAN RECIPIENT SHALL INSURE THAT AUTHORIZED REPRESENTATIVES OF THE UTAH DEQ, STATE HISTORIC PRESERVATION OFFICE, US EPA, COMPTROLLER GENERAL, INSPECTOR GENERAL, AND OTHER APPLICABLE FEDERAL AND STATE AGENCIES AND OFFICIALS WILL HAVE ACCESS TO THE PROJECT WORK WHENEVER IT IS IN PREPARATION OR PROGRESS AND SHALL PROVIDE PROPER FACILITIES FOR SUCH ACCESS AND INSPECTION. CONTRACTOR SHALL ALLOW THESE REPRESENTATIVES TO HAVE ACCESS TO ANY BOOKS, DOCUMENTS, PLANS, REPORTS, PAPERS, AND OTHER RECORDS OF CONTRACTOR WHICH ARE PERTINENT TO THE PROJECT FOR THE PURPOSE OF MAKING AUDIT, EXAMINATION, EXCERPTS, COPIES AND TRANSCRIPTIONS THEREOF AND TO INTERVIEW ANY OFFICER OR EMPLOYEE. CONTRACTOR SHALL INSURE THAT ALL SUB-AGREEMENTS WILL ALSO AFFORD ACCESS TO SUCH PROJECT WORK, SITES, DOCUMENTS, RECORDS, AND PERSONS.

22.09 SITE EROSION AND SEDIMENT CONTROL MEASURES

- 9.01 EVERY EFFORT SHALL BE MADE BY CONTRACTOR AND SUBCONTRACTORS TO PREVENT AND CORRECT PROBLEMS ASSOCIATED WITH EROSION AND RUNOFF PROCESSES WHICH COULD OCCUR DURING AND AFTER PROJECT CONSTRUCTION. THE EFFORTS SHOULD BE CONSISTENT WITH APPLICABLE LOCAL ORDINANCES AND THE NONPOINT SOURCE POLLUTION CONTROL GUIDANCE. WHENEVER APPROPRIATE, CONTRACTOR'S EFFORTS SHALL REFLECT THE FOLLOWING ENGINEERING PRINCIPLES:
- A. When appropriate, land grading and excavating should be kept at a minimum to reduce the possibility of creating runoff and erosion problems which require extensive control measures.
 - B. Whenever possible, topsoil should be removed and stockpiled before grading begins.
 - C. Land exposure should be minimized in terms of area and time.

- D. Exposed areas subject to erosion should be covered as quickly as possible by means of mulching or vegetation.
- E. Natural vegetation should be retained whenever feasible.
- F. Early completion of stabilized drainage systems (temporary and permanent systems) will substantially reduce erosion potential.
- G. Roadways and parking lots should be paved or otherwise stabilized as soon as feasible.
- H. Clearing and grading should not be started until a firm construction schedule is known and can be effectively coordinated with grading and clearing activity.

22.10 UPDES CONSTRUCTION RELATED DISCHARGE PERMITS

- 10.02 CONSTRUCTION PROJECTS WHICH WILL DISTURB ONE OR MORE ACRES WILL REQUIRE COVERAGE UNDER THE STATE OF UTAH GENERAL PERMIT FOR STORM WATER DISCHARGES ASSOCIATED WITH LARGE CONSTRUCTION ACTIVITIES. CONTRACTOR IS RESPONSIBLE FOR OBTAINING COVERAGE UNDER THE APPROPRIATE PERMIT AND MAINTAINING COMPLIANCE UNTIL OWNER ACCEPTS THE WORK AS COMPLETE. FOR ADDITIONAL INFORMATION SEE <HTTPS://DEQ.UTAH.GOV/WATER-QUALITY/STORM-WATER-PERMITS-UPDES-PERMITS>.
- 10.03 CERTAIN CONSTRUCTION ACTIVITIES SUCH AS DEWATERING, FLUSHING, TESTING, AND DISINFECTION REQUIRE COVERAGE UNDER THE STATE OF UTAH GENERAL PERMIT FOR TEMPORARY DISCHARGES OR UNDER A SEPARATE DISCHARGE PERMIT. CONTRACTOR IS RESPONSIBLE FOR OBTAINING ANY NECESSARY COVERAGE AND MAINTAINING COMPLIANCE.

22.11 AIR QUALITY PROTECTION MEASURES

- 11.01 CONTRACTOR SHALL ADHERE TO EFFECTIVE DUST CONTROL PROCEDURES AS REQUIRED UNDER THE UTAH AIR QUALITY STANDARDS AND REGULATIONS UAC R307. IF ASBESTOS IS ENCOUNTERED DURING THIS PROJECT, CONTRACTOR SHALL FOLLOW STANDARDS FOR HANDLING ACCORDING TO UAC R307-801. CONTRACTOR SHALL ADHERE TO PROPER TRADE WASTE AND MATERIALS DISPOSAL.

22.12 PRESERVATION OF OPEN COMPETITION AND GOVERNMENT NEUTRALITY TOWARDS GOVERNMENT CONTRACTORS' LABOR RELATIONS ON FEDERAL AND FEDERALLY FUNDED CONSTRUCTION PROJECTS

- 12.01 THE ASSISTANCE RECIPIENT AGREES TO COMPLY WITH EXECUTIVE ORDER 13202 (FEB. 22, 2001, 66 FEDERAL REGISTER 11225) OF FEBRUARY 17, 2001, ENTITLED "PRESERVATION OF OPEN COMPETITION AND GOVERNMENT NEUTRALITY TOWARDS GOVERNMENT CONTRACTORS' LABOR RELATIONS ON FEDERAL AND FEDERALLY FUNDED CONSTRUCTION PROJECTS," AS AMENDED BY EXECUTIVE ORDER 13208 (APRIL 11, 2001, 66 FEDERAL REGISTER 18717) OF APRIL 6, 2001, ENTITLED "AMENDMENT TO EXECUTIVE ORDER 13202, PRESERVATION OF OPEN COMPETITION AND GOVERNMENT NEUTRALITY TOWARDS GOVERNMENT CONTRACTORS' LABOR RELATIONS ON FEDERAL AND FEDERALLY FUNDED CONSTRUCTION PROJECTS.
- 12.02 AMEND 48 CFR PART 36.202 BY ADDING PARAGRAPH (D) TO READ AS FOLLOWS:
- A. In accordance with Executive Order 13202, of February 17, 2001, Preservation of Open Competition and Government Neutrality Towards Government Contractors'

Labor Relations on Federal and Federally Funded Construction Projects, as amended on April 6, 2001—

1. The Government, or any construction manager acting on behalf of the Government, must not—
 - a. Require or prohibit offerors, contractors, or subcontractors to enter into or adhere to agreements with one or more labor organizations (as defined in 42 U.S.C. 2000e(d)) on the same or other related construction projects; or
 - b. Otherwise discriminate against offerors, contractors, or subcontractors for becoming, refusing to become, or remaining signatories or otherwise adhering to agreements with one or more labor organizations, on the same or other related construction projects.
- B. Nothing in this paragraph prohibits offerors, contractors, or subcontractors from voluntarily entering into project labor agreements.
- C. The head of the agency may exempt a construction project from this policy if the agency head finds that, as of February 17, 2001—
 1. The agency or a construction manager acting on behalf of the Government had issued or was a party to bid specifications, project agreements, agreements with one or more labor organizations, or other controlling documents with respect to that particular project, which contained any of the requirements or prohibitions in paragraph (d)(1) of this section; and
 2. One or more construction contracts subject to such requirements or prohibitions had been awarded.
- D. The head of the agency may exempt a particular project, contract, or subcontract from this policy upon a finding that special circumstances require an exemption in order to avert an imminent threat to public health or safety, or to serve the national security. A finding of "special circumstances" may not be based on the possibility or presence of a labor dispute concerning the use of contractors or subcontractors who are non-signatories to, or otherwise do not adhere to, agreements with one or more labor organizations, or concerning employees on the project who are not members of or affiliated with a labor organization.

22.13 BUY AMERICAN DOMESTIC PROCUREMENT PREFERENCE

13.01 As required by section 70914 of the Bipartisan Infrastructure Law (also known as the Infrastructure Investment And Jobs Act), P.L. 117-58, on or after May 14, 2022, none of the funds under a federal award that are part of federal financial assistance program for infrastructure may be obligated for a project unless all of the iron, steel, manufactured products, and construction materials used in the project are produced in the united states, unless subject to an approved waiver. The requirements of this section must be included in all subawards, including all contracts and purchase orders for work or products under this program.

- A. The Contractor acknowledges to and for the benefit of Jordan Valley Water Conservancy District (“Recipient”) and the Bureau of Reclamation (the “BOR”) that it understands the goods and services under this Agreement are being funded with monies made available by the DOI that have statutory requirements commonly known as “Buy America preference;” that requires all of the iron and steel products used in the project to be produced in the United States including iron and steel products provided by the Contactor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Recipient and the BOR that none of the funds provided under this award may be used for a project for infrastructure unless:
1. All iron and steel used in the project are produced in the United States--this means all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States;
 2. All manufactured products used in the project are produced in the United States— this means the manufactured product was manufactured in the United States; and the cost of the components of the manufactured product that are mined, produced, or manufactured in the United States is greater than 55 percent of the total cost of all components of the manufactured product, unless another standard for determining the minimum amount of domestic content of the manufactured product has been established under applicable law or regulation; and
 3. All construction materials are manufactured in the United States—this means that all manufacturing processes for the construction material occurred in the United States.
- B. The Buy America preference only applies to articles, materials, and supplies that are consumed in, incorporated into, or affixed to an infrastructure project. As such, it does not apply to tools, equipment, and supplies, such as temporary scaffolding, brought to the construction site and removed at or before the completion of the infrastructure project. Nor does a Buy America preference apply to equipment and furnishings, such as movable chairs, desks, and portable computer equipment, that are used at or within the finished infrastructure project, but are not an integral part of the structure or permanently affixed to the infrastructure project.

For further information on the Buy America preference, please visit www.doi.gov/grants/BuyAmerica .

Additional information can also be found at the White House Made in America Office website: www.whitehouse.gov/omb/management/made-in-america/.

- C. When necessary, recipient or Contractor may apply for, and the Department of the Interior (DOI) may grant, a waiver from these requirements, subject to review by the Made in America Office. The DOI may waive the application of the domestic content procurement preference in any case in which it is determined that one of the below circumstances applies:
1. Non-availability Waiver: the types of iron, steel, manufactured products, or construction materials are not produced in the United States in sufficient and reasonably available quantities or of a satisfactory quality;
 2. Unreasonable Cost Waiver: the inclusion of iron, steel, manufactured products, or construction materials produced in the United States will increase the cost of the overall project by more than 25 percent; or
 3. Public Interest Waiver: applying the domestic content procurement preference would be inconsistent with the public interest.

There may be instances where an award qualifies, in whole or in part, for an existing DOI general applicability waiver as described at:

www.doi.gov/grants/BuyAmerica/GeneralApplicabilityWaivers. If the specific financial assistance agreement, infrastructure project, or non-domestic materials meets the criteria of an existing general applicability waiver within the limitations defined within the waiver, the recipient is not required to request a separate waiver for non-domestic materials. If a general applicability waiver does not already apply, and a recipient believes that one of the above circumstances applies to an award, a request to waive the application of the domestic content procurement preference may be submitted to the financial assistance awarding officer in writing. Waiver requests shall include the below information. The waiver shall not include any Privacy Act information, sensitive data, or proprietary information within their waiver request. Waiver requests will be posted to www.doi.gov/grants/buyamerica and are subject to public comment periods of no less than 15 days. Waiver requests will also be reviewed by the Made in America Office

- D. Notwithstanding any other provision of this Agreement, any failure to comply with this requirement by the Contractor shall permit the Recipient or State to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney's fees) incurred by the Recipient or State resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State or any damages owed to the State by the Purchaser). While the Contractor has no direct contractual privity with the State, as a lender to the Purchaser for the funding of its project, the Recipient and the Contractor agree that the State is a third-party beneficiary and neither this

paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the State.

13.02 DEFINITIONS

- A. "Construction materials" includes an article, material, or supply that is or consists primarily of:
1. non-ferrous metals;
 2. plastic and polymer-based products (including polyvinylchloride, composite building materials, and polymers used in fiber optic cables);
 3. glass (including optic glass);
 4. lumber; or
 5. drywall.

"Construction Materials" does **not** include cement and cementitious materials, aggregates such as stone, sand, or gravel, or aggregate binding agents or additives.

- B. "Domestic content procurement preference" means all iron and steel used in the project are produced in the United States; the manufactured products used in the project are produced in the United States; or the construction materials used in the project are produced in the United States.
- C. "Infrastructure" includes, at a minimum, the structures, facilities, and equipment for, in the United States, roads, highways, and bridges; public transportation; dams, ports, harbors, and other maritime facilities; intercity passenger and freight railroads; freight and intermodal facilities; airports; water systems, including drinking water and wastewater systems; electrical transmission facilities and systems; utilities; broadband infrastructure; and buildings and real property. Infrastructure includes facilities that generate, transport, and distribute energy.
- D. "Project" means the construction, alteration, maintenance, or repair of infrastructure in the United States.

22.14 BUILD AMERICA, BUY AMERICA (BABA) REQUIREMENTS

14.01 THE CONTRACTOR ACKNOWLEDGES THAT IT UNDERSTANDS THE GOODS AND SERVICES UNDER THIS AGREEMENT ARE BEING FUNDED WITH FEDERAL MONIES AND HAVE STATUTORY REQUIREMENTS COMMONLY KNOWN AS "BUILD AMERICA, BUY AMERICA;" THAT REQUIRES ALL OF THE IRON AND STEEL, MANUFACTURED PRODUCTS, AND CONSTRUCTION MATERIALS USED IN THE PROJECT TO BE PRODUCED IN THE UNITED STATES ("BUILD AMERICA, BUY AMERICA REQUIREMENTS") INCLUDING IRON AND STEEL, MANUFACTURED PRODUCTS, AND CONSTRUCTION MATERIALS PROVIDED BY THE CONTRACTOR PURSUANT TO THIS AGREEMENT. THE CONTRACTOR HEREBY REPRESENTS AND WARRANTS TO AND FOR THE BENEFIT OF THE OWNER AND FUNDING AUTHORITY (A) THE CONTRACTOR HAS REVIEWED AND UNDERSTANDS THE BUILD AMERICA, BUY AMERICA REQUIREMENTS, (B) ALL OF THE IRON AND STEEL, MANUFACTURED PRODUCTS, AND CONSTRUCTION MATERIALS USED IN THE PROJECT WILL BE AND/OR HAVE BEEN PRODUCED IN THE UNITED STATES IN A MANNER THAT COMPLIES WITH THE BUILD AMERICA, BUY AMERICA REQUIREMENTS, UNLESS A WAIVER OF THE REQUIREMENTS IS APPROVED, AND (C) THE CONTRACTOR WILL PROVIDE ANY FURTHER VERIFIED INFORMATION, CERTIFICATION OR ASSURANCE OF COMPLIANCE WITH THIS PARAGRAPH, OR INFORMATION NECESSARY TO SUPPORT A WAIVER OF THE BUILD AMERICA, BUY AMERICA REQUIREMENTS, AS MAY BE REQUESTED BY THE OWNER OF THE FUNDING AUTHORITY. NOTWITHSTANDING ANY OTHER PROVISION OF THIS AGREEMENT, ANY FAILURE TO COMPLY WITH THIS PARAGRAPH BY THE CONTRACTOR SHALL PERMIT THE OWNER OR FUNDING AUTHORITY TO RECOVER AS DAMAGES AGAINST THE CONTRACTOR ANY LOSS, EXPENSE, OR COST (INCLUDING WITHOUT LIMITATION ATTORNEY'S FEES) INCURRED BY THE OWNER OR FUNDING AUTHORITY RESULTING FROM ANY SUCH FAILURE (INCLUDING WITHOUT ANY IMPAIRMENT OR LOSS OF FUNDING, WHETHER IN WHOLE OR IN PART, FROM THE FUNDING AUTHORITY OR ANY DAMAGES OWED TO THE FUNDING AUTHORITY BY THE OWNER). IF THE CONTRACTOR HAS NO DIRECT CONTRACTUAL PRIVITY WITH THE FUNDING AUTHORITY, AS A LENDER OR AWARDEE TO THE THIRD-PARTY BENEFICIARY AND NEITHER THIS PARAGRAPH (NOR ANY OTHER PROVISION OF THIS AGREEMENT NECESSARY TO GIVE THIS PARAGRAPH FORCE OR EFFECT) SHALL BE AMENDED OR WAIVED WITHOUT PRIOR WRITTEN CONSENT OF THE FUNDING AUTHORITY.

22.15 DAVIS BACON PREVAILING WAGE REQUIREMENTS

15.01 “NOTWITHSTANDING ANY OTHER PROVISION OF LAW AND IN A MANNER CONSISTENT WITH OTHER PROVISIONS IN THIS ACT, ALL LABORERS AND MECHANICS EMPLOYED BY CONTRACTORS AND SUBCONTRACTORS ON PROJECTS FUNDED DIRECTLY BY OR ASSISTED IN WHOLE OR IN PART BY AND THROUGH THE FEDERAL GOVERNMENT PURSUANT TO THIS ACT SHALL BE PAID WAGES AT RATES NOT LESS THAN THOSE PREVAILING ON PROJECTS OF A CHARACTER SIMILAR IN THE LOCALITY AS DETERMINED BY THE SECRETARY OF LABOR IN ACCORDANCE WITH SUBCHAPTER IV OF CHAPTER 31 OF TITLE 40, UNITED STATES CODE. WITH RESPECT TO THE LABOR STANDARDS SPECIFIED IN THIS SECTION, THE SECRETARY OF LABOR SHALL HAVE THE AUTHORITY AND FUNCTIONS SET FORTH IN REORGANIZATION PLAN NUMBERED 14 OF 1950 (64 STAT. 1267; 5 U.S.C. APP.) AND SECTION 3145 OF TITLE 40, UNITED STATES CODE.”

15.02 FEDERAL LABOR STANDARDS PROVISIONS (FROM 29 CFR 5.5)

A. Minimum wages.

1. All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics.
2. Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the Contractor and its subcontractors at the

site of the work in a prominent and accessible place where it can be easily seen by the workers.

3.
 - a. The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:
 - 1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and
 - 2) The classification is utilized in the area by the construction industry; and
 - 3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.
 - b. If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.
 - c. In the event the Contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.
 - d. (D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii) (B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.
4. Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the Contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

5. If the Contractor does not make payments to a trustee or other third person, the Contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the Contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.
- B. Withholding. The project owner shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the Contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the Contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the project owner may, after written notice to the Contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.
 - C. Payrolls and basic records.
 1. Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the Contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

2.

- a. The Contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the project owner. Project owner will provide copies to the DOI upon request. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g. , the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the US Department of Labor/Wage and Hour Division Website at <http://www.dol.gov/whd/programs/dbra/wh347.htm>. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the project owner. Project owner shall provide such information, upon request, to the DOI or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the project owner or other government agencies.
- b. Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the Contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:
 - 1) That the payroll for the payroll period contains the information required to be provided under §5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under §5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;
 - 2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;
 - 3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.
- c. The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the

requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

- d. The falsification of any of the above certifications may subject the Contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.
3. The Contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the project owner, the DOI, or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the Contractor or subcontractor fails to submit the required records or to make them available, the Federal agency may, after written notice to the Contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

D. Apprentices and trainees.

1. *Apprentices.* Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the Contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the Contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must

be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the Contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

2. *Trainees.* Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the Contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.
3. *Equal employment opportunity.* The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

E. Compliance with Copeland Act Requirements.

1. The Contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.
2. Subcontracts.
3. The Contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the project owner and/or the DOI may by appropriate instructions require, and also a clause requiring the subcontractors to include these

clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

- F. Contract termination: debarment.
 - 1. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.
- G. Compliance with Davis-Bacon and Related Act Requirements.
 - 1. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.
- H. Disputes concerning labor standards
 - 1. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the Contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.
- I. Certification of eligibility.
 - 1. By entering into this contract, the Contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the Contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).
 - 2. No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).
- J. Contract Work Hours and Safety Standards Act. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.
 - 1. Overtime requirements.
 - a. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any work week in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.
 - b. Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (b)(1) of this section the Contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect

to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (b)(1) of this section, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (b)(1) of this section.

2. Withholding for unpaid wages and liquidated damages.
 - a. The project owner or the DOI shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the Contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b)(2) of this section.
3. Subcontracts.
 - a. The Contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (b)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (b)(1) through (4) of this section.

15.03 OTHER RELATED REQUIREMENTS AND INFORMATION

- A. Based on 29 CFR 5.6(a)(3): Owner shall make such investigations as may be necessary to assure compliance with the labor standards provisions and related statutes and regulations. Investigations shall be made with such frequency as may be necessary to assure compliance. Such investigations shall include interviews with employees, which shall be taken in confidence, and examinations of payroll data and evidence of registration and certification with respect to apprenticeship and training plans. In making such examinations, particular care shall be taken to determine the correctness of classifications and to determine whether there is a disproportionate employment of laborers and of apprentices or trainees registered in approved programs. Such investigations shall also include evidence of fringe benefit plans and payments thereunder. Complaints of alleged violations shall be given priority.
- B. A brief summary of required Davis Bacon compliance checking activities by Owner:
 1. Make sure the Davis-Bacon poster and the wage determination are posted at the job site in a prominent and accessible place where both can be easily seen by the workers.
 2. Review the weekly payrolls for compliance with the requirements.

3. Interview employees to cross check the payrolls and to help ensure compliance with the requirements.
- C. The regulations do not require a specific interval and number of employee interviews; however, The Owner shall make the interval and number of interviews commensurate with the size and complexity of the project so as to provide a reasonable check on Contractor's compliance.
- D. The regulations do not require a specific interview format. The Owner can use or adapt other agencies' Davis-Bacon interview forms, such as the one provided by the US Department of Housing and Urban Development, form HUD-11, which can be found at https://www.hud.gov/program_offices/davis_bacon_and_labor_standards/olrform.
- E. Owner shall maintain the payrolls, interview records, and other compliance related records for a minimum of three years after completion of the contract and shall provide them upon request to the DOI or to applicable federal agencies.
- F. Additional compliance information and assistance is available at
1. <https://webapps.dol.gov/elaws/elg/dbra.htm> and other related websites.
- G. Following are the *identifier codes* used to reference the various craft unions. Examples of classifications for which their local unions commonly negotiate wage and fringe benefit rates are shown in parentheses.
1. ASBE = International Association of Heat and Frost Insulators and Asbestos Workers
 2. BOIL = International Brotherhood of Boiler Makers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers
 3. BRXX = International Union of Bricklayers, and Allied Craftsmen (bricklayers, cement masons, stone masons, tile, marble and terrazzo workers)
 4. CARP = United Brotherhood of Carpenters and Joiners of America (carpenter, millwright, piledrivermen, soft floor layers, divers)
 5. ELEC = International Brotherhood of Electrical Workers (electricians, communication systems installers, and other low voltage specialty workers)
 6. ELEV = International Union of Elevator Constructors
 7. ENGI = International Union of Operating Engineers (operators of various types of power equipment)
 8. IRON = International Association of Bridge, Structural and Ornamental Iron Workers
 9. LABO = Laborers' International Union of North America
 10. PAIN = International Brotherhood of Painters and Allied Trades (painters, drywall finishers, glaziers, soft floor layers)
 11. PLAS = Operative Plasterers' and Cement Masons' International Association of the United States and Canada (cement masons, plasterers)
 12. PLUM = United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada (plumbers, pipefitters, steamfitters, sprinkler fitters)
 13. ROOF = United Union of Roofers, Waterproofers and Allied Workers

14. SHEE = Sheet Metal Workers International Association
15. SU.... = The "SU..." identifier is for rates derived from survey data where the union rate(s) were not determined to be prevailing for the classification(s) listed. (The data reported for such a classification and used in computing the prevailing rate may have included both union and non-union wage data.) Note that various classifications, for which non-union rates have been determined to be prevailing, may be listed in alphabetical order under this identifier, which the computer places into the wage determination in alphabetical order, as listed here.
16. TEAM = International Brotherhood of Teamsters.

U.S. Department of Labor
 Employment Standards Administration
 Wage and Hour Division

PAYROLL

(For Contractor's Optional Use; See Instructions at www.dol.gov/esa/whd/forms/wh347instr.htm)



Rev. Dec. 2008

Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number.

NAME OF CONTRACTOR OR SUBCONTRACTOR ADDRESS OMB No.: 1215-0149
 Expires: 12/31/2011

PAYROLL NO. FOR WEEK ENDING PROJECT AND LOCATION PROJECT OR CONTRACT NO.

(1) NAME AND INDIVIDUAL IDENTIFYING NUMBER (e.g. LAST FOUR DIGITS OF SOCIAL SECURITY NUMBER) OF WORKER	(2) NO. OF WITHHOLDING EXEMPTIONS	(3) WORK CLASSIFICATION	(4) DAY AND DATE							(5) TOTAL HOURS	(6) RATE OF PAY	(7) GROSS AMOUNT EARNED	(8) DEDUCTIONS					(9) NET WAGES PAID FOR WEEK
			MON	TUE	WED	THUR	FRI	SAT	SUN				FICA	WITH- HOLDING TAX		OTHER	TOTAL DEDUCTIONS	
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While completion of Form WH-347 is optional, it is mandatory for covered contractors and subcontractors performing work on Federally financed or assisted construction contracts to respond to the information collection contained in 29 C.F.R. §§ 3.3, 5.5(a). The Copeland Act (40 U.S.C. § 3145) contractors and subcontractors performing work on Federally financed or assisted construction contracts to "furnish weekly a statement with respect to the wages paid each employee during the preceding week." U.S. Department of Labor (DOL) regulations at 29 C.F.R. § 5.5(a)(3)(i) require contractors to submit weekly a copy of all payrolls to the Federal agency contracting for or financing the construction project, accompanied by a signed "Statement of Compliance" indicating that the payrolls are correct and complete and that each laborer or mechanic has been paid not less than the proper Davis-Bacon prevailing wage rate for the work performed. DOL and federal contracting agencies receiving this information review the information to determine that employees have received legally required wages and fringe benefits.

Public Burden Statement

We estimate that it will take an average of 55 minutes to complete this collection, including time for reviewing Instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. If you have any comments regarding these estimates or any other aspect of this collection, including suggestions for reducing this burden, send them to the Administrator, Wage and Hour Division, ESA, U.S. Department of Labor, Room S3502, 200 Constitution Avenue, N.W., Washington, D.C. 20210

(over)

Date _____

I, _____ (Name of Signatory Party) _____ (Title)

do hereby state:

(1) That I pay or supervise the payment of the persons employed by

_____ on the _____ (Contractor or Subcontractor)

_____ ; that during the payroll period commencing on the _____ (Building or Work)

_____ day of _____, _____, and ending the _____ day of _____, _____,

all persons employed on said project have been paid the full weekly wages earned, that no rebates have been or will be made either directly or indirectly to or on behalf of said

_____ from the full _____ (Contractor or Subcontractor)

weekly wages earned by any person and that no deductions have been made either directly or indirectly from the full wages earned by any person, other than permissible deductions as defined in Regulations, Part 3 (29 C.F.R. Subtitle A), issued by the Secretary of Labor under the Copeland Act, as amended (48 Stat. 948, 63 Stat. 108, 72 Stat. 967; 76 Stat. 357; 40 U.S.C. § 3145), and described below:

(2) That any payrolls otherwise under this contract required to be submitted for the above period are correct and complete; that the wage rates for laborers or mechanics contained therein are not less than the applicable wage rates contained in any wage determination incorporated into the contract; that the classifications set forth therein for each laborer or mechanic conform with the work he performed.

(3) That any apprentices employed in the above period are duly registered in a bona fide apprenticeship program registered with a State apprenticeship agency recognized by the Bureau of Apprenticeship and Training, United States Department of Labor, or if no such recognized agency exists in a State, are registered with the Bureau of Apprenticeship and Training, United States Department of Labor.

(4) That:

(a) WHERE FRINGE BENEFITS ARE PAID TO APPROVED PLANS, FUNDS, OR PROGRAMS

- in addition to the basic hourly wage rates paid to each laborer or mechanic listed in the above referenced payroll, payments of fringe benefits as listed in the contract have been or will be made to appropriate programs for the benefit of such employees, except as noted in section 4(c) below.

(b) WHERE FRINGE BENEFITS ARE PAID IN CASH

- Each laborer or mechanic listed in the above referenced payroll has been paid, as indicated on the payroll, an amount not less than the sum of the applicable basic hourly wage rate plus the amount of the required fringe benefits as listed in the contract, except as noted in section 4(c) below.

(c) EXCEPTIONS

EXCEPTION (CRAFT)	EXPLANATION

REMARKS:

Exception 8

NAME AND TITLE

SIGNATURE

THE WILLFUL FALSIFICATION OF ANY OF THE ABOVE STATEMENTS MAY SUBJECT THE CONTRACTOR OR SUBCONTRACTOR TO CIVIL OR CRIMINAL PROSECUTION. SEE SECTION 1001 OF TITLE 18 AND SECTION 231 OF TITLE 31 OF THE UNITED STATES CODE.

22.16 REQUIRED SIGNS AND POSTERS

16.01 THE CONTRACTOR IS REQUIRED TO PROVIDE THE FOLLOWING SIGNS AND POSTERS FOR THE PROJECT INCLUDING BUT NOT NECESSARILY LIMITED TO:

1.	Minimum Wage Poster	https://webapps.dol.gov/elaws/firststep/poster_direct.htm?p_flsa=1
2.	Davis-Bacon Wage Poster WH-1321	https://webapps.dol.gov/elaws/firststep/poster_direct.htm?p_dbra=1
3.	Davis-Bacon Wage Determinations	https://webapps.dol.gov/elaws/elg/dbra.htm
4.	Equal Opportunity Employer Poster:	https://webapps.dol.gov/elaws/firststep/poster_direct.htm?p_eeo=1
5.	OSHA Poster	https://webapps.dol.gov/elaws/firststep/poster_direct.htm?p_osea=1

22.17 DBA WAGE DECISIONS

17.01 THE FOLLOWING WAGE DECISIONS ARE PROVIDED FOR REFERENCE AND ARE ATTACHED AT THE END OF THIS SECTION. CURRENT WAGE DECISIONS FOR UTAH ARE AVAILABLE AT <HTTPS://SAM.GOV/CONTENT/WAGE-DETERMINATIONS>.

- A. For bidding purposes, wage decisions for 2025 shall be assumed to be 3% higher than for 2024. A change of conditions may need to be negotiated for 2025 based on documented hours of work if the wage increase is more or less than 3%.

22.18 DRUG FREE WORKPLACE (2 CFR 182 AND 1401)

18.01

- A. The Department of the Interior regulations at 2 CFR 1401—Governmentwide Requirements for Drug-Free Workplace (Financial Assistance), which adopt the portion of the Drug-Free Workplace Act of 1988 (41 U.S.C. 701 et seq, as amended) applicable to grants and cooperative agreements, are hereby incorporated by reference and made a part of this agreement. By entering into this grant or cooperative agreement with the Bureau of Reclamation, the Recipient and the Bidder agrees to comply with 2 CFR 182.

22.19 DEPARTMENT OF THE INTERIOR STANDARD AWARD TERMS AND CONDITIONS

19.01

- A. The Department of the Interior (DOI) Standard Award Terms and Conditions found at <https://www.doi.gov/sites/doi.gov/files/uploads/doi-standard-award-terms-and-conditions-effective-december-2-2019-revised-june-19-2020.pdf>. are hereby incorporated by reference as though set forth in full text. These terms and conditions are in addition to the assurances and certifications made as part of the award and terms, conditions or restrictions reflected on this Agreement. Recipient acceptance of this Agreement carries with it the responsibility to be aware of and comply with all DOI terms and conditions applicable to this Agreement. The Recipient is responsible for ensuring their subrecipients and contractors are aware of and comply with applicable statutes, regulations, and agency requirements.
- B. Recipient and subrecipient failure to comply with the general terms and conditions outlined below and those directly reflected in this Agreement can result in the DOI taking one or more of remedies described in 2 Code of Federal Regulations parts 200.338 and 200.339. The DOI will notify the recipient whenever terms and conditions are updated to accommodate instances in the passage of a regulation or statute that requires compliance. Also, DOI will inform the Recipient of revised terms and conditions in the action of an Agreement amendment adding additional Federal funds. Reclamation will make such changes by issuing a Notice of Award amendment that describes the change and provides the effective date. Revised terms and conditions do not apply to the Recipient's expenditures of funds or activities the Recipient carries out before the effective date of the revised DOI terms and conditions.

Superseded General Decision Number: UT20230085

State: Utah

Construction Type: Building

County: Salt Lake County in Utah.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least \$17.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2024.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least \$12.90 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2024.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <http://www.dol.gov/whd/govcontracts>.

2	03/15/2024
3	04/19/2024
4	05/31/2024
5	07/19/2024
6	08/09/2024
7	08/16/2024
8	08/23/2024

CARP0801-002 12/01/2022

	Rates	Fringes
CARPENTER (Drywall Hanging and Metal Stud Installation Only).....	\$ 31.66	13.97

ELEC0354-001 06/11/2024

	Rates	Fringes
ELECTRICIAN (Low Voltage Wiring Only).....	\$ 29.83	1.5%+15.20
ELECTRICIAN.....	\$ 41.23	1.3%+17.12

ELEV0038-003 01/01/2024

	Rates	Fringes
ELEVATOR MECHANIC.....	\$ 53.10	37.885+a+b

FOOTNOTE:

a: Vacation Pay: 8% with 5 or more years based on regular hourly rate for all hours worked, 6% under 5 years based on regular hourly rate for all hours worked. b: Paid holidays: New Year's Day; Memorial Day; Independence Day; Labor Day; Veteran's Day; Thanksgiving Day; Friday after Thanksgiving and Christmas Day

PAIN0077-003 07/01/2022

	Rates	Fringes
DRYWALL FINISHER/TAPER.....	\$ 31.00	8.44

PAIN0077-004 08/01/2022

	Rates	Fringes
PAINTER (Brush, Roller, and Spray, excluding Drywall/Finisher and Taper).....	\$ 22.50	8.93

PLUM0140-001 08/01/2024

	Rates	Fringes
PLUMBER/PIPEFITTER.....	\$ 43.55	14.78

SFUT0669-003 01/01/2024

	Rates	Fringes
SPRINKLER FITTER (Fire Sprinklers).....	\$ 39.43	26.04

* SHEE0312-002 07/01/2024

	Rates	Fringes
SHEET METAL WORKER (Including HVAC Duct Installation).....	\$ 44.74	13.64

* SUUT2012-017 07/29/2014

	Rates	Fringes
CARPENTER (Acoustical Ceiling Installation Only).....	\$ 21.25	2.15
CARPENTER (Form Work Only).....	\$ 16.93 **	1.93
CARPENTER, Excludes Acoustical Ceiling Installation, Drywall Hanging, Form Work, and Metal Stud Installation.....	\$ 20.66	7.47
CEMENT MASON/CONCRETE FINISHER...\$	15.00 **	0.00
IRONWORKER, STRUCTURAL.....\$	20.21	3.22
LABORER: Common or General.....\$	13.84 **	0.00
LABORER: Mason Tender - Brick...\$	16.38 **	1.00
LABORER: Mason Tender - Cement/Concrete.....\$	14.94 **	0.00
LABORER: Pipelayer.....\$	13.57 **	0.00
LABORER: Landscape and Irrigation.....\$	9.50 **	0.00
OPERATOR: Backhoe/Excavator/Trackhoe.....\$	14.48 **	0.00
OPERATOR: Loader.....\$	19.34	0.00
PLASTERER.....\$	18.36	0.00
ROOFER.....\$	13.22 **	0.00
TILE FINISHER.....\$	13.54 **	0.00
TILE SETTER.....\$	23.50	0.00
TRUCK DRIVER: Dump Truck.....\$	15.50 **	0.00

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

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** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$17.20) or 13658 (\$12.90). Please see the Note at the top of the wage determination for more information. Please also note that the minimum wage requirements of Executive Order 14026 are not

currently being enforced as to any contract or subcontract to which the states of Texas, Louisiana, or Mississippi, including their agencies, are a party.

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

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and

the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data.

EXAMPLE: UAVG-OH-0010

08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination.

08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

State Adopted Rate Identifiers

Classifications listed under the "SA" identifier indicate that the prevailing wage rate set by a state (or local) government was adopted under 29 C.F.R. 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination.

01/03/2024 reflects the date on which the classifications and rates under the ?SA? identifier took effect under state law in the state from which the rates were adopted.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described

in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION"

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.1 GENERAL

- A. The work to be performed under this project shall consist of furnishing all labor, materials, and equipment necessary or required to complete the work in all respects as shown on the Contract Drawings and as herein specified. All work, materials, and services not expressly shown or called for in the Contract Documents which may be necessary to complete the construction of the work in good faith shall be performed, furnished, and installed by CONTRACTOR as though originally so specified or shown, at no increase in cost to OWNER.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. The construction of two deep well pump stations at two separate sites (7618 South 700 East and 7750 South 1000 East) related items and site work, as set forth in the Bidding Documents. Work shall include furnishing and installing the well pump, motor, discharge head, column pipe, shafting, and pump/driver appurtenances at the two sites. The work shall also include all earthwork; footings; foundations; buildings; mechanical piping; valving; HVAC; electrical; instrumentation and controls; chemical storage and feed systems; communications; vaults; surge tanks; site work; landscape and landscape irrigation; fencing; security systems; utilities; grading; backfill; drainage and drainage piping; site and transmission piping; general appurtenances; and to construct, install and test all mechanical, electrical, HVAC, landscape irrigation, drainage, and other systems and project features on and off the sites as shown and/or specified in these documents. The work also includes testing agency services and construction surveying. The work includes but is not limited to supply, installation, startup, and testing of the complete and functional facilities.
- B. CONTRACTOR shall provide start-up testing, and training of district personnel for all equipment supplied under these contract documents and furnish operation, maintenance and technical manuals pertaining to all equipment that is supplied.
- C. CONTRACTOR shall be responsible for complete improvements and systems in accordance with the intent of these Contract Documents, coordinating the details of equipment and systems which affect the work covered under the Contract Documents; and furnishing all incidental items not actually shown or specified, but which are required by good practice to provide a complete and properly functioning pump house, pump house systems, and site improvements.

1.3 CONTRACT METHOD

- A. The Work hereunder will be constructed under a lump sum contract.
- B. CONTRACTOR shall include the General Conditions and Supplementary Conditions of the Contract as a part of all its subcontract agreements.

1.4 WORK SEQUENCE

- A. Work requiring connection or abandonment to OWNER's existing waterlines shall be scheduled between October 15th through April 1st and the work shall be completed within a one-week shutdown period.
- B. The contract time for substantial and final completion is as indicated in the Agreement.

1.5 CONTRACTOR USE OF PROJECT SITE

- A. CONTRACTOR's use of the project site shall be limited to its construction operations, including on-site storage of materials and on-site fabrication facilities. Hours of construction shall be limited to from 7:00 a.m. to 7:00 p.m.

1.6 PROJECT SECURITY

- A. CONTRACTOR shall make all necessary provisions to protect the project and CONTRACTOR's facilities from fire, theft, and vandalism, and the public from unnecessary exposure to injury.

1.7 CHANGES IN THE WORK

- A. It is mutually understood that it is inherent in public works construction that some changes in the plans and specifications may be necessary during the course of construction to adjust them to unforeseen field conditions, and that it is of the essence of the Contract to recognize a normal and expected margin of change. ENGINEER shall have the right to make such changes, from time to time, in the plans, in the character of the work, and in the scope of the project as may be necessary or desirable to ensure the completion of the work in the most satisfactory manner without invalidating the Contract.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION -

SECTION 01 14 19
CONTRACTOR'S USE OF PREMISES

PART 1 GENERAL

1.1 PROJECT LOCATION

- A. The Work covered by this contract will be performed at the locations shown on the Contract Drawings.

1.2 ACCESS TO THE SITE

- A. Access to the sites shall be from public rights-of-way.
- B. CONTRACTOR shall take necessary steps to protect the rights and property of private property owners.

1.3 WORKING HOURS

- A. CONTRACTOR shall abide by all local ordinances or laws regarding work between 7:00 PM and 7:00 AM and shall obtain written variances from the regulating entities if needed or required. CONTRACTOR shall also abide by all conditions issued by OWNER.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION -

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**SECTION 01 22 00
MEASUREMENT AND PAYMENT**

PART 1 GENERAL

A.All work completed under this Contract shall be in accordance with the Contract Drawings and Specifications and will be measured by ENGINEER/OWNER. The quantities appearing on the Bid Schedule or Schedule of Values are approximate only and are prepared for the comparison of bids. The scheduled quantities of work to be done and materials to be furnished may be increased or decreased in accordance with the General Conditions.

B.The term "Lump Sum" when used as an item of payment will mean complete payment for the work described in the Contract. When a complete structure, portion of work, or unit is specified "Lump Sum" as the unit of measurement, the unit will include fittings, accessories, and all work necessary to complete the work as shown on the Contract Drawings and as specified.

1.2 BID SCHEDULE

A.BID ITEM NO. 1 - "7618 SOUTH 700 EAST PUMP STATION AND SITE IMPROVEMENTS COMPLETE"

1. **METHOD OF MEASUREMENT** This Bid Item shall not be measured but shall be paid for on a lump sum basis for the construction of the facilities, including all of the work shown and specified for the site.

2. **BASIS OF PAYMENT** Payment shall be made at the contract lump sum bid price. Payment shall be considered complete compensation for all labor, equipment, tools, and materials, mobilization/demobilization, including but not limited to adjusting well casings height; furnishing and installing the well pump, motor, discharge head, column pipe, shafting, and pump/driver appurtenances; all earthwork; excavation; footings; foundations; curb walls; sound wall; building; mechanical piping; valving; HVAC; electrical; instrumentation and controls; chlorine chemical storage and dosing system; emergency shower; SCADA and instrumentation systems; vaults; surge tank; site work; landscape and landscape irrigation; fence demolition, new fencing and 3-foot ornamental iron man gate; replace existing ornamental iron main drive gate, security systems; utilities; grading; concrete curbing, curb and gutter, and flatwork; asphalt; backfill and compaction; drainage piping and system; structures, and new detention pond; disposal of excess excavated materials; site and transmission piping and connections; general appurtenances; drain system including: floor drains, drain lines, piping, and other appurtenances as shown and as specified; installation of site drainage improvements; restoration of surface and underground improvements, including any improvement damaged or affected by the Work; new gas piping from relocated meter on New Pump House to Existing Chemical Building; permits; construction surveying and control; and to construct, install and test all mechanical, electrical, HVAC, landscape irrigation, drainage, and other systems and project features on and off the sites as shown and/or specified in these documents. Payment also includes but is not limited to supply, installation, startup, and testing of the complete and functional facilities, and all other work required to provide a complete and functioning system as identified on the drawings and specifications.

B.BID ITEM NO. 2 - "7750 SOUTH 1000 EAST PUMP STATION AND SITE IMPROVEMENTS COMPLETE"

1. **METHOD OF MEASUREMENT** This Bid Item shall not be measured but shall be paid for on a lump sum basis for the construction of the facilities, including all of the work shown and specified for the site.
2. **BASIS OF PAYMENT** Payment shall be made at the contract lump sum bid price. Payment shall be considered complete compensation for all labor, equipment, tools, and materials, mobilization/demobilization, including but not limited to adjusting well casings height; furnishing and installing the well pump, motor, discharge head, column pipe, shafting, and pump/driver appurtenances; all earthwork; excavation; footings; foundations; curb walls; sound wall; building; mechanical piping; valving; HVAC; electrical; SCADA and instrumentation systems; fluoride chemical storage and dosing system; chlorine chemical dosing system (including, but not limited to installing and start up of the tablet chlorinator unit supplied by OWNER); emergency shower; vaults; surge tank; site work; landscape and landscape irrigation; fence demolition and new fencing; security systems; utilities; grading; concrete curbing, curb and gutter, and flatwork; asphalt; new seal coat over existing pavement at the site; backfill and compaction; drainage piping; disposal of excess excavated materials; site and transmission piping and connections; general appurtenances; drain system including: floor drains, drain line, piping, and other appurtenances as shown and as specified; installation of site drainage improvements; restoration of surface and underground improvements, including any improvement damaged or affected by the Work; new gas piping from existing meter at the Existing East Building to the New Pump House; permits; construction surveying and control; and to construct, install and test all mechanical, electrical, HVAC, landscape irrigation, drainage, and other systems and project features on and off the sites as shown and/or specified in these documents. Payment also includes but is not limited to supply, installation, startup, and testing of the complete and functional facilities; and all other work required to provide a complete and functioning system as identified on the drawings and specifications.
- 3.

- END OF SECTION -

SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 COORDINATION AND PROJECT CONDITIONS

- A. Coordinate scheduling, submittals, and Work of various sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements.
- B. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion.
- C. After OWNER occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of OWNER's activities.
- D. Sandy City, OWNER (Jordan Valley Water Conservancy District), and/or utility owners may be working within the project area while this contract is in progress. If so, CONTRACTOR shall schedule his work in conjunction with these other organizations to minimize mutual interference.
- E. Water service to these areas can't be interrupted for an extended period. If water service is to be interrupted on any other pipeline, CONTRACTOR shall provide a minimum notice of 24 hours to each home or business affected. A copy of CONTRACTOR'S notification letter shall be reviewed and approved by OWNER prior to distribution. Where practicable, shutdowns shall be during the nighttime hours.
- F. If required to work in City Streets or Utah Department of Transportation (UDOT) right-of-way, CONTRACTOR shall notify UDOT or City 72 hours prior to work being performed therein. Work within the City Streets or UDOT right-of-way shall be in accordance with their required permit and any license agreement with OWNER. CONTRACTOR shall obtain and comply with all required permits.
- G. Coordination with Adjacent Property Owner
 - 1. Once each week hand-deliver or mail a written "**Construction Status Update Notice**" to all residents, businesses, schools, and property owners adjacent to and affected by the Work. Notice shall be on CONTRACTOR's company letterhead paper and be secured to doorknob should occupants not be home. Obtain ENGINEER's review of notice prior to distribution. As a minimum the notice shall contain the following:
 - a. name and phone number of CONTRACTOR's representative for the project.
 - b. work anticipated for the next 7 days including work locations and work by subcontractors and utility companies.
 - c. rough estimate of construction schedule through end of project
 - d. anticipated driveway approach closures
 - e. anticipated water, sewer, or power outages
 - f. anticipated vehicular traffic impacts, rerouting or lane closures
 - g. anticipated pedestrian impacts and sidewalk closures
 - h. changes to public transportation bus routes

- i. any other construction or work items which will impact or restrict the normal use of streets and amenities.
2. Failure to comply with this contract provision is considered grounds for project suspension per Article 15.01 of the General Conditions.

1.2 FIELD ENGINEERING

- A. CONTRACTOR shall provide all survey and construction staking as necessary to complete the required work according to the contract documents. Construction staking and surveying shall be performed by a registered Land Surveyor in the State of Utah.
- B. Locate and protect survey control and reference points. Promptly notify ENGINEER of discrepancies discovered.
- C. Control datum for survey is that shown on Contract Drawings.
- D. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- E. Promptly report to ENGINEER loss or destruction of reference point or relocation required because of changes in grades or other reasons.
- F. CONTRACTOR shall be responsible to coordinate with all property owners to determine the location of existing sewer and water service laterals.
- G. All service laterals shall be verified and indicated on the ARecord Drawings@ supplied by CONTRACTOR to ENGINEER.

1.3 PRECONSTRUCTION MEETING

- A. Prior to the commencement of work at the site, a preconstruction conference will be held at a mutually agreed time and place which shall be attended by CONTRACTOR's Project Manager, its superintendent, and its subcontractors as appropriate. Other attendees will be:
 1. ENGINEER and the Resident Project Representative (RPR)
 2. Representatives of OWNER
 3. Governmental representatives as appropriate
 4. Others as requested by CONTRACTOR, OWNER, or ENGINEER.
- B. Unless previously submitted to ENGINEER, CONTRACTOR shall bring to the conference one copy of each of the following:
 1. Progress schedule
 2. Procurement schedule of major equipment and materials and items requiring long lead time
 3. Shop Drawings/Sample/Substitute or "Or Equal" submittal schedule.
- C. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The agenda may include the following:
 1. CONTRACTOR's tentative schedules

2. Transmittal, review, and distribution of CONTRACTOR's submittals
 3. Processing applications for payment
 4. Maintaining record documents
 5. Critical work sequencing
 6. Field decisions and Change Orders
 7. Use of project site, office and storage areas, security, housekeeping, and OWNER's needs
 8. Major equipment deliveries and priorities
 9. CONTRACTOR's assignments for safety and first aid
- D. ENGINEER will preside at the preconstruction conference and will arrange for keeping the minutes and distributing the minutes to all persons in attendance.
- E. CONTRACTOR should plan on the conference taking no less than 2 hours.

1.4 PROGRESS MEETINGS

- A. CONTRACTOR shall schedule and hold regular on-site progress meetings at least weekly and at other times as required by ENGINEER or as required by progress of the work. CONTRACTOR, ENGINEER, and all subcontractors active on the site shall be represented at each meeting. CONTRACTOR may at its discretion request attendance by representatives of its suppliers, manufacturers', and other subcontractors.
- B. ENGINEER shall preside at the meetings and provide for keeping and distribution of the minutes. The purpose of the meetings will be to review the progress of the work, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop.
- C. At each construction progress meeting a progress report shall be presented by the CONTRACTOR containing an updated Progress Schedule. Where the delayed completion date of a project phase is noted, CONTRACTOR shall describe the anticipated delays or problems and outline the action plan being taken to resolve the issues.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION -

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SECTION 01 31 00
PROGRESS SCHEDULES

PART 1 GENERAL

1.1 SUBMITTALS

A. Informational Submittals:

1. Detailed Overall Progress Schedule:
 - a. Submit Progress Schedule within 14 days after Effective Date of the Agreement.
 - b. Submit an Updated Progress Schedule each month.
 - c. Provide written 2-week look ahead schedule at each progress meeting broken down in daily increments.

1.2 PROGRESS SCHEDULE

A. In addition to basic requirements outlined in General Conditions, show a detailed schedule, beginning with Notice to Proceed through Final Completion.

B. Show activities including, but not limited to the following:

1. Notice to Proceed.
2. Submittal Approval for Long Lead
3. Mobilization and Equipment Set Up
4. Construction Activities
5. Delivery of Equipment
6. Electrical System
7. Mechanical Systems
8. Commissioning, & Startup
9. Demobilization and site clean-up
10. Intermediate and Work Completion Milestones

C. Update the Overall Progress Schedule monthly, as part of progress payment process. Failure to do so may result in OWNER withholding all or part of the monthly progress payment until the Progress Schedule is updated in a manner acceptable to OWNER/ENGINEER.

1.3 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

1.4 ADJUSTMENT OF CONTRACT TIMES

- A. Reference General Conditions.
- 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.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUBMITTAL PROCEDURES

- A. General
1. This Section outlines the general terms that CONTRACTOR must follow for preparing and providing Submittals to ENGINEER for review.
 2. CONTRACTOR shall anticipate resubmitting Submittals for major equipment or complex systems.
 3. If CONTRACTOR has questions about submittal requirements, CONTRACTOR is encouraged to communicate with ENGINEER to discuss requirements prior to submitting the Submittal.
 4. Substitutions shall be clearly identified on the Submittal transmittal form and shall include all the information required per Section 01 60 00 – Product Requirements.
- B. Within 21 days after Notice to Proceed, submit a complete list of anticipated submittals, including Specifications and Drawing references for each.
- C. Wherever submittals are required by the Contract Documents, Shop Drawings, and data shall be transmitted in an electronic format to ENGINEER with a submittal transmittal form which is acceptable to ENGINEER.
- D. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix, i.e. Submittal 1, Submittal 1.A, etc.
- E. Identify Project, Contractor, subcontractor and/or supplier, pertinent drawing and detail number, and specification section number, appropriate to submittal.
- F. Each Submittal shall contain material pertaining to no more than one equipment or material item.
- G. Each Submittal shall have the Specification section and applicable paragraph number clearly identified on the front of the Submittal transmittal form. A copy of the Specification section and applicable paragraph shall be included with the Submittal and items included shall be clearly marked as either in compliance or not in compliance. For items not in compliance a description shall be provided explaining the reason for non-compliance.
- H. CONTRACTOR shall review submittals prior to submission to ENGINEER. Apply Contractor's stamp, signed and dated, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents. Identify any deviations from the Contract Documents on the submittal transmittal form.
- I. Schedule submittals to expedite Project and deliver to ENGINEER at their business address. Coordinate submission of related items.
- J. Submittals shall be submitted sufficiently in advance to allow ENGINEER not less than ten regular working days for examining the drawings. These drawings shall be accurate,

distinct, and complete and shall contain all required information, including satisfactory identification of items and unit assemblies in relation to the contract drawings and/or specifications.

- K. Identify variations from Contract Documents and product or system limitations which may adversely affect successful performance of completed Work.
- L. If a submittal is returned to CONTRACTOR marked "APPROVED", or similar notification, formal revision and resubmission will not be required.
- M. If a submittal is returned marked "APPROVED – MAKE CORRECTIONS NOTED", or similar notification, CONTRACTOR shall make the corrections on the submittal, however, formal revision and resubmission will not be required.
- N. Resubmittals
 - 1. If a Submittal is returned marked "AMEND AND RESUBMIT", or similar notification, CONTRACTOR shall revise the submittal and resubmit an electronic copy.
 - 2. Identify changes made since the previous submission.
- O. Rejected Submittals
 - 1. If a submittal is returned marked "REJECTED – RESUBMIT", or similar notification, it shall mean either that the proposed material or product does not satisfy the specification, the submittal is so incomplete that it cannot be reviewed or is a substitution request not submitted in accordance with Section 01 60 00 – Product Requirements.
 - 2. CONTRACTOR shall prepare a new submittal or submit a substitution request according to Section 01 60 00 – Product Requirements and shall submit an electronic copy.
- P. Instruct parties to promptly report inability to comply with requirements.
- Q. Submittals not requested will not be recognized or processed.
- R. Unless noted otherwise, corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as changes to the contract requirements.
- S. Fabrication or purchase of an item may only commence after ENGINEER has reviewed the pertinent submittals and returned copies to CONTRACTOR marked either "APPROVED" or "APPROVED – MAKE CORRECTIONS NOTED".
- T. ENGINEER's review of CONTRACTOR submittals shall not relieve CONTRACTOR of the entire responsibility for the corrections of details and dimensions. CONTRACTOR shall assume all responsibility and risk for any misfits due to any errors in CONTRACTOR submittals. CONTRACTOR shall be responsible for dimensions and quantities, coordinating with all trades, the design of adequate connections and details, and satisfactory and safe performance of the work.

1.2 CONSTRUCTION PROGRESS SCHEDULES

- A. Submit construction progress schedule in accordance with Section 01 31 00 – Progress

Schedule.

1.3 PRODUCT DATA

- A. Product Data: Submit to ENGINEER for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- C. After review, produce copies and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents described in Section 01 78 50 - Project Closeout.

1.4 SHOP DRAWINGS

- A. Shop Drawings: Submit to ENGINEER for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Fabrication of an item may be commenced only after ENGINEER has reviewed the pertinent submittals and returned copies to CONTRACTOR marked either "APPROVED", or "APPROVED - MAKE CORRECTIONS NOTED". Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis of claims for extra work.
- C. When required by individual specification sections, provide shop drawings signed and sealed by professional engineer responsible for designing components shown on shop drawings.
 - 1. Include signed and sealed calculations to support design.
 - 2. Submit drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
 - 3. Make revisions and provide additional information when required by authorities having jurisdiction.
- D. After review, produce copies and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents described in Section 01 78 50 - Project Closeout.

1.5 SAMPLES

- A. Whenever indicated in the Specifications or requested by ENGINEER, CONTRACTOR shall submit at least 1 sample of each item or material to ENGINEER for acceptance at no additional cost to OWNER.
- B. Samples, as required herein, shall be submitted for acceptance prior to ordering such material for delivery to the jobsite, and shall be submitted in an orderly sequence so that dependent materials or equipment can be assembled and reviewed without causing delay in the Work.
- C. Unless otherwise specified, all colors and textures of specified items will be selected by

ENGINEER from the manufacturer's standard colors and standard materials, products, or equipment lines.

1.6 CERTIFICATES

- A. When specified in individual Specification sections, submit certification by manufacturer, installation/application subcontractor, or CONTRACTOR to ENGINEER, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or Product, but must be acceptable to ENGINEER.

1.7 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to ENGINEER for delivery to OWNER in quantities specified for Product Data.
- B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.8 MANUFACTURER'S FIELD REPORTS

- A. When required in individual sections, have manufacturer or Supplier provide qualified representative to observe field conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance of equipment as applicable and to make written report of observations and recommendations to ENGINEER.

1.9 OPERATIONS AND MAINTENANCE MANUAL SUBMITTAL

- A. CONTRACTOR shall furnish ENGINEER one copy of the Operations and Maintenance Manuals in PDF electronic format. A Table of Contents shall be provided which indicates all equipment and suppliers in the Operations and Maintenance Manuals.
- B. CONTRACTOR shall include in the Operations and Maintenance manuals full details for care and maintenance for all visible surfaces as well as the following for each item of mechanical, electrical, and instrumentation equipment (except for equipment furnished by OWNER):
 - 1. Complete operating instructions, including location of controls, special tools or other equipment required, related instrumentation, and other equipment needed for operation.
 - 2. Preventative maintenance procedures and schedules
 - 3. A description of proper maintenance activities
 - 4. Complete parts lists, by generic title, identification number, and catalog number, complete with exploded views of each assembly.
 - 5. Disassembly and reassembly instruction
 - 6. Name and location of nearest supplier and spare parts warehouse

7. Name and location of manufacturer
 8. Recommended troubleshooting and start-up procedures
 9. Prints of the record drawings, including diagrams and schematics, as required under the electrical and instrumentation portions of these specifications.
- C. All Operations and Maintenance manuals shall be submitted in final form to ENGINEER not later than the 75 percent of construction completion date. All discrepancies found by ENGINEER in the Operations and Maintenance manuals shall be corrected by CONTRACTOR prior to final acceptance of the project.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION -

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SECTION 01 42 13
ABBREVIATIONS

PART 1 GENERAL

1.1 DESCRIPTION

- A. Wherever in these Specifications references are made to the standards, specifications, or other published data of the various national, regional, or local organizations, such organizations may be referred to by their acronym or abbreviation only. As a guide to the user of these specifications, the following acronyms or abbreviations which may appear in these specifications shall have the meanings indicated herein.

1.2 ABBREVIATIONS AND ACRONYMS

AASHTO	American Association of the State Highway and Transportation Officials
ACI	American Concrete Institute
AGA	American Gas Association
AGC	American General Contractors
AHA	American Hardboard Association
AI	The Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American Nation Standards Institute, Inc.
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASOC	American Society of Quality Control
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
AWPB	American Wood Preservers Bureau
BBC	Basic Building Code, Building Officials and Code Administrators International
CLFMI	Chain Link Fence Manufacturer's Institute
CMA	Concrete Masonry Association
CRSI	Concrete Reinforcing Steel Institute
DIPRA	Ductile Iron Pipe Research Association
DOC	Department of Commerce
DWQ	Department of Water Quality
DWR	Drinking Water Regulations
ECTC	Erosion Control Technology Council
EIA	Electronic Industries Association
EPA	Environmental Protection Agency
ETC	Electrical Test Laboratories

FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
HI	Hydraulic Institute
IBC	International Building Code
ICBO	International Conference of Building Officials
ICC	International Code Council
ICC-ES	International Code Council Evaluation Service
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IFC	International Fire Code
IMC	International Mechanical Code
IPC	International Plumbing Code
ISA	Instrument Society of America
ISO	International Organization of Standardization
ITE	Institute of Traffic Engineers
LPI	Lightning Protection Institute
LRQA	Lloyd's Register Quality Assurance
MBMA	Metal Building Manufacturer's Association
MSS	Manufacturers Standardization Society
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NISO	National Information Standards Organization
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
RMA	Rubber Manufacturers Association
RWMA	Resistance Welder Manufacturer's Association
SAE	Society of Automotive Engineers
SSPC	Society for Protective Coating (formerly Steel Structure Painting Council)
SSPWC	Standard Specification for Public Works Construction
TPI	Truss Plate Institute
UDOT	Utah Department of Transportation
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
WCRSI	Western Concrete Reinforcing Steel Institute
WI	Woodwork Institute
WRI	Wire Reinforcements Institute, Inc.
WWPA	Western Wood Products Association

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION -

SECTION 01 42 19
REFERENCE STANDARDS

PART 1 GENERAL

1.1 QUALITY ASSURANCE

- A. TITLES OF SECTIONS AND PARAGRAPHS. Captions accompanying Specifications sections and paragraphs are for convenience of reference only, and do not form a part of the Specification.
- B. APPLICABLE PUBLICATIONS. Whenever in these specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards or requirements of the respective issuing agencies which have been published as of the date that the work is advertised for bids, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the drawings shall be waived because of any provision of, or omission from, said standards or requirements.
- C. SPECIALISTS, ASSIGNMENTS. In certain instances, specifications test requires (or implies) that specific work is to be assigned to specialists or expert entities, who must be engaged for the performance of that work. Such assignments shall be recognized as special requirements and shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the work; also, they are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of contract requirements remains with CONTRACTOR.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of the specifications, all work specified herein shall conform to or exceed the requirements of all applicable codes and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of these Specifications nor the applicable codes.
- B. Reference herein to "Building Code" or "Uniform Building Code" shall mean the International Building Code of the International Code Council. The latest edition of the code as approved and used by the local agency as of the date of award, as adopted by the agency having jurisdiction, shall apply to the work herein, including all addenda, modifications, amendments, or other lawful changes thereto.
- C. In case of conflict between codes, reference standards, drawings and the other Contract Document, the most stringent requirements shall govern. All conflicts shall be brought to the attention of ENGINEER for clarification and directions prior to ordering or providing any materials or labor. CONTRACTOR shall bid the most stringent requirements.
- D. APPLICABLE STANDARD SPECIFICATIONS. CONTRACTOR shall construct the work specified herein in accordance with the requirements of the Contract Documents

and the referenced portions of those referenced codes, standards, and specifications listed herein; except, that wherever references to "Standard Specifications" are made, the provisions therein for measurement and payment shall not apply.

- E. References in the Contract Documents to "Standard Specifications" shall mean the Contract Documents including all current supplements, addenda, and revisions thereof.
- F. References herein to "OSHA Regulations for Construction" shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.
- G. References herein to "OSHA Standards" shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including changes and amendments thereto.
- H. UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY. Wells, tanks, pumping stations and culinary water pipelines shall conform to the requirements of Utah Administrative Code Rule R 309. Water and sewer pipeline installation shall conform to the requirements of Utah Administrative Code Rule R 317-3-2.9 "Protection of Water Supplies" for horizontal and vertical separation.
- I. UTAH DEPARTMENT OF TRANSPORTATION (UDOT) REQUIREMENTS. CONTRACTOR's work on UDOT property or right-of-way shall conform to UDOT's latest edition of Standard Specifications for Road and Bridge Construction.
- J. U.S. ARMY CORPS OF ENGINEERS (COE) REQUIREMENTS. CONTRACTOR's work shall conform to C.O.E. Specifications in accordance with Section 404 of the Clean Water Act for excavation in wetlands.
- K. Reference herein to APWA shall mean the latest edition of the "Manual of Standard Specifications" and "Manual of Standard Plans" as prepared by the American Public Works Association and the Associated General Contractors of America.
- L. All provisions of the Manual of Standard Specifications, Latest Edition and Manual of Standard Plans, Latest Edition both published by the Utah Chapter of the American Public Works Association are hereby made a part of the Contract Documents by reference. The publications may be purchased separately from the Utah Technology Transfer Center, Utah State University, 4111 Old Main Hill, Logan, UT 84322-4111. Any conflicts, between the technical specifications, drawings, and other provisions or documents contained in the Contract Form or Contract Documents versus provisions contained in the Manual of Standard Specifications, Latest Edition and Manual of Standard Plans, Latest Edition published by the Utah Chapter of the American Public Works Association, shall be resolved in favor of the most stringent of the criteria and conditions as determined by ENGINEER.
- M. All provisions of JWCD standards and City standards for the various municipalities in which this project is located (i.e. Sandy City and Midvale City) are hereby made a part of the Contract Documents by reference. Any conflicts, between the technical Specifications, Contract Drawings, and other provisions or documents contained in the Contract Form or Contract Documents versus provisions contained in JWCD standards, or City standards, shall be resolved in favor of the most stringent of the criteria and conditions as determined by ENGINEER.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION -

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SECTION 01 45 00
QUALITY CONTROL AND MATERIALS TESTING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section outlines responsibilities for controlling quality of materials, products, and workmanship.

1.2 MATERIALS

- A. All materials incorporated in the project shall be new and shall fully comply with the specifications. Unless otherwise clearly provided in the specifications, all workmanship, equipment, materials, and articles incorporated in the work covered by the Contract are to be of the best available grade of their respective kinds. Whenever, in the Specifications, any material, article, device, product, fixture, form, type of construction, or process indicated or specified by patent or proprietary name, by name of manufacturer, or by catalog number, such specifications shall be deemed to be used for the purpose of establishing a standard of quality and facilitating the description of the material or process desired and shall be deemed to be followed by the words "or approved equal" and CONTRACTOR may in such case, upon receiving ENGINEER's approval, purchase and use any item, type, or process which shall be substantially equal in every respect to that indicated or specified.
- B. Materials and equipment may be used in the Work based upon receipt of a Supplier's certificate of compliance. Certificate must be in possession of CONTRACTOR and reviewed by ENGINEER prior to use.
- C. Quality Assurance Testing by OWNER and/or ENGINEER shall not relieve CONTRACTOR of responsibility to furnish materials and work in full compliance with Contract Documents.

1.3 MANUFACTURER'S INSTRUCTIONS

- A. Should instructions conflict with Contract Documents, request clarification before proceeding.
- B. When required in individual sections, submit manufacturer's instructions in the quantity required for product data, delivery, handling, storage, assembly, installation, start-up, adjusting, balancing, and finishing, as appropriate.

1.4 WORKMANSHIP

- A. Maintain performance control and supervision over Subcontractors, Suppliers, manufacturers, products, services, workmanship, and site conditions, to produce work in accordance with Contract Documents.
- B. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- C. Provide suitable qualified personnel to produce specified quality.

- D. Ensure finishes match approved samples.

1.5 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from ENGINEER before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.6 TESTING AND INSPECTION SERVICES

- A. The testing agency and testing for quality control and material testing shall be furnished by OWNER as part of the project. CONTRACTOR shall coordinate work to ensure all required testing is performed by OWNER provided testing agency. Results of testing shall be reported to CONTRACTOR and ENGINEER on site. Reports of the testing shall be transmitted directly to the ENGINEER.
- B. Materials to be supplied under this contract will be tested and/or inspected either at their place of origin or at the site of the work by the testing agency. CONTRACTOR shall give ENGINEER written notification well in advance of actual readiness of materials to be tested and/or inspected at point of origin so ENGINEER may witness testing by the testing agency. Satisfactory tests and inspections at the point of origin shall not be construed as a final acceptance of the material nor shall it preclude retesting or reinspection at the site of the work.
- C. CONTRACTOR shall furnish such samples of materials as are requested by the ENGINEER, without charge. No material shall be used until reports from the testing agency have been reviewed and accepted by ENGINEER. See Section 01 33 00, Submittal Procedures.

1.7 UNSATISFACTORY CONDITIONS

- A. Examine areas and conditions under which materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

1.8 AUTHORITY AND DUTIES OF PROJECT REPRESENTATIVE

- A. Refer to Section 9.03 of the General Conditions.

1.9 QUALITY CONTROL TESTING

- A. ENGINEER's failure to detect any defective Work or materials does not prevent later rejection when such defect is discovered, nor does it obligate ENGINEER for acceptance.
- B. CONTRACTOR shall provide 24-hours minimum notice to ENGINEER for all testing required by these specifications so that ENGINEER may coordinate or be present during testing.

1.10 TESTING ACCEPTANCE AND FREQUENCY

- A. Minimum Quality Control Testing Frequency: As defined in Table 01 45 00-1, CONTRACTOR shall be responsible to ensure that all testing is performed at the frequencies shown. CONTRACTOR shall uncover any work at no cost to OWNER to allow the testing agency to perform required testing at the frequency shown.
- B. Acceptance of Defective Work: As defined in Article 13.06 of the General Conditions.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

TABLE 01 45 00-1: QUALITY CONTROL TESTING FREQUENCY

SYSTEM or MATERIAL	TESTS	MINIMUM REQUIRED FREQUENCY
SUBGRADE AND BACKFILL MATERIALS		
Section 31 23 15 Excavation and Backfill for Buried Pipelines	Field Density	1 test per 200 linear feet per 1.5 feet of backfill thickness placed.
	Laboratory	1 test for each material type which includes proctor, classification, and gradation.
Section 31 23 23 Excavation and Backfill for Structures	Field Density	1 test per 200 linear feet per 1.5 feet of backfill thickness placed.
	Laboratory	1 test for each material type which includes proctor, classification, and gradation.
Section 32 11 23 Road Base - Untreated Base Course	Field Density	<u>Base course subgrade</u> : 1 test per 2,000 square feet of area. <u>Base course</u> : 1 test per 2,000 square feet of area.
	Laboratory	<u>Base course</u> : 1 test for each material type which includes proctor, classification, and gradation.
ASPHALT		
Section 32 12 16 Hot-Mix Asphalt Concrete Paving	Mix Design	<u>Marshall Test Method</u> : 1 test initially per each type of material and each change in target, and for each day of production thereafter. <u>Specific Gravity</u> : 1 per each Marshall Test <u>Extraction</u> : 1 test per each Marshall Test
	Field Density	<u>Bituminous surfaces</u> : 1 test per 2,000 square feet placed or part thereof.
	Asphalt Thickness and Core Density	<u>Bituminous surfaces</u> : 1 test sample every 300 linear feet of completed roadway.
PORTLAND CEMENT CONCRETE		
Section 3 30 00 Cast-in-Place Concrete	Slump	1 test every day of placement (if less than 100 cubic yards in a day), 1 test for every 100 cubic yards, or 1 test for each 3,000 square feet of surface area for slabs and more frequently if batching appears inconsistent.
	Entrained air	1 test with slump test.
	Ambient and concrete temperatures	1 test with slump test.
	Water cement ratio.	to be verified and provided with batch tickets.

SYSTEM or MATERIAL	TESTS	MINIMUM REQUIRED FREQUENCY
	Compressive strength	1 set of 5 cylinders (See Note 5). 1 test every day of placement (if less than 100 cubic yards in a day), 1 test for every 100 cubic yards, or 1 test for each 3,000 square feet of surface area for slabs, and more frequently if batching appears inconsistent. (See Section 03 30 00-3.5.A.3 for additional requirements.) Each sample used to mold strength test specimens shall be tested for slump, air content, and temperature.
<p>NOTES:</p> <ol style="list-style-type: none"> 1 Additional tests shall be conducted when variations occur due to CONTRACTOR's operations, weather conditions, site conditions, etc. 2 Classification, moisture content, Atterberg limits and specific gravity tests shall be conducted for each compaction test, if applicable. 3 Tests can substitute for same tests required under "Aggregates" (from bins or source), although gradations will be required when blending aggregates. 4 Aggregate moisture tests are to be conducted in conjunction with concrete strength tests for water/cement calculations. 5 Strength tests shall be the average of the strengths of at least two (2) 6-inch diameter by 12-inch high cylinders. If 4-inch diameter cylinders are used, collect an additional cylinder (6 total) and the strength test shall be the average of the strengths of at least three (3) 4-inch by 8-inch high cylinders. 		

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SECTION 01 45 23
TESTING AGENCY SERVICES

PART 1 GENERAL

1.1 SUMMARY

- A. OWNER shall be responsible for providing Construction Quality Control Testing of all soils, concrete, asphalt, etc. as required by the various sections of these specifications. This section includes the following:
1. Use of independent testing agency
 2. Control testing report submittal requirements
 3. Responsibilities of testing agency

1.2 RELATED WORK

- A. Related Work specified in other Sections includes, but is not limited to:
1. Section 01 22 00 Measurement and Payment
 2. Section 01 33 00 Submittal Procedures
 3. Section 01 45 00 Quality Control and Materials Testing

1.3 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM D 3740: Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
 2. ASTM D 4561 Standard Practice for Quality Control Systems for Organizations Producing and Applying Bituminous Paving Materials
 3. ASTM E 329 Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

1.4 DEFINITIONS

- A. Independent Testing Agency: A testing agency NOT owned by CONTRACTOR, and an agency that does not have any preferential affiliation or association with CONTRACTOR, or any of CONTRACTOR's Subcontractors and Suppliers.
- B. Professional Engineer: An engineer who complies with Utah licensing law and is acceptable to the authority having jurisdiction.

1.5 QUALITY CONTROL

- A. OWNER shall employ and pay for services of an independent testing agency which complies with ASTM D 3740, ASTM D 4561, and ASTM E 329 to test materials for contract compliance.

1.6 CONTRACTOR SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures

1.7 TESTING AGENCY SUBMITTALS

- A. Field Test Report: Submit report no later than the end of the current day.
- B. Laboratory Test Report: Submit original report within 48 hours after test results are determined.
- C. Final Summary Report: Submit prior to final payment
- D. On all reports include:
 - 1. Project title, number and date of the report
 - 2. Date, time and location of test
 - 3. Name and address of material Supplier
 - 4. Identification of product being tested and type of test performed
 - 5. Identify whether test is initial test or retest
 - 6. Results of testing and interpretation of results
 - 7. Name of technician who performed the testing

1.8 RESPONSIBILITIES OF TESTING AGENCY

- A. Calibrate testing equipment at least annually with devices with an accuracy traceable to either National Bureau of Standards or acceptable values of natural physical constraints.
- B. Provide sufficient personnel at site and cooperate with CONTRACTOR, ENGINEER and OWNER's Representative in performance of testing service.
- C. Secure samples using procedures specified in the applicable testing code.
- D. Perform testing of products in accordance with applicable sections of the Contract Documents.
- E. Immediately report any compliance or noncompliance of materials and mixes to CONTRACTOR, ENGINEER, and OWNER's Representative.
- F. When an out-of-tolerance condition exists, perform additional inspections and testing until the specified tolerance is attained, and identify retesting on test reports.

1.9 LIMITS ON TESTING AGENCY AUTHORITY

- A. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.

B. Agency may not suspend Work.

C. Agency has no authority to accept Work for OWNER.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION -

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SECTION 01 50 00

TEMPORARY CONSTRUCTION UTILITIES AND ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers temporary utilities, including electricity, lighting, telephone service, water, and sanitary facilities; temporary controls, including barriers, protection of work, and water control; and construction facilities, including parking, progress cleaning, and temporary buildings.

1.2 TEMPORARY UTILITIES

- A. Temporary Electricity: CONTRACTOR shall provide, maintain, and pay for all power required by CONTRACTOR, including electrical service to any CONTRACTORS field office.
- B. Temporary Lighting: CONTRACTOR shall provide all temporary lighting required for execution of his work and for employee and public safety. As a minimum, lighting levels during working hours shall meet the requirements of OSHA Subsection 1926.56 illumination.
- C. Temporary Heating and Cooling
1. Provide heating and cooling devices as needed to maintain specified conditions for construction operations.
- D. Temporary Ventilation
1. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- E. Telephone Service: CONTRACTOR shall provide, maintain and pay for telephone services and to the field office (if required), at time of project mobilization.
- F. Temporary Water Service
1. CONTRACTOR shall provide for all his workers on the project, adequate and reasonably convenient uncontaminated drinking water supply. All facilities shall comply with the regulations of the local and State Departments of Health.
 2. CONTRACTOR shall be responsible to arrange for water, both potable and non-potable water.
 3. When water is taken from a city water system or any other potable water supply source for construction purposes, suitable precautions shall be taken to prevent cross connections and contamination of the water supply.
- G. Temporary Sanitary Facilities: CONTRACTOR shall provide and maintain sanitary facilities for his employees and his subcontractors' employees that will comply with the regulations of the local and State Departments of Health.

1.3 TEMPORARY CONTROLS

- A. Barriers: Provide barriers as necessary to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.
- B. Project Security
 - 1. CONTRACTOR shall make all necessary provisions to protect the project and CONTRACTOR's facilities from fire, theft, and vandalism, and the public from unnecessary exposure to injury.
 - 2. Entry Control:
 - a. Restrict entrance of persons and vehicles into Project site.
 - b. Allow entrance only to authorized persons.
- C. Dust Control: Execute Work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into the atmosphere. Give all unpaved streets, roads, detours, or haul roads used in the construction area an approved dust-preventive treatment or periodically water to prevent dust. Applicable environmental regulations for dust prevention shall be strictly enforced. **If required, CONTRACTOR shall submit a Fugitive Dust Control Plan to the Division of Air Quality, which meets all state requirements (R307-309). CONTRACTOR shall comply with all the state requirements in R307-309**
- D. Pest Control: Provide methods, means, and facilities to prevent rodents, pests and insects from damaging the Work.
- E. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. All chemicals used during construction or furnished for project operation whether defoliant, soil sterilant, herbicide, pesticide, disinfectant, polymer, reactant or of other classification, shall show approval of the U.S. Department of Agriculture. Use of all such chemicals and disposal of residues shall be in strict accordance with the printed instruction of the manufacturer.
- F. Protection of Work: CONTRACTOR shall protect installed work and provide special protection where specified in individual specifications sections. CONTRACTOR shall provide temporary and removable protection for installed products and shall control activity in immediate work area to minimize damage.
- G. Open Burning: No open burning of waste materials will be allowed.
- H. Explosives and Blasting: The use of explosives on the work will not be permitted.
- I. Noise Abatement: In inhabited areas, particularly residential, operations shall be performed in a manner to minimize unnecessary noise generation.
- J. Storm and Ground Water
 - 1. CONTRACTOR shall provide and always maintain during construction, ample means and devices with which to promptly remove and properly dispose of all water entering

- the excavation or other parts of the work, whether the water be from surface or underground water sources.
2. In excavation, fill, and grading operations, care shall be taken to disturb the pre-existing drainage pattern as little as possible. Particular care shall be taken not to direct drainage water into private property or into streets or drainage ways inadequate for the increased flow.
 3. CONTRACTOR shall maintain effective means to minimize the quantity of sediments leaving the work area either by storm water or CONTRACTOR's own dewatering operations. CONTRACTOR shall be responsible for obtaining required permits and complying with all City, State, and Federal storm water management regulations and requirements.
 4. For the 700 East Well House, CONTRACTOR shall adopt and implement the Storm Water Pollution Prevention Plan (SWPPP) for Construction Activities provided by OWNER. CONTRACTOR shall complete the SWPPP by filling in all required information, including obtaining and inserting the Notice of Intent into the document, and submitting the SWPPP to the OWNER and Sandy City for review and approval. In addition, CONTRACTOR shall be fully responsible for implementing the SWPPP, including implementing all required Best Management Practices (BMPs) identified in the SWPPP, performing and documenting all required inspections at the minimum frequency identified in the SWPPP, executing the delegation of authority form, maintaining the corrective action log, performing all required record keeping and training (including maintaining documentation of training), maintaining a log of any changes to the SWPPP, executing the Certification and Notification form at the completion of the project, executing Subcontractor Certification/Agreements, etc., and filing the Notice of Termination.
 5. For the 1000 East Well House located in Midvale City, CONTRACTOR shall prepare and implement an Erosion Control Plan or a Storm Water Pollution Prevention Plan (SWPPP) for Construction Activities as required by Midvale City. If required by the City, CONTRACTOR shall submit a copy of the Notice of Intent and the SWPPP or Erosion Control Plan to OWNER and Midvale City for review and approval.

1.4 CONSTRUCTION FACILITIES

A. VEHICULAR ACCESS

1. Construct temporary access roads from public thoroughfares to serve construction area, of width and load bearing capacity to accommodate unimpeded traffic for construction purposes.
2. Extend and relocate vehicular access as Work progress requires, provide detours as necessary for unimpeded traffic flow.
3. Location of temporary access roads and detours shall be approved by ENGINEER.
4. Provide unimpeded access for emergency vehicles.
5. Provide and maintain access to fire hydrants and control valves free of obstructions.
6. Provide means of removing mud from vehicle wheels before entering streets.
7. When possible, use existing on-site roads for construction traffic.

- B. Parking: CONTRACTOR shall provide temporary parking areas to accommodate use of construction personnel. Parking shall be located in an area approved by ENGINEER.

C. Progress Cleaning

1. CONTRACTOR shall maintain areas free of waste materials, debris, and rubbish. Maintain the site in a clean and orderly condition. Upon completion of work, repair all damage caused by equipment and leave the project site free of rubbish or excess materials of any kind.
2. Thoroughly clean all spilled dirt, gravel, or other foreign materials caused by the construction operations from all streets and roads at the conclusion of each day's operation.
3. It shall be the responsibility of CONTRACTOR to promptly clean up and remove any oil and/or fuel spills caused by CONTRACTOR or his Sub-contractors during the project. Contaminated soil shall be properly disposed of by CONTRACTOR in accordance with all applicable laws. CONTRACTOR shall be responsible for any damages to OWNER resulting from CONTRACTOR's negligence in promptly cleaning up said spills.

1.5 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Prior to Final Application for Payment, CONTRACTOR shall remove temporary above grade or buried utilities, equipment, facilities, and materials; clean and repair damage caused by installation or use of temporary work; and restore existing facilities used during construction to original condition.

1.6 CULTURAL RESOURCES

- A. CONTRACTOR's attention is directed to the National Historic Preservation Act of 1966 (16 U.S.C. 470) and 36 CFR 800 which provides for the preservation of potential historical architectural, archeological, or cultural resources (hereinafter called "cultural resources").
- B. CONTRACTOR shall conform to the applicable requirements of the National Historic Preservation Act of 1966 as it relates to the preservation of cultural resources.
- C. If a suspected or unsuspected historical, archaeological, or paleontological item, feature, or site or other cultural resource is encountered during subsurface excavations at the site of construction, the following procedures shall be instituted:
 1. Construction operations shall be immediately stopped in the vicinity of the discovery and ENGINEER and OWNER shall be notified of the nature and exact location of the finding. CONTRACTOR shall not damage the discovered objects and shall provide written confirmation of the discovery to ENGINEER within two (2) calendar days.
 2. OWNER and ENGINEER will then immediately notify the State Historical Preservation Office (SHPO) and the Utah Geological Survey (UGS).
 3. SHPO and UGS will investigate the finding and determine if the resource requires protection and the disposition of the said resource.
- D. If SHPO and UGS determine that the potential find is a bona fide cultural resource, CONTRACTOR shall suspend work at the location of the find under the provisions for changes contained in Articles 10, 11, and 12 of the General Conditions.

PART 2 PRODUCTS

2.1 TEMPORARY EROSION CONTROL MATERIALS

- A. EROSION CONTROL BLANKETS

1. Erosion control blankets shall meet the requirements of the Erosion Control Technology Council (ECTC) and the FHWA Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects, FP-03 Section 713.17 as a Type 3.B Extended Term Double Net Erosion Control Blanket. The erosion control blanket shall be fabricated from UV-stabilized polypropylene and a straw/coconut blend. The blanket shall be **Model SC150 by Tensar North American Green, Excel CS-3 by Western Excelsior**, or approved equal. The functional longevity shall be 24 months minimum.

B. SILT FENCE

1. Use woven fabric meeting the following properties.

Table 1 - Silt Fence Geotextile			
Property	ASTM	MARV's	
		Standard	High Performance
Grab Tensile Strength, lbs.	D 4632	90 ^(a)	120 ^(a)
Grab Elongation, %	D 4632	< 40	< 40
Flux, gal/min/ft ²	D 4491	15	90
Apparent Opening Size, (AOS-US sieve)	D 4751	> 20	> 30
Ultraviolet Degradation, %	D 4355	70	90
NOTES (a) Percent of tensile strength retained determined after weathering per ASTM D 4355 for 500-hours			

2. High performance fence to have tape yarns in one principal direction only.
3. Add stabilizers or inhibitors to make the filaments resistant to sunlight or heat deterioration.
4. Finish edges to prevent outer yarn from pulling away from the fabric.
5. Sheets of fabric may be sewn or bonded together. Provide minimum width recommended by manufacturer.
6. No deviation from any requirement in Table 2 due to the presence of seams.
7. Manufactured with pockets for posts, hems with cord, or with posts pre-attached using staples or button head nails.

C. POSTS

1. Minimum length: 4-feet.
2. Steel: Round, U shaped, T shaped, or C shaped with a minimum weight of 1.3-pounds per foot and have projections for fastening wire.

3. Wood as follows:
 - a. Soft wood posts at least 3-inches in diameter, or nominal 2 x 4-inches and straight to provide a fence without noticeable misalignment.
 - b. Hard wood post providing a minimum cross-sectional area of 2.25 square-inches.
4. Fasteners for Wooden Posts:
 - a. Wire staples No. 17 gage minimum with a crown at least 3/4-inches wide and legs at least 1/2-inch long.
 - b. Nails 14 gage minimum, 1-inch long with 3/4-inch button.

PART 3 EXECUTION

3.1 SILT FENCE

- A. Beginning work means acceptance of existing conditions.
- B. Maintain the silt fence until revegetation is complete (defined as when cover reaches a density of at least 70% of pre-disturbance levels. (See storm water permit requirements in Section 01 41 00).
- C. Clear area of any debris and obstructions that may damage geotextile.
- D. Place post in all low points.
- E. Install posts a maximum of 8-feet apart with at least 18-inches in the ground. If not possible to achieve depth, secure posts to prevent overturning.
- F. Attach filter fabric by wire, cord, pockets, staples, nails, or other effective means.
 1. When using a wire support fence, provide at least 6 horizontal wires with a minimum of 12 gage wire. Space vertical wires 6-inches maximum. Secure geotextile to the up-slope side of the post. Extend wire into the trench a minimum of 2-inches and extend a maximum of 36-inches above the ground surface.
- G. Install fabric so 6 to 8-inches of fabric is left at the bottom to be buried. Splice together only at support posts with at least a minimum overlap of 18-inches. Extend buried portion 6-inches deep and the rest upstream of the fabric fence.
- H. Sediment Removal: Remove sediment before deposit reaches 1/2 of the height of the silt fence or extend height of silt fence. After removal of sediment, dress landscape.
- I. Schedule of Locations: Typical locations include the toe of fill slopes, the downhill side of fill slopes, the downhill side of large cut areas, and at natural drainage areas. Limit geotextile materials to handle an area equivalent to 1,000 square feet per 10-feet of fence. Use caution should site slope be steeper than 1:1 (horizontal: vertical), and water flow rates exceed 1 cubic foot per second per 10-feet of fence face.

- END OF SECTION -

SECTION 01 55 26
TRAFFIC CONTROL

PART 1 GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall comply with all rules and regulations of the City, County, and State authorities regarding the closing of public streets or highways. If conditions justify, ENGINEER may authorize CONTRACTOR to conduct his work in specific areas and to specific tasks to avoid sporadic and unorganized work efforts.
- B. All work performed on or within the right-of-way of state roads shall have traffic control devices in place before work begins that meet the requirements of Utah Department of Transportation's "Specifications for Excavation on State Highways".
- C. No road shall be closed by CONTRACTOR to the public except by express permission of the City in which the work is located and after obtaining the required permits. Where it is necessary to close a county or city road to thru traffic, the road shall be closed to thru traffic only - not local traffic. The road shall be closed for one block only, not over 700 feet. The road shall be barricaded at each point of public access with barricades meeting the Utah Department of Transportation's specifications.
- D. Traffic must be kept open on those roads and streets where no detour is possible. CONTRACTOR shall always conduct his work so as to insure the least possible obstruction to traffic and normal commercial pursuits. All obstructions within traveled roadways shall be protected by approved signs, barricades, and lights where necessary for the safety of the traveling public. The convenience of the public and residents, and the protection of persons and property are of prime importance and shall be provided for by CONTRACTOR in an adequate and satisfactory manner.
- E. Excavations on project sites from which the public is excluded shall be marked or guarded in a manner appropriate for the hazard.

1.2 TRAFFIC CONTROL

- A. For the protection of traffic in public or private streets and ways, CONTRACTOR shall provide, place, and maintain all necessary barricades, traffic cones, warning signs, lights, and other safety devices in accordance with the requirements of the "Manual on Uniform Traffic Control Devices for Streets and Highways, Part VI - Temporary Traffic Control," published by U.S. Department of Transportation, Federal Highway Administration. CONTRACTOR shall take all necessary precautions for the protection of the work and the safety of the public. All barricades and obstructions shall be illuminated at night, and all lights shall be kept burning from sunset until sunrise. CONTRACTOR shall station such guards or flaggers and shall conform to such special safety regulations relating to traffic control as may be required by the public authorities within their respective jurisdictions. All signs, signals, and barricades shall conform to the requirements of Subpart G, Part 1926, of the OSHA Safety and Health Standards for Construction.
- B. If at any time the conditions indicate that CONTRACTOR's protective facilities and service are inadequate to assure the safety of the public or CONTRACTOR's workers,

CONTRACTOR shall provide additional facilities or services as may be necessary to assure protection at no additional cost to the OWNER.

- C. Where required, CONTRACTOR shall obtain a traffic control permit from the governing agency prior to beginning work and shall comply with all requirements of the permit.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION -

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 PRODUCTS

- A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.
- B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.
- C. Furnish interchangeable components from the same manufacturer for components being replaced.

1.2 PRODUCT DELIVERY REQUIREMENTS

- A. Transport and handle products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.3 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect products in accordance with manufacturers' instructions.
- B. Store with seals and labels intact and legible.
- C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- D. For exterior storage of fabricated products, place on sloped supports above ground.
- E. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- F. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- G. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- H. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.4 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.

- B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with the following article.

1.5 PRODUCT SUBSTITUTION PROCEDURES

- A. ENGINEER will consider requests for Substitutions only after Notice of Award.
- B. Substitutions may be considered when a product becomes unavailable through no fault of CONTRACTOR.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- D. A request constitutes a representation that CONTRACTOR:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of specified product.
 - 2. Will provide the same warranty for a Substitution as for specified product.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to OWNER.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 5. Will reimburse OWNER for review or redesign services associated with re-approval by authorities having jurisdiction.
- E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.
- F. Substitution Submittal Procedure:
 - 1. Submit electronic copies of request for Substitution for consideration to ENGINEER.
 - 2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. The burden of proof is on the proposer.
 - 3. ENGINEER may require CONTRACTOR to provide additional data about the proposed substitution.
 - 4. ENGINEER will be the sole judge as to the type, function, and quality of any such substitution and ENGINEER's decision shall be final.
 - 5. ENGINEER will notify CONTRACTOR in writing of decision to accept or reject request.
 - 6. Acceptance by ENGINEER of a substitution proposed by CONTRACTOR shall not relieve CONTRACTOR of the responsibility for full compliance with the Contract Documents and for the adequacy of the substitution.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 GENERAL

- A. Products shall be installed in accordance with the manufacturers' requirements in a workmanlike manor.

- END OF SECTION -

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SECTION 01 71 13
MOBILIZATION

PART 1 GENERAL

1.1 DESCRIPTION

- A. This Section is provided to cover CONTRACTOR's cost of general and miscellaneous responsibilities and operations not normally attributed to, or included in, any other single bid item. This shall include, but not necessarily be limited to, work described or enumerated in this section under the following subsections.

1.2 MOVING TO AND FROM THE JOB SITE

- A. This shall include CONTRACTOR's preliminary arrangement for starting and stopping construction operations, work schedules, and transportation of equipment and personnel to and from the project.

1.3 CLEAN-UP

- A. The cost of all clean-up work as specified and not covered under other items shall be included in the Bid. Values shall be included in the Schedule of Values, lump-sum price, for "Mobilization/Demobilization".

1.4 TEMPORARY UTILITIES

- A. The cost of water, power, etc. required by CONTRACTOR in performing the work specified in the contract shall be included in the Bid. Values shall be included in the Schedule of Values, lump-sum price, for "Mobilization/Demobilization".

1.5 PERFORMANCE BOND, PAYMENT BOND, AND INSURANCE

- A. The cost of the performance bond, payment bond, and any required insurance and/or other miscellaneous cost associated with this project shall be included in the Bid. Values shall be included in the Schedule of Values, lump-sum price, for "Mobilization/Demobilization".

1.6 PERMITS

- A. CONTRACTOR shall provide all necessary permits for completion of the work. Values shall be included in the Schedule of Values, lump-sum price, for "Mobilization/Demobilization".

1.7 PRE-CONSTRUCTION VIDEO RECORDS

- A. CONTRACTOR required to produce a preconstruction video recording of areas where Work is to be performed. The video record shall be of professional quality and the coverage shall be such as to allow accurate determination of location, size, and conditions, etc. of existing features and improvements within the rights-of-way. CONTRACTOR shall provide OWNER with a copy of the rights-of-way video in electronic format on a digital video disc (DVD) or solid-state drive (USB or Thumb Drive) before construction begins.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION -

SECTION 01 76 30
PROTECTION OF EXISTING FACILITIES

PART 1 GENERAL

1.1 DESCRIPTION

- A. Any existing facilities disturbed, which are located in or adjacent to the line of work such as curbs, gutters, drive approaches, sidewalks, driveways, fences, underground pipes, conduits, or utilities, shall be cleaned up and restored in kind by CONTRACTOR and in accordance with the Specifications contained herein governing the various types of services involved.
- B. CONTRACTOR shall not perform work that would affect any oil, gas, sewer, or water pipeline; any telephone, fiber optic, television cable, or electric transmission line; any fence; or any structure, until authorization has been obtained from owner of the improvement. Provide owner of the improvement due notice of the beginning of the work, and remove, shore, support, or otherwise protect such improvement or replace the same.

1.2 RELATED WORK

- A. Related work specified in other sections includes, but is not limited to:
 - 1. Section 01 78 50 – Project Closeout

1.3 RESTORATION OF FENCES

- A. Where it is necessary to remove any fence to facilitate CONTRACTOR's operation, CONTRACTOR shall obtain prior agreement with owner for removal of the fence and shall be responsible for any damage due to negligence of CONTRACTOR. As soon as practical, the fence shall be restored substantially to the same or improved condition as it was prior to the commencement of the work. Where livestock is present CONTRACTOR shall provide temporary fencing to keep livestock away from the construction area.

1.4 UNDERGROUND SERVICE ALERT

- A. Prior to any excavation in the vicinity of any existing underground facilities, including all water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities; and all roadway and state highway rights-of-way, CONTRACTOR shall notify the regional notification center (Blue Stakes of Utah) at 1-800-662-4111 or 811 or submit an on-line request at www.bluestakes.org at least 2 days, but no more than 7 days, prior to such excavation.

1.5 INTERFERING STRUCTURES AND UTILITIES

- A. CONTRACTOR shall exercise all possible caution to prevent damage to existing structures and utilities, whether above ground or underground. Prior to submittal of Shop Drawings, and prior to commencing any excavations for new pipelines or structures, conduct investigations, including exploratory excavations and borings, to determine the

location and type of underground utilities and services connections that could result in damage to such utilities. It shall be the responsibility of CONTRACTOR to locate and expose all existing underground and overhead structures and utilities in such a manner as to prevent damage to same. CONTRACTOR shall notify all utility offices concerned at least 48 hours in advance of construction operations in which a utility agency's facilities may be involved. This shall include, but not be limited to, irrigation water, culinary water, telephone, television cables, fiber optic communication, gas, sewer, storm drain, traffic signals, street lighting and electric. CONTRACTOR shall be responsible for any and all changes to reconnections to public utility facilities encountered or interrupted during prosecution of the work, and all costs relating hereto shall be at CONTRACTOR's expense. CONTRACTOR shall contract with and pay Public Utility Agencies for work required in connection with all utility interferences and handle all necessary notifications, scheduling, coordination, and details. The cost of public utility interferences shall be included in CONTRACTOR's lump sum or unit price bid covering the major contract facility to which interference or changes are attributable.

- B. All exploratory excavations shall be performed as soon as practicable after Notice to Proceed and, in any event, a sufficient time in advance of the construction to avoid possible delays to CONTRACTOR's progress. Prepare a report identifying each utility by its size, elevation, station, and material of construction. Immediately notify ENGINEER and the utility in writing as to any utility discovered in a different position than as marked in the field or shown on the Drawings, or any utility which is not marked in the field or not shown on the Drawings.
- C. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the utility. Conform to local agency requirements for backfill and pavement repair after performing exploratory excavations.
- D. Any damage to private property, either inside or outside the limits of the easements provided by OWNER, shall be the responsibility of CONTRACTOR. Any roads, structures, or utilities damaged by the work shall be repaired or replaced in a condition equal to or better than the condition prior to the damage. Such repair or replacement shall be accomplished at CONTRACTOR's expense without additional compensation from OWNER.
- E. CONTRACTOR shall remove and replace small miscellaneous structures such as fences and culverts which are damaged by the construction activity at his own expense without additional compensation from OWNER. CONTRACTOR shall replace these structures in a condition as good as or better than their original condition.
- F. At points where CONTRACTOR's operations are adjacent to or across properties of railway, fiber optic, telephone, irrigation canal, power, gas, water, or adjacent to other property (damage to which might result in considerable expense, loss, and inconvenience), no work shall be started until all arrangements necessary for the protection thereof have been made.
- G. The locations of the major existing culinary water lines, sewer lines, storm water, gas pipes, underground electric, cable television, fiber optic communication, and telephone lines that are shown on the plans were taken from city maps, and maps supplied by the utility owner. No excavations were made to verify the locations shown for underground utilities, unless specifically stated on the Contract Drawings. It should be expected that some location discrepancies will occur. Neither OWNER nor its officers or agents shall

be responsible for damages to CONTRACTOR as a result of the locations of the utilities being other than those shown on the plans or for the existence of utilities not shown on the plans.

- H. CONTRACTOR shall be solely and directly responsible to OWNERS and operators of such properties for any damage, injury, expense, loss or inconvenience, delay, suits, actions, or claims of any character brought because of an injury or damage which may result from the carrying out of the work to be done under the contract.
- I. All utilities including all water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities encountered along the line of the work shall remain continuously in service during all operations under the Contract, unless other arrangements satisfactory to ENGINEER are made with owner of said utility.
- J. In the event of interruption to either domestic or irrigation water, or to other utility services as a result of accidental breakage, or as a result of being exposed or unsupported, CONTRACTOR shall promptly notify the proper authority. CONTRACTOR shall cooperate with the authority in restoration of service as soon as possible and shall not allow interruption of any water or utility service outside working hours unless prior approval is received.
- K. In case it shall be necessary to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon request of CONTRACTOR, be notified by OWNER to move such property within a specified reasonable time. When utility lines that are to be moved are encountered within the area of operations, CONTRACTOR shall notify ENGINEER a sufficient time in advance for the necessary measures to be taken to prevent interruption of service.
- L. Where the proper completion of the WORK requires the temporary or permanent removal and/or relocation of an existing Utility or other improvement which is indicated, CONTRACTOR shall remove and, without unnecessary delay, temporarily replace or relocate such Utility or improvement in a manner satisfactory to ENGINEER and OWNER of the facility. In all cases of such temporary removal or relocation, restoration to the former location shall be accomplished by CONTRACTOR in a manner that will restore or replace the Utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.

1.6 RIGHTS-OF-WAY

- A. CONTRACTOR shall be required to confine construction operations within the dedicated rights-of-way for public thorough fares, or within areas for which construction easements have been obtained, unless they have made special arrangements with the affected property owners in advance. CONTRACTOR shall be required to protect stored materials, cultivated trees and crops, and other items adjacent to the proposed construction site.
- B. CONTRACTOR shall submit for approval by ENGINEER the type and size of equipment used, and the methods for work performed on the rights-of-way across private properties, to avoid or minimize injury to trees, shrubs, gardens, lawns, fences, driveways, retaining walls, or other improvements within the rights-of-way.

- C. The construction easement widths and access to private properties are as shown on the Contract Drawings and as described in the easement documents; however, CONTRACTOR is to minimize impacts to surface improvements within the right-of-way. CONTRACTOR shall obtain a signed release from the property owner, approving restoration of work in the construction easements across or bordering private properties. See Project Closeout Section 01 780 50, 1.4.D.
- D. Property owners affected by the construction shall be notified by CONTRACTOR at least 48 hours in advance of the time the construction begins. During all construction operations, CONTRACTOR shall construct and maintain such facilities as may be required to provide access by all property owners to their property. No person shall be cut off from access to his property for a period exceeding 8 hours unless CONTRACTOR has made special arrangements with the affected persons. CONTRACTOR shall, daily or more frequently, if necessary, grade all disturbed areas to be smooth for motor vehicle traffic.

1.7 PROTECTION OF SURVEY, STREET OR ROADWAY MARKERS

- A. CONTRACTOR shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization (Salt Lake County permit required). No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced per Salt Lake County requirements. Survey markers or points disturbed by CONTRACTOR shall be accurately restored after street or roadway resurfacing has been completed.

1.8 TREES OR SHRUBS WITHIN PROJECT LIMITS

- A. Except where trees or shrubs are indicated to be removed, CONTRACTOR shall exercise all necessary precautions so as not to damage or destroy any trees or shrubs, including those lying within street rights-of-way and project limits, and shall not trim or remove any trees unless such trees have been approved for trimming or removal by the jurisdictional agency or OWNER. Existing trees and shrubs which are damaged during construction shall be trimmed or replaced by CONTRACTOR or a certified tree company under permit from the jurisdictional agency and/or OWNER. Tree trimming and replacement shall be accomplished in accordance with the following paragraphs.
 1. The symmetry of the tree shall be preserved; no stubs or splits or torn branches left; clean cuts shall be made close to the trunk or large branch. Spikes shall not be used for climbing live trees. Cuts over 1-1/2 inches in diameter shall be coated with a tree paint product that is waterproof, adhesive, and elastic, and free from kerosene, coal tar, creosote, or other material injurious to the life of the tree.
 2. CONTRACTOR shall immediately notify the jurisdictional agency and/or OWNER if any tree or shrub is damaged by CONTRACTOR's operations. If, in the opinion of said agency or OWNER, the damage is such that replacement is necessary, CONTRACTOR shall replace the tree or shrub at its own expense. The tree or shrub shall be of a like size and variety as the one damaged, or, if of a smaller size, CONTRACTOR shall pay to owner of said tree a compensatory payment acceptable to the tree or shrub owner, subject to the approval of the jurisdictional agency or OWNER. The size of the tree or shrub shall be not less than 1-inch diameter nor less than 6 feet in height.

1.9 RESTORATION OF PAVEMENT

- A. Pavement work shall meet the specifications for installation as noted in APWA Section 33 12 16 or in accordance with more stringent requirements of City, County, or State agencies where the project is located.
- B. Concrete pavement restoration shall meet the specifications for installation as noted in APWA Plan 256.2 and APWA Section 32 01 19 or in accordance with more stringent requirements of City, County, or State agencies where the project is located.
- C. All asphalt paved areas damaged during construction shall be replaced with similar materials of equal thickness plus 1 inch to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract or in the requirements of the agency issuing the permit. The pavement restoration requirement to match existing sections shall apply to all components of existing sections, including sub-base, base, and pavement. Pavements which are subject to partial removal shall be neatly sawcut in straight lines.
- D. Wherever required by the local agency having jurisdiction, CONTRACTOR shall place temporary surfacing promptly after backfilling and shall maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration of improvements.

1.10 CONCRETE WORK

- A. Concrete work shall meet the specifications for installation as noted in APWA Section 32 16 13 - Driveway, Sidewalk, Curb and Gutter.
- B. All flat work in streets tying into existing flatwork shall be doweled into the existing concrete. Dowels to be spaced at 12" O.C. and be No. 5 rebar x 14" for slabs up to 8 inches in thickness and No. 8 rebar x 18" for slabs over 8 inches.

1.11 LAWNS

- A. Any lawns that are damaged or destroyed during performance of the work shall be repaired or replaced with turf sod according to APWA Section 32 92 00 - Turf and Grass.

1.12 FENCES

- A. Fences that are damaged or destroyed during performance of the work shall be repaired or replaced back to the original condition or better to the satisfaction of the landowner and OWNER.

1.13 LANDSCAPING

- A. All landscaping on private property that is damaged or destroyed during performance of the work shall be repaired or replaced back to the original condition or better to the satisfaction of the landowner and OWNER.

1.14 OTHER SURFACE IMPROVEMENTS

- A. All other surface improvements not explicitly mentioned herein that are damaged or destroyed during performance of the work shall be repaired or replaced back to original condition or better.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION -

SECTION 01 78 50
PROJECT CLOSEOUT

PART 1 GENERAL

1.1 FINAL CLEANUP

- A. CONTRACTOR shall promptly remove from the vicinity of the completed work, all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the Work by OWNER will be withheld until CONTRACTOR has satisfactorily complied with the foregoing requirements for final cleanup of the project site.

1.2 TOUCH-UP AND REPAIR

- A. CONTRACTOR shall touch up or repair all finished surfaces on structures, equipment, fixtures, etc., that have been damaged prior to final acceptance. Surface on which such touch-up or repair cannot be successfully accomplished shall be completely refinished or in the case of hardware and similar small items, the item shall be replaced.

1.3 CLOSEOUT TIMETABLE

- A. CONTRACTOR shall establish dates for equipment testing, acceptance periods and on-site instructional periods (as required under the Contract). Such dates shall be established not less than one week prior to beginning any of the foregoing items, to allow OWNER, ENGINEER, and their authorized representatives sufficient time to schedule attendance at such activities.

1.4 MAINTENANCE AND GUARANTEE

- A. CONTRACTOR shall comply with the maintenance and guarantee requirements contained in Article 13 of the General Conditions.
- B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as part of such required repair work, and any repair or resurfacing which becomes necessary by reason of such required repair work shall be completed by CONTRACTOR at no cost to OWNER.
- C. CONTRACTOR shall make all repairs and replacements promptly upon receipt of written order from OWNER. If CONTRACTOR fails to make such repairs or replacement promptly, OWNER reserves the right to do the work and CONTRACTOR and his surety shall be liable to OWNER for the cost thereof.
- D. CONTRACTOR shall obtain a signed release from the property owner approving restoration of work in the construction easements across or bordering private property.

1.5 BOND

- A. CONTRACTOR shall provide a bond to guarantee performance of the provisions contained in Paragraph "Maintenance and Guarantee" above, and Article 13 of the General Conditions of the Contract.

1.6 FINAL ACCEPTANCE

- A. Final acceptance and final payment shall not be made until all provisions of the General Conditions of the Contract Article 14 have been satisfied.

1.7 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed Shop Drawings, Product Data, and Samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by OWNER.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress, not less than weekly.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda and modifications.
- F. Record Drawings: Legibly mark each item to record actual construction including:
 - 1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements
 - 2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work
 - 3. Field changes of dimension and detail
 - 4. Details not on original Contract drawings
- G. Submit documents to Engineer with claim for final Application for Payment.

1.8 CONTRACT CLOSEOUT

- A. As a condition precedent to final acceptance of the project, the Contractor shall complete the following forms and submit the original and two copies of each form to the Project Representative.
 - 1. Contractor's Certificate of Substantial Completion
 - 2. Contractor's Certificate of Final Completion
 - 3. Contractor's Final Waiver of Lien
 - 4. Consent of Surety for Final Payment
 - 5. Affidavit of Payment
 - 6. Affidavit of Release of Liens by the Contractor

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

CONTRACTOR'S CERTIFICATE OF SUBSTANTIAL COMPLETION

OWNER

TO: Jordan Valley Water Conservancy District
8215 South 3200 West
West Jordan, Utah 84088

PROJECT: _____

ATTENTION: _____

FROM: _____
Firm or Corporation

This is to certify that I, _____ am an authorized official of _____
_____ working in the capacity of _____
_____ and have been properly authorized by said form or corporation to sign the following
statements pertaining to the subject contract.

I know of my own personal knowledge, and do hereby certify, that the work of the Contract described above has been substantially performed, and materials used and installed to date in accordance with, and in conformity to, the Contract drawings and specifications. A list of all incomplete work is attached.

The Contractor hereby releases the Owner and its agents from all claims and liability to the Contractor for anything done or finished for or relating to the Work, as specified in the Project Manual, except demands against the Owner for the remainder of progress payments retained to date, and unresolved written claims prior to this date.

The Contract Work is now substantially complete, ready for its intended use, and ready for your inspection. You are requested to issue a Certificate of Substantial Completion.

Signature: _____

Date: _____

CONTRACTOR'S CERTIFICATE OF FINAL COMPLETION

OWNER

TO: Jordan Valley Water Conservancy District
8215 South 3200 West
West Jordan, Utah 84088

PROJECT: _____

ATTENTION: _____

FROM: _____
Firm or Corporation

This is to certify that I, _____ am an authorized official of _____
_____ working in the capacity of _____
_____ and have been properly authorized by said form or corporation to sign the following
statements pertaining to the subject contract.

I know of my own personal knowledge, and do hereby certify, that the work of the Contract described above has been substantially performed, and materials used and installed to date in accordance with, and in conformity to, the Contract drawings and specifications.

The Contractor hereby releases the Owner and its agents from all claims and liability to the Contractor for anything done or finished for or relating to the Work. The Contract Work is now complete in all parts and requirements, ready for its intended use, excepting the attached list of minor deficiencies and the reason for each being incomplete to date, for which exemption from final payment requirements is requested (if no exemptions requested, write "none") _____
_____. The Work is now ready for your final inspection. The following items are required from the Contractor prior to application for final payment and are submitted herewith, if any:

I understand that neither the issuance, by the Owner, or a Certificate of Final Completion, nor the acceptance thereof by the Owner, shall operate as a bar claim against the Contractor under the terms of the guarantee provisions of the Contract Documents.

Signature: _____
Date: _____

CONTRACTOR'S FINAL WAIVER OF LIEN

TO ALL WHOM IT MAY CONCERN:

WHEREAS, the undersigned has furnished labor and materials for (A) _____

in the City of _____, County of Salt Lake, State of Utah, of which Jordan Valley Water Conservancy District is the Owner.

NOW THEREFOR, this _____ day of _____, 20____, for and in consideration of the sum of (B) _____ dollars paid simultaneously herewith, the receipt whereof is hereby acknowledged by the undersigned, the undersigned does hereby waive and release any lien* right to, or claim of lien with respect to and on said above described premises, and the improvements thereon, and on the monies or other consideration due or to become due from the Owner, on account of labor, services, materials, fixtures, apparatus or machinery heretofore or which may hereafter be furnished by the undersigned to or for the above described premises by virtue of said contract.

(C) _____ (SEAL)
(Name of sole ownership, corporation or partnership)

(C) _____ (SEAL)
(Signature of Authorized Representative)

Title: _____

INSTRUCTION FOR FINAL WAIVER:

- A. Project name.
- B. Final Contract amount received (total amount of Contract as adjusted).
- C. If the waiver is for a corporation, corporate name should be used, corporate seal affixed, and title of officer signing waiver should be set forth; if waiver is for a partnership, the partnership name should be used, partner should sign and designate himself/herself as partner.

* The word Lien as used herein shall include Stop Orders, Stop Notices, or Freeze Orders on monies or other consideration of the Owner which are due or are to become due on the Contract referenced above.

CONSENT OF SURETY FOR FINAL PAYMENT

Project Name: _____

Location: _____

Type of Contract: _____

Amount of Contract: _____

In accordance with the provisions of the above-named contract between the Owner and the Contractor, the following named surety:

on the Payment Bond of the following named Contractor:

hereby approves of final payment to the Contractor, and further agrees that said final payment to the Contractor shall not relieve the Surety Company named herein of any of its obligations to the following named Owner (as set forth in said Surety Company's bond):

Jordan Valley Water Conservancy District
8215 South 3200 West
West Jordan, Utah 84088

IN WITNESS WHEREOF, the Surety Company has hereunto set its hand and seal this __ day of _____, 20__.

(Name of Surety Company)

(Signature of Authorized Representative)

Title: _____

AFFIDAVIT OF PAYMENT

TO ALL WHOM IT MAY CONCERN:

WHEREAS, the undersigned has been employed by Jordan Valley Water Conservancy District to furnish labor and materials under a contract dated _____ for the project named _____ in the City of _____ County of Salt Lake, State of Utah.

NOW THEREFORE, this _____ day of _____, 20____, the undersigned, as the Contractor for the above named Contract pursuant to the conditions of the Contract, hereby certifies that, except as listed below, he has paid in full or has otherwise satisfied all obligations for all materials and equipment furnished, for all work, labor, and services performed, and for all known indebtedness and claims against the Contractor for damages arising in any manner in connection with the performance of the Contract referenced above for which the Owner or its property might in any way be held responsible.

EXCEPTIONS: (If none, write "none". If required by the Owner, the Contractor furnish bond satisfactory to the Owner for each exception).

{AFFIX CORPORATE}
{SEAL HERE}

Contractor (Name of sole ownership,
Corporation or partnership)

(Signature of Authorized Representative)

Title: _____

AFFIDAVIT OF RELEASE OF LIENS BY THE CONTRACTOR

TO ALL WHOM IT MAY CONCERN:

WHEREAS, the undersigned has been employed by Jordan Valley Water Conservancy District to furnish labor and materials under a contract dated _____ for the project named _____ in the City of _____ County of Salt Lake, State of Utah.

NOW THEREFOR, this _____ day of _____, 20_____, the undersigned, as the Contractor for the above named Contract pursuant to the conditions of the Contract, hereby certifies that to the best of his/her knowledge, information and belief, except as listed below, the Releases or Waivers of Lien* attached hereto include the Contractor, all subcontractors, all suppliers of material and equipment, and all performers of work, labor or services, who have or may have liens against any property of the Owner and on the monies or other consideration due to becomes due from the Owner arising in any manner in connection with the performance of the Contract referenced above.

EXCEPTIONS: (If none, write "none". If required by the Owner, the Contractor will furnish bond satisfactory to the Owner for each exception).

ATTACHMENTS:

- 1. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.
- 2. Separate Release or Waiver of Liens from subcontractors and material suppliers.

{AFFIX CORPORATE}
{SEAL HERE}

Contractor (Name of sole ownership,
Corporation or partnership)

(Signature of Authorized Representative)

Title: _____

* The word Lien as used herein shall include Stop Orders, Stop Notices, or Freeze Orders on monies or other consideration of the Owner which are due or are to become due on the Contract referenced above.

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SECTION 01 91 00
COMMISSIONING, TESTING AND STARTUP

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Commissioning description.
 - 2. Submittals.
 - 3. Commissioning services.
 - 4. Commissioning responsibilities.
 - 5. Commissioning reports.
 - 6. Test equipment.
 - 7. Verification check and startup procedures.
 - 8. Functional performance test procedures.
 - 9. Function performance test methods.
 - 10. Deficiencies and test approvals.
 - 11. Demonstration.

1.2 COMMISSIONING DESCRIPTION

- A. Commissioning: Systematic process of ensuring systems perform interactively according to design intent and OWNER's operational needs. The commissioning process encompasses and coordinates system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training, and verification of actual performance.
- B. Commissioning does not relieve CONTRACTOR of responsibility to provide finished and fully functioning Project.

1.1 CONTRACTOR SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Qualifications Data: Submit to ENGINEER prior to start of Work:
- C. Furnish one copy of verification check and startup plan to ENGINEER for review and approval.
- D. Submit written training plan to ENGINEER for review and approval prior to conducting training.
- E. ENGINEER will review and approve submittals for conformance to Contract Documents as related to commissioning process for primary purpose of aiding development of functional testing procedures and secondarily to verify compliance with equipment specifications.

1.2 CLOSEOUT SUBMITTALS

- A. Commissioning Record: CONTRACTOR shall submit one copy of commissioning record for inclusion in operation and maintenance manuals.

- B. Final Commissioning Report: CONTRACTOR shall submit one copy of final commissioning report.

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with specified requirements and guidelines.
- B. Perform Work in accordance with State, Municipality, District or other specified standards.
- C. Maintain one copy of each document on site.

1.4 COMMISSIONING SERVICES

- A. CONTRACTOR shall employ and pay for services of independent firms as required for the work, acceptable to OWNER to perform specified commissioning and/or startup.

1.5 COMMISSIONING RESPONSIBILITIES

- A. CONTRACTOR Responsibilities:
 - 1. Include requirements for commissioning submittal data, operation and maintenance data, commissioning tasks and training in each purchase order and subcontract for equipment and systems indicated to be commissioned.
 - 2. Facilitate coordination of commissioning of work.
 - 3. Cooperate with independent firms and provide access to the Work and to manufacturers' facilities.
 - 4. Require equipment and system installers to review and provide comments on functional test procedures.
 - 5. Require manufacturers to review commissioning test procedures for equipment installed by manufacturer.
 - 6. Furnish proprietary test equipment required by manufacturers to complete equipment and system tests.
 - 7. Furnish qualified personnel to assist in completing commissioning.
 - 8. Furnish manufacturer's qualified field representatives to assist in completing commissioning.
 - 9. Ensure equipment and system installers execute commissioning responsibilities according to Contract Documents and schedule.
 - 10. Coordinate OWNER's personnel training.
 - 11. Prepare operation and maintenance manuals. Update original sequences of operation reflecting actual installation.
 - 12. Ensure equipment and system installers correct deficiencies and make necessary adjustments to operation and maintenance manuals and Record Documents for issues identified in testing.

1.6 COMMISSIONING REPORTS

- A. Reports: Submit reports regularly to OWNER/ENGINEER.
- B. Functional Performance Test Procedures: Develop test procedures including forms to be completed during commissioning. Include completed documentation in operation and maintenance manuals.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

- A. Testing Equipment: Calibrated within the last year; of sufficient quality and accuracy to test and measure system performance within the specified tolerances unless otherwise specified for individual equipment or systems.
- B. Recalibrate test equipment according to manufacturer's recommended intervals and when dropped or damaged.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify equipment and systems are installed in accordance with individual Specification sections.
- B. Verify utility and power connections are complete and services operational.

3.2 VERIFICATION CHECK AND STARTUP PROCEDURES

- A. Notify ENGINEER/OWNER and schedule verification check and startup activities with each party required to complete verification check and startup minimum 2 weeks in advance.
- B. Allow ENGINEER to witness verification check and startup.
 - 1. Primary Equipment: ENGINEER will witness procedures for each piece of equipment.
 - 2. Secondary Equipment: ENGINEER will witness sampling of each type of unit as specified in Commissioning Plan.
- C. Verification Check and Startup:
 - 1. Perform verification check and startup in accordance with approved verification check and startup plan.
 - 2. Complete each procedure in sequence performed by party assigned to each procedure.
 - 3. Record completion of each procedure. Indicate results of procedure where required. Sign and date plan by individual performing procedure.
 - 4. Submit the executed plan to ENGINEER within 2 days of completion.
- D. Deficiencies and Approvals:
 - 1. ENGINEER will review verification check and startup reports and issue deficiency report or approval.
 - 2. Correct deficiencies and resubmit updated verification check and startup report with statement indicating corrections made for ENGINEER approval.

3.3 FUNCTIONAL PERFORMANCE TEST PROCEDURES

- A. Notify ENGINEER of completion of verification check and startup activities.

- B. CONTRACTOR shall witness and document results of functional performance tests.
- C. Demonstrate each piece of equipment and system is operating according to documented design intent and Contract Documents.
- D. Operate each piece of equipment and system through each specified mode of operation including seasonal, occupied, unoccupied, warm up, cool down, partial load and full load conditions.

3.4 FUNCTIONAL PERFORMANCE TEST METHODS

- A. Perform testing and verification by using manual testing or by monitoring performance and analyzing results using control system trend log capabilities or by stand-alone data loggers as specified for each piece of equipment or system.
- B. Simulated Conditions: Simulating conditions, not by overwritten values, is permitted. Timing tests to use real conditions is encouraged wherever practical.
- C. Overwritten Values: Overwriting sensor values to simulate conditions may be used with caution and avoided when possible.
- D. Simulated Signals: Using signal generator to create simulated signals to test and calibrate transducers automatic temperature controls is generally recommended over using sensors as signal generators with simulated conditions or overwritten values.
- E. Altering Setpoints: Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test specific sequence is acceptable. Reset setpoint after completing test.
- F. Indirect Indicators: Using indirect indicators for responses or performance is permitted only after visually and directly verifying and documenting indirect readings through control system representing actual conditions and responses over tested parameter range.
- G. Perform each function and test under conditions simulating actual conditions as close as is practically possible.
- H. Sampling: Multiple identical pieces of equipment or equipment with only small size or capacity differences may be functionally tested using sampling strategy when permitted by other sections.

3.5 DEFICIENCIES AND TEST APPROVALS

- A. Deficiencies:
 - 1. CONTRACTOR shall record and report deficiencies to OWNER.
 - 2. Minor deficiencies may be corrected during tests at the installer's discretion. Deficiency and resolution will be documented on procedure form.
 - 3. Failure to attend scheduled verification check, startup, or functional performance test will be considered deficiency.
 - 4. When a deficiency is identified, CONTRACTOR shall discuss issue with party executing test.
 - a. When party executing test accepts responsibility to correct deficiency:

- 1) CONTRACTOR submits deficiency report to OWNER, and party executing test.
 - 2) Party executing test corrects deficiency, signs statement of correction on deficiency form certifying equipment is ready retesting and submits form to ENGINEER.
 - 3) CONTRACTOR reschedules test and test is repeated until satisfactory performance is achieved.
- b. When party executing test disputes deficiency or responsibility for deficiency:
- 1) CONTRACTOR submits deficiency report to ENGINEER/OWNER, and party executing test and party believed to be responsible for deficiency.
 - 2) CONTRACTOR negotiates resolution with parties involved and refers continuing disputes to OWNER/ENGINEER for resolution in accordance with Contract Documents.
 - 3) CONTRACTOR documents resolution process.
 - 4) When resolution is decided, appropriate party corrects deficiency, signs statement of correction on deficiency form certifying equipment is ready for retesting and submits form to OWNER/ENGINEER.
 - 5) CONTRACTOR reschedules test and test is repeated until satisfactory performance is achieved.

B. Retesting Costs:

1. When verification check and startup or functional performance test deficiency is discovered requiring rescheduling or retesting:
 - a. OWNER will deduct additional testing compensation from final payment due to CONTRACTOR.

3.6 DEMONSTRATION

- A. Demonstrate equipment and systems and train OWNER's personnel as specified in individual equipment and system specifications.
- B. ENGINEER/OWNER will develop criteria for determining training was satisfactorily completed, including attending some training sessions.

- END OF SECTION -

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SECTION 02 41 00
DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Removal of designated piping and valves within the existing structures and removal of existing structures where designated on the Contract Drawings.
- B. If demolition of electrical equipment is required, see the requirements in the Electrical Specifications.

1.2 RELATED WORK

- A. Related work in other sections includes, but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures

1.3 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Shop Drawings and Schedule: Describe demolition, removal procedures, sequence and schedule.

1.4 CLOSEOUT SUBMITTALS

- A. Provide Project Record Documents: Record actual locations of any changes to the design.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Piping modifications shall include the materials noted in the specific Sections related to the changes.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Document condition of adjacent structures and buildings indicated to remain.

3.2 PREPARATION

- A. Contact OWNER not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Provide, erect, and maintain temporary barriers and security devices.

- C. Notify adjacent owners of work which may affect their property, potential noise or vibration, utility outage, or disruption seven days prior to the start of Work. Coordinate with Owner.
- D. Prevent movement or settlement of adjacent structures. Provide bracing and shoring.
- E. Protect existing structures indicated to remain.

3.3 DEMOLITION REQUIREMENTS

- A. Conduct demolition to minimize interference with adjacent structures.
- B. Conduct operations with minimum interference to public or private access.
- C. Maintain egress and access at all times. Do not close or obstruct roadways without permits.
- D. Water sprinkling, temporary enclosures, chutes, and other suitable methods shall be used to limit dust and debris rising and scattering in the area. CONTRACTOR shall comply with local, State, and Federal environmental regulations pertaining to environmental protection. Water shall not be used if it creates hazardous or objectionable conditions such as ice, flooding, or pollution.
- E. Cease operations immediately when adjacent structures appear to be in danger. Notify OWNER and ENGINEER.

3.4 STRUCTURE DEMOLITION

- A. Disconnect, remove as required, and cap designated utilities. Identify utilities at termination of demolition. Record termination or capped location on Record Documents.
- B. Remove the existing piping as noted on the Contract Drawings.
- C. Remove existing structures as noted on the Contract Drawings.
- D. Demolish and remove components in an orderly and careful manner.
- E. Protect all existing structures not to be removed.

3.5 CLEAN UP

- A. Remove and properly dispose of demolished materials from site as work progresses.
- B. Leave areas of work in clean condition.
- C. Adjacent structures shall be cleaned of dust, dirt, and debris caused by the demolition, as requested by ENGINEER or directed by governing authorities, and adjacent areas shall be returned to pre-demolition conditions.

- END OF SECTION -

SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section covers the work necessary to furnish, install, and complete, the concrete formwork.

1.2 RELATED WORK

- A. Related work in other sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 03 30 00 Cast-in-Place Concrete

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
1. American Concrete Institute (ACI) -ACI 347R- Guide to Formwork for Concrete
 2. American Hardboard Association (AHA) -AHA A135.4- Basic Hardboard
 3. Department of Commerce (DOC) -DOC PS 1- Structural Plywood
 4. ACI 350R-01 – Code Requirements for Environmental Engineering Concrete Structures and Commentary
 5. NSF International (NSF) 61 - Drinking Water System Components - Health Effects

1.4 DESIGN

- A. Formwork shall be designed in accordance with the methodology of ACI 347R for anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface which meets the requirements of the finish specified in Section 03 30 00 Cast-in-Place Concrete. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

1.5 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. The following shall be submitted:
1. Drawings showing details of forming, shoring, and bracing for footings, walls, and floors shall be submitted to the Engineer at least 3 weeks prior to their use. Drawings showing details of formwork shall include joints, supports, studding and shoring, and sequence of form and shoring removal.
 2. If requested by ENGINEER, design analysis and calculations shall be submitted for form design and methodology used in the design. The analysis and calculations shall verify the selection of form ties, horizontal and vertical stiff-backs or braces for wall panels, forming and form openings, or any other part of forming, shoring or bracing which may be considered critical by ENGINEER.

3. Manufacturer's data including literature describing form materials, accessories, and form releasing agents.
 4. Manufacturer's recommendation on method and rate of application of form releasing agent.
- C. ENGINEER's review will not relieve CONTRACTOR from any responsibility as to the adequacy of the forming, shoring and bracing design. Any formwork installed by CONTRACTOR shall be solely at CONTRACTOR's risk. ENGINEER's review will not lessen or diminish CONTRACTOR's liability.

PART 2 PRODUCTS

2.1 FORM MATERIALS

- A. Form surfaces shall be in "new and undamaged" condition and may be plywood, hard plastic finished plywood, overlaid waterproof particle board, and steel of sufficient strength and surface smoothness to produce the specified finish. CONTRACTOR shall verify that his types of form surfaces and panel sizes satisfy all requirements of these specifications.
- B. The wall form design shall be such that wall sections can be poured full height without creating horizontal cold joints and without causing snapping of form ties which shall be of sufficient strength and number to prevent spreading of the forms during the placement of concrete, and which shall permit ready removal of the forms without spalling or damaging the concrete.

2.2 FORM TIES

- A. Form ties on exposed surfaces shall be located in a uniform pattern. Snap ties shall not be broken until the concrete has reached the design concrete strength. The use of tie wires as form ties will not be permitted. Snap ties, designed so that the ends must be broken off before the forms can be removed, shall not be used. Form ties shall be **Plastic Cone Snap Tie by Dayton-Superior, Wrench Head Snap Tie by MASCO Mason Supply**, or approved equal.
- B. Taper ties with plastic or rubber plugs of an approved and proven design may also be used. The plugs must be driven into the hole with a steel rod, placed in a cylindrical recess made therefore in the plug. At no time shall plugs be driven on the flat area outside the cylindrical recess. Taper ties shall be **Taper Tie by Dayton-Superior, Taper-Tie by MASCO Mason Supply**, or approved equal.

2.3 FORM RELEASING AGENTS

- A. Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in Section 03 30 00 Concrete. Forms shall be used, whenever necessary, to confine the concrete, to shape the concrete to the required lines and grades, and to obtain a thoroughly compacted dense concrete through proper vibrating. The forms shall have sufficient strength and rigidity to hold the concrete and to withstand the necessary pressure, tamping and vibration, without deflection from the prescribed lines. Where forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface so as to obtain accurate alignment of the surface and to prevent leakage of mortar.
- B. The surfaces of all forms in contact with the concrete shall be clean, rigid, tight and smooth. All dirt, chips, sawdust, mud, water and other foreign matter shall be removed from within the forms or within the excavated areas, before any concrete is deposited therein.
- C. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be thoroughly cleaned of mortar from previous concreting and of all other dirt and foreign matter before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker.
- D. Bulkheads to form vertical wall joints shall be strong enough to withstand concrete pressures during pouring and vibrating, and shall be properly placed between the forms to avoid mortar seepage. Holes shall be provided in the bulkheads to permit passage of horizontal mild steel reinforcing where required by the Drawings. Unless these are specifically called for on the Drawings, no chamfer strips shall be placed in the corners of vertical construction joints.

3.2 COATING

- A. Form inside surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written instructions. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.3 ALIGNMENT AND TOLERANCES

Forms shall be properly aligned and adequately supported to produce concrete surfaces conforming to construction tolerance given in Table 03 10 00-1, Tolerances for Formed Surfaces.

TABLE 03 10 00-1
TOLERANCES FOR FORMED SURFACES

Condition	Measurement	Tolerance
1. Variations from the plumb:	In any 10 feet of length	1/4 inch
a. In the lines and surfaces of columns, piers, walls and in arises	Maximum for entire length	1 inch
b. For exposed corner columns, control-joint grooves, and other conspicuous lines	In any 20 feet of length Maximum for entire length	1/4-inch 1/2-inch
2. Variation from the level or from the grades indicated on the drawings	In any 10 feet of length In any bay or in any 20 feet of length	1/4-inch 3/8 inch
3. Variation of the linear building lines from established position in plan	In any 20 feet Maximum	1/2-inch 1 inch
4. Variation of distance between walls, columns, partitions	1/4 inch per 10 feet of distance, but not more than 1/2 inch in any one bay, and not more than 1 inch total variation	
5. Variation in the thickness of slabs and walls	Minus Plus	1/4-inch 1/2-inch

3.4 FORM REMOVAL

- A. Forms shall be removed in a manner that will prevent injury to the concrete and ensure the complete safety of the structure. Forms shall not be removed until approval is given by ENGINEER. Formwork for columns, walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement.
- B. CONTRACTOR shall remove all wood splinters on concrete surfaces after stripping of wood forms.

- END OF SECTION -

SECTION 03 20 00
CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SUMMARY

- A. This section covers the reinforcing steel bars, wire fabric or rod mats for cast-in-place concrete and reinforced masonry construction.

1.2 RELATED WORK

- A. Related work in other sections includes but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 03 30 00 Cast-in-Place Concrete
3. Section 04 22 00 Reinforced Unit Masonry

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. AMERICAN CONCRETE INSTITUTE (ACI)

1. ACI 301 Specifications for Structural Concrete
2. ACI 315 Details and Detailing of Concrete Reinforcement
3. ACI 318 Building Code Requirements for Structural Concrete and Commentary
4. ACI 350R Code Requirements for Environmental Engineering Concrete Structures and Commentary

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM A 184 Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
2. ASTM A 615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
3. ASTM A 767 Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
4. ASTM A 775 Standard Specification for Epoxy-Coated Steel Reinforcing Bars
5. ASTM A 1064 Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

D. CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

1. CRSI (DA4) Manual of Standard Practice (MSP-1)

1.4 SUBMITTALS

- A. The following shall be submitted in accordance with Section 01 33 00 - Submittal Procedures:

1. Drawings of Concrete Reinforcement System with details showing reinforcing steel schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.
2. Reinforcing Steel with certified copies of mill reports attesting that the reinforcing steel furnished meets the requirements specified, prior to the installation of reinforcing steel.

1.5 DELIVERY AND STORAGE

- A. Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

PART 2 PRODUCTS

2.1 DOWELS

- A. Dowels shall conform to ASTM A 615, Grade 60.

2.2 FABRICATED BAR MATS

- A. Fabricated bar mats shall conform to ASTM A 184.

2.3 REINFORCING STEEL

- A. Reinforcing steel shall be deformed bars conforming to ASTM A 615 grades and sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A 1064. When no grade is indicated use 60 ksi grade steel. Special coated bars (epoxy and zinc) may be specified for use in a highly corrosive atmosphere where concrete cover is not considered sufficient. In which case reference to ASTM A 767 and A 775 will be included.

2.4 WELDED WIRE FABRIC

- A. Welded wire fabric shall conform to ASTM A 1064. Welded wire fabric with longitudinal wire of W4 size and smaller shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches. Welded wire fabric with longitudinal wires larger than W4 size shall be furnished in flat sheets only.

2.5 WIRE TIES

- A. Wire ties shall be 16-gauge or heavier black annealed steel wire.

2.6 SUPPORTS

- A. Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI (DA4) MSP-1 and shall be steel or precast concrete blocks. Precast concrete blocks shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete.

- B. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within ½ inch of concrete surface shall be plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

- 2.7 Epoxy for grouting reinforcing bars shall be specifically formulated for such application, for the moisture condition, application temperature, and orientation of the hole to be filled. Epoxy anchor grout shall meet the requirements of Section 03 60 00 – Grout.

PART 3 EXECUTION

3.1 GENERAL

- A. All reinforcement steel, welded wire fabric, and other appurtenances shall be fabricated, and placed in accordance with the requirements of the Building Code and the requirements specified herein.

3.2 REINFORCEMENT

- A. Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete.
- B. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety.
- C. Placement:
 - 1. Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete.
 - 2. Reinforcement shall be placed in accordance with ACI 318 at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.
 - 3. All reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties which are embedded in the blocks.
 - 4. For concrete over formwork, CONTRACTOR shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.
 - 5. Limitations on the use of bar support materials shall be as follows.
 - a. Concrete Dobies: permitted at all locations except where architectural finish is

- required.
- b. Wire Bar Supports: permitted only at slabs over dry areas, interior dry wall surfaces, and exterior wall surfaces.
 - c. Plastic Bar Supports: permitted at all locations except on grade.
6. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
 7. Bars additional to those shown which may be found necessary or desirable by CONTRACTOR for the purpose of securing reinforcement in position shall be provided by CONTRACTOR at no additional cost to OWNER.
 8. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction.
 9. Epoxy coated reinforcing bars shall be stored, transported, and placed in such a manner as to avoid chipping of the epoxy coating. Specially coated bar supports shall be used. CONTRACTOR shall repair all chips or cracks in the epoxy coating with a compatible epoxy repair material prior to placing concrete.
 10. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory from the weight of the supported bars. When used to space the reinforcing bars from wall forms, the forms and bars shall be located so that there is no deflection of the accessory when the forms are tightened into position.

D. Splicing:

1. Splices of reinforcement shall conform to ACI 318 and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6-inches. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

3.3 WELDED-WIRE FABRIC

- A. Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 2 inches. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 4 feet. Fabric shall be positioned using supports.

3.4 DOWELS

- A. Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately aligned parallel to the finished concrete surface and rigidly supported during concrete placement. A PVC sleeve shall cover one end of dowels up to the joint location at the center of the bar. Grease to be placed at the

back of the sleeve prior inserting dowel so that the grease will flow out, around, and fully encase the inserted bar. Grease the bar before insertion. Grease shall be semi-solid, inert lubricant, such as lithium grease.

3.5 EMBEDMENT OF DRILLED REINFORCING STEEL DOWELS

A. Dowel Epoxy Installation

1. The hole diameter shall be as recommended by the epoxy manufacturer but shall be no larger than 0.25 inch greater than the diameter of the outer surface of the reinforcing bar deformations.
2. The depth of the hole shall be as recommended by the epoxy manufacturer to fully develop the bar but shall not be less than 12 bar diameters, unless noted otherwise.
3. The hole shall be drilled by methods which do not interfere with the proper bonding of epoxy.
4. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling. The location of holes to be drilled shall be adjusted to avoid drilling through or damaging any existing reinforcing bars.
5. The hole shall be blown clean with clean, dry compressed air to remove all dust and loose particles.
6. Epoxy shall be injected into the hole through a tube placed to the bottom of the hole. The tube shall be withdrawn as epoxy is placed but kept immersed to prevent formation of air pockets. The hole shall be filled to a depth that ensures that excess material will be expelled from the hole during dowel placement.
7. Dowels shall be twisted during insertion into the partially filled hole to guarantee full wetting of the bar surface with epoxy. CONTRACTOR shall insert the bar slowly enough to avoid developing air pockets.

3.6 CLEANING AND PROTECTION

- A. CONTRACTOR shall protect reinforcement steel from conditions conducive to corrosion until concrete is placed.
- B. The surfaces of all reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed. Where there is a delay in placing concrete, reinforcement shall be reinspected and if necessary, recleaned.

- END OF SECTION -

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SECTION 03 25 00

EXPANSION JOINTS, CONSTRUCTION JOINTS AND WATERSTOPS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This Section covers the work necessary to furnish, install and complete expansion and construction joints, including waterstops.
- B. All waterstops and sealants in contact with potable water including waterstops embedded in concrete floors and walls of potable water tanks shall be NSF 61 certified.

1.2 RELATED WORK

- A. Related work in other Sections includes but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 03 33 00 Cast-in-Place Concrete

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN CONCRETE INSTITUTE (ACI)
 - 1. ACI 318 Building Code Requirements for Reinforced Concrete
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM A 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 2. ASTM C 920 Standard Specification for Elastomeric Joint Sealants
 - 3. ASTM D 412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
 - 4. ASTM D 570 Standard Test Method for Water Absorption of Plastics
 - 5. ASTM D 624 Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
 - 6. ASTM D 638 Standard Test Method for Tensile Properties of Plastics
 - 7. ASTM D 746 Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
 - 8. ASTM D 747 Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.
 - 9. ASTM D 792 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
 - 10. ASTM D 1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)

- 11. ASTM D 1752 Standard Specification for Preformed Sponge Rubber and Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
- 12. ASTM D 2240 Standard Test Method for Rubber Property-Durometer Hardness

D. FEDERAL SPECIFICATIONS (FS)

- 1. FS-TT-S-00227E Sealing Compound: Elastomeric Type, Multi-Component (For Calking, Sealing, and Glazing in Buildings and Other Structures)

E. NSF International (NSF)

- 1. NSF/ANSI 61 Drinking Water System Components – Health Effects

1.4 SUBMITTALS

- A. The following shall be submitted in accordance with Section 01 33 00 – Submittal Procedures:

- 1. Submit certificates of compliance stating that the joint filler and sealant materials and waterstops conform to the requirements specified. ENGINEER, at his option, may take samples of any materials and have them tested by an independent testing laboratory to verify their compliance with these Specifications. All such costs shall be borne by OWNER. If any materials should fail to meet these Specifications, all costs for further testing of the replacement material shall be borne by CONTRACTOR.
- 2. Samples of factory fabricated waterstop joints representing in all respects the material and workmanship of the material that will be furnished under this contract. Samples will be submitted and approved by ENGINEER prior to use of the factory joints in the field.
- 3. Manufacturer's catalog data and manufacturer's recommended instructions for splicing of waterstops.

1.5 OBSTRUCTIONS

- A. CONTRACTOR shall pay particular attention to removing all obstructions such as concrete, nails, etc., from joints when movements of floor or wall sections can be expected under temperature and other conditions.

1.6 QUALITY ASSURANCE

- A. Waterstop manufacturer shall demonstrate five years (minimum) continuous, successful experience in production of waterstops.

1.7 DELIVERY AND STORAGE

- A. Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

PART 2 PRODUCTS

2.1 HORIZONTAL JOINT SEALANT

- A. Horizontal joints not requiring waterstops or when so indicated on the drawings, shall be sealed using **Sikaflex-2c NS**, or approved equal, and shall meet the requirements of ASTM C-920, Type M, Grade NS, Class 25 and FS-TT-S-00227E, Type II, Class A, and shall be NSF 61 certified (Sikaflex 2c NS EZ) if in contact with potable water. Color shall match color of concrete structure.

2.2 VERTICAL JOINT SEALANT

- A. Vertical joints not requiring waterstops or when so indicated on the drawings, shall be sealed using **Sikaflex-2c NS**, or approved equal, and shall meet the requirements of ASTM C-920, Type M, Grade NS, Class 25 and FS-TT-S-00227E, Type II, Class A, and shall be NSF 61 (Sikaflex 2c NS EZ) certified if in contact with potable water. Color shall match color of concrete structure.

2.3 JOINT PRIMER

- A. All joints receiving a joint sealant shall be primed using **Sikaflex Primers 429/202**, or approved equal.

2.4 EXPANSION JOINTS

- A. Expansion joints shall be composed of cellular fibers securely bonded together and uniformly saturated with asphalt. Joint shall be resilient, flexible, and non-extruding. Expansion joints shall meet the requirements of ASTM D 1751. Manufacturer shall be **Fibre Expansion Joint by W.R. Meadows, Fiberflex by JD Russel Company**, or approved equal.

2.5 PVC WATERSTOPS

- A. Waterstops shall be of an approved type, supplied by an approved manufacturer and shall be plastic made of virgin polyvinylchloride (PVC) compound, shall be ribbed, uniform in dimensions, dense, homogeneous, free from porosity, and as detailed on the Drawings. No reclaimed PVC shall be used in the compound. Waterstop in contact with potable water shall be NSF 61 certified.

- B. The finished waterstop material shall meet the following minimum requirements:

Tensile strength	2,000 psi min.	(ASTM D-638)
Ultimate elongation	350% min.	(ASTM D-638)
Shore hardness	75 \pm 5	(ASTM D-2240)
Specific gravity	1.38 max	(ASTM D-792)
Stiffness in flexure	700 psi min.	(ASTM D-747)
Cold brittleness	No Failure at -35°F	(ASTM D-746)
Water absorption: 48 hours	0.15% max	(ASTM D-570)
Tear Resistance	290 lb./in. min.	(ASTM D-624)

- C. Manufacturer, or approved equal:
1. Vinylex Waterstop & Accessories
 2. Greenstreak, Inc. (Sika Corporation)
 3. Durajoint Concrete Accessories
- D. Factory made waterstop joints shall have a tensile strength across the joint equal to at least 600 psi. Field splices and joints shall be made in accordance with the waterstop manufacturer's instructions using a thermostatically-controlled heating iron.

2.6 HYDROPHILIC WATERSTOP

- A. Non-bentonite rubber hydrophilic waterstop shall only be used where shown on the Contract Drawings or when approved by ENGINEER. Hydrophilic waterstop in contact with potable water including in potable water tank floor slabs and walls shall be NSF 61 certified. Size shall be as indicated on the Contract Drawings.
- B. The hydrophilic waterstop shall meet the following physical properties:

Physical Property	Test Method	Result
Tensile Strength (Minimum)	ASTM D412	350 psi
Elongation (minimum)	ASTM D412	600 %
Hardness	ASTM D2240	52 +/-5 Shore A
Tear Resistance	ASTM D624	50 lb/in
Specific Gravity	ASTM D792	1.35 +/-5

- C. Manufacturer, or approved equal:
1. Conseal CS-231
 2. Sika Hydrotite CJ-1020-2K

PART 3 EXECUTION

3.1 WATERSTOPS

- A. Waterstops shall be of the type indicated and shall be installed at the locations shown to form a continuous water-tight diaphragm. The waterstop shall be correctly positioned in the forms so that the center of the waterstop is centered on the joint. Waterstop shall be held in place in the forms by use of a split form or other approved method that will positively hold the waterstop in the correct position and to the correct alignment. Vibrate concrete to obtain impervious concrete in the vicinity of all joints. In horizontal joints, ensure that the areas below the water stop are completely filled with concrete.
- B. Horizontal plastic waterstops shall be bent up during placing of concrete until the concrete has been brought to the level of the waterstop; additional concrete shall then be placed over the waterstop, after which the concrete shall be thoroughly vibrated. All horizontal and vertical waterstops, which are not accessible during pouring, shall be tied off in two directions every 12 inches in such a manner that bending over one way or another is prevented. A hog-ring or nail may be driven through both ends of the waterstop to facilitate placing and tying of waterstops to reinforcing steel forms or form-ties.

- C. Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Any waterstop punctured or damaged shall be repaired or replaced. All waterstops shall be properly spliced and joints shall be checked for strength and pinholes after splicing. Splices shall be strong enough to develop a pulling force of 75 percent of the strength of the waterstop, and shall be watertight. Splices in waterstop shall be made in conformance with the recommendations of the waterstop manufacturer. Continuity of cross sectional features shall be maintained across the splice. Splices showing evidence of separation after bending shall be remade.
- D. Install hydrophilic waterstop in accordance with the manufacturer's written instructions. Adhesives used on hydrophilic waterstop shall be NSF 61 certified. Adhesives shall meet the requirements of ASTM C 920 and shall be **Manus Bond 75-AM Lot NSF61, DAP Premium Polyurethane Construction Adhesive**, or approved equal.

3.2 JOINTS

- A. Joints shall be installed at locations indicated and as authorized. Joints shall be constructed so as to produce straight joints, and shall be vertical or horizontal, except where walls intersect sloping floors.
- B. Construction Joints
 - 1. Prior to placing the abutting concrete for all construction joints, the contact surface shall be cleaned by approved means to remove all laitance and expose the aggregate. The exposed portion of the reinforcing steel shall be cleaned of all concrete. The cleaning method shall be conducted so as to not damage waterstop, if waterstop is present. Where the joint is to receive a sealant, a recess 3/4-inch deep shall be formed along the joint using a dressed-and-oiled wood strip or other method approved by ENGINEER. The wood strip shall be removed after the concrete has set.
- C. Expansion Joints
 - 1. Expansion joint filler shall be used where required on the drawings. The edges of the joint shall be neatly finished with an edging tool of 1/8-inch radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed-and-oiled wood strip temporarily secured to the top thereof to form a recess 3/4-inch deep to be filled with sealant. The wood strip shall be removed after the concrete has set. In lieu of the wood strip a removable expansion filler cap designed and fabricated for this purpose may be used.
- D. Joint Sealant
 - 1. The joint cavity shall be cleaned by sandblasting or power wire brushing and shall be blown clean of dust and sand with compressed air before the joint sealant may be applied. Joints must be frost-free, free of oils, grease, curing compound residues, and any other foreign matter that might prevent bond. A bond breaker tape shall be installed over the joint per manufacturer's instructions. After the joints have been prepared as described above, the joints shall be primed and the sealant shall be applied in accordance with the manufacturer's recommendations.

- END OF SECTION -

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

- A. This Section covers cast-in-place concrete.
- B. CONTRACTOR shall provide cast-in-place concrete as indicated in the Specifications and the Contract Drawings.

1.2 RELATED WORK

- A. Related work specified in other Sections includes, but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 01 45 00 Quality Control and Material Testing
 - 3. Section 03 10 00 Concrete Forming and Accessories
 - 4. Section 03 20 00 Concrete Reinforcement
 - 5. Section 03 25 00 Expansion Joints, Construction Joints, and Waterstops
 - 6. Section 09 91 00 Painting and Finishes
 - 7. Section 31 23 23 Excavation and Backfill for Structures

1.3 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publications are referred to in the text by basic designation only.
- B. AMERICAN CONCRETE INSTITUTE (ACI)
 - 1. ACI 117 Specifications for Tolerances for Concrete Construction and Materials and Commentary
 - 2. ACI 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
 - 3. ACI 301 Structural Concrete for Buildings
 - 4. ACI 305R Hot Weather Concreting
 - 5. ACI 306R Cold Weather Concreting
 - 6. ACI 318 Building Code Requirements for Structural Concrete and Commentary
 - 7. ACI 350R Code Requirements for Environmental Engineering Concrete Structures and Commentary
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM C 31 Standard Practice for Making and Curing Concrete Test Specimens in the Field
 - 2. ASTM C 33 Standard Specification for Concrete Aggregates
 - 3. ASTM C 39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - 4. ASTM C 42 Standard Test Method for Obtaining and Testing Drilled Cores and

- 5. ASTM C 78 Sawed Beams of Concrete
Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading)
- 6. ASTM C 94 Standard Specification for Ready-Mixed Concrete
- 7. ASTM C 109 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)
- 8. ASTM C 143 Standard Test Method for Slump of Hydraulic-Cement Concrete
- 9. ASTM C 150 Standard Specification for Portland Cement
- 10. ASTM C 171 Standard Specification for Sheet Materials for Curing Concrete
- 11. ASTM C 172 Standard Specification for Sampling Freshly Mixed Concrete
- 12. ASTM C 173 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
- 13. ASTM C 192 Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
- 14. ASTM C 231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- 15. ASTM C 260 Standard Specification for Air-Entraining Admixtures for Concrete
- 16. ASTM C 309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- 17. ASTM C 494 Standard Specification for Chemical Admixtures for Concrete
- 18. ASTM C 595 Standard Specification for Blended Hydraulic Cements
- 19. ASTM C 618 Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- 20. ASTM C 1107 Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- 21. ASTM C 1157 Standard Performance Specification for Hydraulic Cement

D. NSF INTERNATIONAL (NSF)

- 1. NSF/ANSI 61 Drinking Water System Components - Health Effects.

1.4 DEFINITIONS

- A. Average Strength (f_{cr}): The required average strength for 30 consecutive strength tests which statistically assures not more than the permissible proportions of tests will fall below Specified Strength.
- B. Specified Strength (f_c'): The indicated strength.

1.5 SUBMITTALS

- A. The following shall be submitted in accordance with Section 01 33 00 – Submittal Procedures.
- B. Provide catalog information for all products to be used as part of the submitted mix design.
- C. The results of trial mix designs along with a statement giving the maximum nominal coarse aggregate size and the proportions of all ingredients that will be used in the manufacture of each strength of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an independent

commercial testing laboratory, attesting that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the work without additional tests to show that the quality of the concrete is satisfactory. Indicate whether mixes have been designed for pumping. Include in the report the following information:

1. Water-cement ratio.
 2. Proportion of materials in the mix.
 3. Source and type of cement.
 4. Analysis of water to be used unless potable.
 5. Type and name of admixtures applied. Indicate when accelerating or retarding admixtures are to be used and the resulting change in placement times.
 6. Slump, air content and temperature of samples.
 7. Unit weight of fresh and dry light weight concrete.
- D. Preapproved Mix Design Data: If supplier has on record, an OWNER approved mix design, submit name and address of supplier for each mix design 1 day prior to using concrete mix.
- E. Certified copies of laboratory test reports, including all test data, for aggregate, admixtures, and curing compound. These tests shall be made by an approved commercial laboratory or by a laboratory maintained by the manufacturers of the materials. Test shall meet the following requirements:
1. Date of mix design: No older than 365 days from the date of submission.
 2. Physical properties of the aggregate: Test results shall not be older than 455 days from the date of submission. A new report will be required if the aggregate source is changed.
- F. Cementitious Materials showing Manufacturer's certification of compliance, accompanied by mill test reports attesting that the materials meet the requirements of the specification under which it is furnished, for cement and pozzolan.
- G. Submit catalog information on the curing compound and the proposed location(s) to be used.

1.6 QUALITY ASSURANCE

- A. Do not change material sources, type of cement, air-entraining agent, water reducing agent, other admixtures, or aggregate without ENGINEER'S approval.
- B. In proportioning materials for mixing, use scales certified by the State of Utah. Do not use volume measurement except for water and liquid admixtures.
- C. Do not change the quantity of cement per cubic yard for approved mix design without written approval of ENGINEER.
- D. Use of admixtures will not relax hot or cold weather placement requirements.
- E. Ready-mixed concrete to be in accordance with Alternate No. 3 of ASTM C-94 and the requirements in this Section.

- F. Tolerances for concrete construction and materials shall be in accordance with ACI 117.

1.7 PRODUCT STORAGE AND HANDLING

- A. Store bagged and bulk cement in weatherproof enclosures to exclude moisture and contaminants.
- B. Stockpile aggregate to avoid segregation and prevent contamination.
- C. Avoid contamination, evaporation, or damage to admixtures. Protect liquid admixtures from freezing.

PART 2 PRODUCTS

2.1 SANDY CITY SPECIFICATIONS

- A. Refer to Sandy City Specification Section 03000 for concrete work within Sandy City right-of-way.

2.2 ADMIXTURES

- A. Air Entrainment: ASTM C 260.
- B. Later Reducing and Set Retarding Agents: ASTM C494.
 - 1. Type A: Set water reducing.
 - 2. Type B: Set retarding.
 - 3. Type C: Set accelerating.
 - 4. Type D: Water reducing and set retarding.
 - 5. Type E: Water reducing and set accelerating.
 - 6. Type F: High range water reducing (super plasticizer).*
 - 7. Type G: High range water reducing and set retarding.*
- * The relative durability factor of water reducing admixtures shall not be less than 80 and the chlorides content (as Cl-) expressed as a percent of the cement shall not exceed 0.1 percent by weight.
- C. Calcium Chloride: None allowed.
- D. Pozzolan: Pozzolan conforming to the requirements of ASTM C 618, Class F, is allowed as a Portland cement replacing agent under the following conditions:
 - 1. The maximum percentage of Portland cement replacement is:
 - a. 15 percent, for concrete exposed to weather.
 - b. 20 percent, for interior concrete.
 - 2. Pozzolan should not exceed 25% by weight of the cement plus pozzolans.
 - 3. The minimum cement content shall be used in the design formulas before replacement is made.
 - 4. Loss of ignition of pozzolan is less than 3 percent and the water requirement does not exceed 100 percent.
 - 5. All other requirements of this section still apply.
 - 6. Mix designs including trial batches are required for each aggregate source and for each concrete class.

- E. Cementitious Materials showing Manufacturer's certification of compliance, accompanied by mill test reports attesting that the materials meet the requirements of the specification under which it is furnished, for cement and pozzolan.

2.3 CEMENTITIOUS MATERIALS

- A. Cementitious materials shall each be of one type and from one source when used in concrete which will have surfaces exposed in the finished structure. Cementitious materials shall each be of one type and from one source when used in concrete which will have surfaces exposed in the finished structure. Cementitious materials shall conform to one of the following:
 1. Cement: Use Portland cement, ASTM C 150, Type II, Type IIA, or Type V, low alkali, or ASTM C 595 and ASTM C 1157 IL(10)-A-MS, unless noted otherwise.
 2. Portland - Pozzolan Cement: ASTM C-595, Type IP(20 max)-A(MS). Do not use Pozzolan cement unless approved by ENGINEER
- B. Only one brand of cement from one manufacturing plant may be used.

2.4 AGGREGATES

- A. Aggregates shall be natural aggregates, free from deleterious coatings, and shall conform to the requirements of ASTM C 33, except as modified herein. Aggregates shall not be potentially reactive as defined in Appendix XI of ASTM C 33. CONTRACTOR shall import nonreactive aggregates if local aggregates are reactive.
- B. Fine Aggregates
 1. Fine aggregate shall consist of clean, sharp, natural sand and shall conform to the requirements of ASTM C 33. Fine aggregate shall be graded as follows:

FINE AGGREGATES	
Sieve Size	Percent Passing by Weight
3/8 inch	100
#4	95-100
#8	80-100
#16	50-85
#30	25-60
#50	10-30
#100	2-10

2. Fine aggregates shall have no more than two percent by weight passing #200 sieve.

- C. Coarse Aggregate

1. Coarse aggregate shall be washed gravel or crushed stone, or a combination of these materials, consisting of hard, tough, durable particles free from adherent coatings. It shall contain no more than 15 percent flat or elongated particles. A thin, flat or elongated particle is defined as a particle having a maximum dimension in excess of five times its minimum dimension. Aggregate which has disintegrated or weathered badly under exposure conditions similar to those which will be encountered in the work under consideration shall be not be used. Coarse

aggregate shall be graded as follows (ASTM C 33):

COARSE AGGREGATES	
Sieve Size	Percent Passing by Weight
1-1/2 inch	100
1 inch	95-100
1/2 inch	25-60
#4	0-10
#8	0-5

2. Coarse aggregates shall have no more than 1.75 percent by weight passing #200 sieve. Proof of gradation will be provided to ENGINEER by CONTRACTOR.

2.5 ACI MIX DESIGN

- A. The amount by which the average strength (f_{cr}) of a concrete mix exceeds the specified compressive strength (f'_c) shall be based upon no more than 1 in 100 random individual strength tests falling more than 500 psi below the specific strength.
- B. Proportion the materials in accordance with ACI 211.1, 211.2 or 211.3 as applicable to produce concrete having the properties or limitations of Table No. 03 30 00-A.

2.6 HAND MIXING

- A. Do not hand mix batches exceeding 0.5 cubic yards.
- B. Hand mix only on watertight platform. Mix cement and aggregate prior to adding water.
- C. Ensure all stones are thoroughly covered with mortar and mixture is of uniform color and consistency.

2.7 HEATING, WATER AND AGGREGATE

- A. Do not allow products of fuel combustion to contact the aggregate.
- B. Heat mixing water to maximum temperature of 150 degrees F. Heat aggregates uniformly.
- C. Do not mix cement with water and aggregate at a mix temperature greater than 100 degrees F.

2.8 WATER

- A. Water shall be potable, except that non-potable water may be used if it produces mortar cubes having 7- and 28-day strengths at least 90 percent of the strength of similar specimens made with water from a municipal supply. The strength comparison shall be made on mortars, identical except for mixing water, prepared and tested in accordance with ASTM C 109. Water for curing shall not contain any substance injurious to concrete, or which causes staining.

2.9 PROPORTIONS OF MIX

- A. Mixture Proportioning, Normal Weight Concrete: All concrete that must be watertight and resistant to freeze-thaw cycles and to naturally occurring or commonly used chemicals should be air entrained. All materials should be proportioned to produce a well-graded mixture of high density and maximum workability with a minimum specified 28 day compressive strength of concrete classification. Trial batches shall contain materials proposed to be used in the project. Trial mixtures having proportions, consistencies and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios. Trial mixes shall be proportioned to produce concrete strengths specified. In the case where ground iron blast-furnace slag is used, the weight of the slag will be substituted in the equations for the term P which is used to denote the weight of pozzolan. Trial mixtures shall be designed for maximum permitted slump and air content. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192. They shall be tested at 7 and 28 days in accordance with ASTM C 39. From these test results a curve shall be plotted showing the relationship between water-cement ratio and strength. Maximum water-cement or water-cement plus pozzolan Ratio: 0.45.
- B. Average Strength: In meeting the strength requirements specified, the selected mixture proportion shall produce an average compressive strength exceeding the specified strength by the amount indicated below. Where a concrete production facility has test records, a standard deviation shall be established. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths within 1000 psi of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days or at other test age designated for determination of the specified strength.

1. SEE SANDY CITY SPECIFICATION SECTION 03000 FOR CONCRETE WITHIN SANDY CITY LIMITS

TABLE NO. 03 30 00-A

CONCRETE MIX PROPERTIES (e)			
CONCRETE PROPERTIES	CONCRETE CLASSIFICATION(S)		
	Class 4000	Class 3500	Class 3000
Specified Compressive Strength f_c' at 28 days, min., psi	4000	3500 (d)	3000 (d)
Compressive Strength at 7 days, min., psi (a)	2680	2345	2010
Cement content (94 lb. sacks of cement per cubic yard of concrete), min. (b)	6.0	5.75	5.5
Entrained air content, (% by volume).	6±1	6±1	6±1

Slump Range, in. (c)	1 - 4 (f)	2 - 4	2 - 4
Maximum Water Cement Ratio	0.45	0.45	0.45

- (a) Used for monitoring purposes only.
- (b) May include pozzolan replacements if approved by ENGINEER.
- (c) Not more than 8 inches after adding high range water reducing admixture (super-plasticizer) at site.
- (d) Not allowed if concrete is exposed to freezing and thawing temperatures. Use Class 4000 or higher compressive strength and 6±1.0 percent air entrainment.
- (e) All mix designs must be approved by ENGINEER.
- (f) 1-3" for footings, sub-structural walls and 1-4" for slabs, beams, reinforced walls and columns.

A. Normal Curing Compound

1. The curing compound shall be white pigmented and shall conform to ASTM C 309, Type 2 Class B.
2. Sodium silicate compounds cannot be used.
3. Manufacturer, or approved equal:
 - a. 1200-White by W.R. Meadows
 - b. White Resin Cure J10W by Dayton Superior
 - c. Safe-Cure 2000 by ChemMasters
 - d. Aqua Kure White by Lambert Corporation

B. Dissipating Curing Compound

1. When the curing compound must be removed for finishes or grouting, compounds shall be of a dissipating type, conforming to the requirements of ASTM C 309, Type 1 or Type 2, Class B
2. Manufacturer, or approved equal:
 - a. 1100-Clear by W.R. Meadows
 - b. Kurez DR VOX by Euclid Chemical Company
 - c. Clear Cure VOC J7WB by Dayton Superior
 - d. Safe-Cure Clear DR by ChemMasters

PART 3 EXECUTION

3.1 GENERAL

- A. CONTRACTOR shall inform ENGINEER at least 72 hours in advance of time and places at which CONTRACTOR intends to place concrete. All preparation work for concrete placements shall be substantially completed at least 2 workdays prior to the scheduled start of concrete placement to allow for ENGINEER's review and any necessary corrections.

3.2 PREPARATION OF SURFACES

- A. Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Conduit and other similar items shall be in place and clean of any deleterious substance.

- B. Foundations: Earthwork shall be as specified. Flowing water shall be diverted without washing over freshly deposited concrete. Rock foundations shall be cleaned by high velocity air-water jets, sandblasting, or other approved methods. Debris and loose, semi-detached or unsound fragments shall be removed. Rock surfaces shall be moist but without free water when concrete is placed. Semi porous subgrades for foundations and footings shall be damp when concrete is placed. Pervious subgrades shall be sealed by blending impervious material with the top 6 inches of the in-place pervious material or by covering with an impervious membrane.
- C. Preparation of Previously Placed Concrete: Concrete surfaces to which other concrete is to be bonded shall be roughened in an approved manner that will expose sound aggregate uniformly without damaging the concrete. Laitance and loose particles shall be removed. Surfaces shall be moist but without free water when concrete is placed.

3.3 INSTALLATION OF EMBEDDED ITEMS

- A. Embedded items shall be free from oil, loose scale or rust, and paint. Embedded items shall be installed at the locations indicated and required to serve the intended purpose. Voids in sleeves, slots and inserts shall be filled with readily removable material to prevent the entry of concrete.
- B. Reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms at locations as indicated or shown on the Contract Drawings. Proper placement and locations shall be the responsibility of CONTRACTOR.

3.4 BATCHING, MIXING AND TRANSPORTING CONCRETE

- A. Ready-mixed concrete shall be batched, mixed and transported in accordance with ASTM C 94, except as otherwise specified. Truck mixers, agitators, and non-agitating units shall comply with NRMCA TMMB-1. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA-QC 3.
- B. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quantity and quality of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by ENGINEER.
- C. Truck mixers and their operation must be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than 1 inch when the specified slump is 3 inches or less, or more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.
- D. Admixtures: Admixtures shall be batched within an accuracy of 3 percent. Where two or more admixtures are used in the same batch, they shall be batched separately and

must be compatible. Retarding admixture shall be added within one minute after addition of water is complete or in the first quarter of the required mixing time, whichever is first. Superplasticizing admixtures shall be added at the project site, and the concrete with the admixture shall be mixed 4 to 5 minutes before placing as recommended by manufacturer. Concrete that shows evidence of total collapse or segregation caused by the use of admixture shall be removed from the site.

- E. Control of Mixing Water: No water from the truck system or elsewhere shall be added after the initial introduction of mixing water for the batch. No water shall be added at the jobsite without the approval of ENGINEER.

3.5 SAMPLING AND TESTING

- A. Sampling and Testing of the concrete will be as defined in Section 01 45 00 – Quality Control and Material Testing.

1. Aggregates: Aggregates for normal weight concrete shall be sampled and tested in accordance with ASTM C 33.
2. Sampling of Concrete: Samples of concrete for air, slump, unit weight, and strength tests shall be taken in accordance with ASTM C 172.
 - a. Air Content: Test for air content shall be performed in accordance with ASTM C 173 or ASTM C 231. A minimum of 1 test shall be conducted each time a slump test is made.
 - b. Slump: At least 1 slump test shall be made on randomly selected batches of each mixture of concrete for every 100 cubic yards of ready-mixed concrete delivered to the job site. Also note the time batched at the plant and the starting time when unloading began at the site. Tests shall be performed in accordance with ASTM C 143.
 - c. Temperature: Concrete and air temperatures shall be measured and recorded with each set of cylinders and the air temperature shall also be recorded when the air temperature at the site is 40 degrees F or below and/or 90 degrees F or above.
3. Evaluation and Acceptance of Concrete
 - a. Frequency of Testing: Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 100 cubic yards of concrete, nor less than once for each 3000 square feet of surface area for slabs or walls. If this sampling frequency results in less than 5 strength tests for a given class of concrete, tests shall be made from at least 5 randomly selected trucks or from each truck if fewer than 5 truck loads are used. Field cured specimens for determining form removal time or when a structure may be put in service shall be made in numbers directed to check the adequacy of curing and protection of concrete in the structure. The specimens shall be removed from the molds at the age of 24 hours and shall be cured and protected, insofar as practicable, in the same manner as that given to the portion of the structure the samples represent.

- b. Testing Procedures: Cylinders for acceptance tests shall be molded and cured in accordance with ASTM C 31. Cylinders shall be tested in accordance with ASTM C 39. A strength test shall be the average of the strengths of two (2) 6-inch diameter by 12-inch-high cylinders made from the same sample of concrete and tested at 28 days or at another specified test age. If 4-inch diameter cylinders are used, the strength shall be the average of the strengths of three (3) 4-inch by 8-inch-high cylinders.
 - c. Evaluation of Results: Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength and no individual strength test result falls below the required strength by more than 500 pounds per square inch.
 - d. Unless noted otherwise, make a minimum of five (5) 6-inch diameter by 12-inch-high concrete cylinders or six (6) 4-inch diameter by 8-inch high cylinders each time a test is required. When concrete is being placed in suspended slabs, beams and retaining walls make two (2) extra cylinders which must be cured on site. The extra cylinders will be used to determine when to remove forms and/or when to backfill.
- B. Investigation of Low-Strength Test Results: When any strength test of standard-cured test cylinder falls below the specified strength requirement by more than 500 pounds per square inch, or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that load-carrying capacity of the structure is not jeopardized. Nondestructive testing in accordance with ASTM C 597, ASTM C 803 or ASTM C 805 may be permitted by ENGINEER to determine the relative strengths at various locations in the structure as an aid in evaluating concrete strength in place or for selecting areas to be cored. Such tests, unless properly calibrated and correlated with other test data, shall not be used as a basis for acceptance or rejection. When strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores shall be determined by ENGINEER to least impair the strength of the structure. If the concrete in the structure will be dry under service conditions, the cores shall be air dried (temperature 60 to 80 degrees F, relative humidity less than 60 percent) for seven days before testing and shall be tested dry. If the concrete in the structure will be more than superficially wet under service conditions, the cores shall be tested after moisture conditioning in accordance with ASTM C 42. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to or at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. If the core tests are inconclusive or impractical to obtain, or if structural analysis does not confirm the safety of the structure, load tests may be directed by ENGINEER in accordance with the requirements of ACI 318. Concrete work evaluated by structural analysis or by results of a load test and found deficient shall be corrected in a manner satisfactory to ENGINEER. All investigations, testing, load tests, and correction of deficiencies shall be performed, and approved by ENGINEER, at the expense of CONTRACTOR.

3.6 CONVEYING CONCRETE

- A. Concrete shall be conveyed from mixer to forms as rapidly as possible and within the

time interval specified in paragraph 3.6 CONCRETE PLACEMENT by methods which will prevent segregation or loss of ingredients.

1. Chutes: When concrete can be placed directly from a truck mixer or other transporting equipment, chutes attached to this equipment may be used. Separate chutes will not be permitted except when specifically approved.
2. Buckets: Bucket design shall be such that concrete of the required slump can be readily discharged. Bucket gates shall be essentially grout tight when closed. The bucket shall provide means for positive regulations of the amount and rate of deposit of concrete in each dumping position.
3. Belt Conveyors: Belt conveyors may be used when approved. Belt conveyors shall be designed for conveying concrete and shall be operated to assure a uniform flow of concrete to the final place of deposit without segregation or loss of mortar. Conveyors shall be provided with positive means for preventing segregation of the concrete at transfer points and point of placement.
4. Pumps: Concrete may be conveyed by positive displacement pumps when approved. Pump shall be the piston or squeeze pressure type. Pipeline shall be steel pipe or heavy duty flexible hose. Inside diameter of the pipe shall be at least three times the maximum size of the coarse aggregate. Distance to be pumped shall not exceed the limits recommended by the pump manufacturer. Concrete shall be supplied to the pump continuously. When pumping is completed, the concrete remaining in the pipeline shall be ejected without contaminating the concrete in place. After each use, the equipment shall be thoroughly cleaned. Flushing water shall be wasted outside the forms.

3.7 CONCRETE PLACEMENT

- A. Mixed concrete which is transported in truck mixers or agitators or concrete which is truck mixed, shall be discharged within 1-1/2 hours or before the drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates. These limitations may be waived by ENGINEER if the concrete is of such slump after the 1-1/2 hour time or 300 revolution limit has been reached that it can be placed, without the addition of water to the batch. When the concrete temperature exceeds 85 degrees F, the time shall be reduced to 45 minutes. Concrete shall be placed within 15 minutes after it has been discharged from the truck.
 1. Placing Operation: Concrete shall be handled from mixer to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by CONTRACTOR prevent proper consolidation, finishing and curing. Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 4 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Concrete should not be allowed to drop through a cage of reinforcing steel. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 12 inches thick, except that all slabs shall be placed in a single layer. Concrete to receive other construction shall be screened to the proper level to avoid excessive shimming or grouting.

- a. Additional requirements for depositing concrete in walls include, but are not limited to:
 - 1) Deposit concrete in a continuous operation until section is completed.
 - 2) Place concrete in approximately horizontal layers 2 ft maximum thickness.
 - 3) Each layer of concrete shall be plastic when covered with the following layer.
 - 4) Rate of vertical rise not more than 4 ft per hour.
 - 5) Pump concrete or use a tremie having varying lengths for placing concrete in columns and walls to prevent free fall of more than 4 ft.
 - 6) Allow concrete to thoroughly settle before top is finished. Remove all laitance, debris, and surplus water from surfaces at tops of forms by screeding, scraping, or other effective means.
 - b. Additional requirements for depositing concrete in slabs include, but are not limited to:
 - 1) Deposit concrete in a continuous operation until section is completed.
 - 2) Concrete shall be deposited as nearly as practicable to its final position to avoid segregation due to rehandling or flowing.
 - 3) In sloping slabs, proceed uniformly from the bottom of the slab to the top for the full width of the placement.
2. Consolidation: Immediately after placing, each layer of concrete shall be consolidated by internal vibrators, except for slabs 4 inches or less. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; a spare vibrator shall be kept at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 8000 vibrations per minute, and the head diameter and amplitude shall be appropriate for the concrete mixture being placed. Vibrators shall be inserted vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a few inches. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then withdrawn slowly. The use of form vibrators must be specifically approved. Vibrators shall not be used to transport concrete within the forms. Slabs 4 inches and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique.
- B. Cold Weather Requirements: Special protection measures, approved by ENGINEER, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. Provisions should be made to keep the concrete at a minimum temperature of 50 degrees F for 7 days. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete shall be not less than 40 degrees F. No concrete shall be placed on frozen ground. The temperature of the concrete when placed shall be not less than 55 degrees F nor more than 75 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. Calcium chloride shall not be used.
- C. Hot Weather Requirements: The temperature of the concrete placed during hot weather shall not exceed 85 degrees F except where an approved retarder is used. The mixing

water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. In no case shall the placing temperature exceed 95 degrees F.

3.8 CONSTRUCTION JOINTS

- A. Construction joints shall be located as indicated or approved. Where concrete work is interrupted by weather, end of work shift or other similar type of delay, location and type of construction joint shall be subject to approval of ENGINEER. Unless otherwise indicated and except for slabs on grade, reinforcing steel shall extend through construction joints. Construction joints in slabs on grade shall be keyed or doweled as shown. Concrete columns, walls, or piers shall be in place at least 2 hours, or until the concrete is no longer plastic, before placing concrete for beams, girders, or slabs thereon. In walls having door or window openings, lifts shall terminate at the top and bottom of the opening. Other lifts shall terminate at such levels as to conform to structural requirements or architectural details. Where horizontal construction joints are required, a strip of 1-inch square-edge lumber, beveled and oiled to facilitate removal, shall be tacked to the inside of the forms at the construction joint. Concrete shall be placed to a point 1 inch above the underside of the strip. The strip shall be removed 1 hour after the concrete has been placed, and any irregularities in the joint line shall be leveled off with a wood float, and all laitance shall be removed. Prior to placing additional concrete, horizontal construction joints shall be prepared as specified in paragraph 3.1, PREPARATION OF SURFACES.

3.9 FINISHING CONCRETE

A. Formed Surfaces

1. Repair of Surface Defects: Surface defects shall be repaired within 24 hours after the removal of forms. Honeycombed and other defective areas shall be cut back to solid concrete or to a depth of not less than 1 inch, whichever is greater. Edges shall be cut perpendicular to the surface of the concrete. The prepared areas shall be dampened and brush-coated with neat cement grout. The repair shall be made using mortar consisting of not more than 1 part cement to 2-1/2 parts sand. The mixed mortar shall be allowed to stand to stiffen (approximately 45 minutes), during which time the mortar shall be intermittently remixed without the addition of water. After the mortar has attained the stiffest consistency that will permit placing, the patching mix shall be thoroughly tamped into place by means approved by ENGINEER and finished slightly higher than the surrounding surface. For Class A and Class B finished surfaces the cement used in the patching mortar shall be a blend of job cement and white cement proportioned to produce a finished repair surface matching, after curing, the color of adjacent surfaces. Holes left after the removal of form ties shall be cleaned and filled with patching mortar. Holes left by the removal of tie rods shall be reamed and filled by dry-packing. Repaired surfaces shall be cured as required for adjacent surfaces. The temperature of concrete, mortar patching material, and ambient air shall be above 50 degrees F while making repairs and during the curing period. Concrete with defects which affect the strength of the member or with excessive honeycombs will be rejected, or the defects shall be corrected as directed.
2. Class A Finish: Where a Class A finish is indicated, fins shall be removed. A mortar mix consisting of one-part Portland cement and two parts well-graded sand passing a No. 30 sieve, with water added to give the consistency of thick paint, shall be

prepared. White cement shall be used to replace part of the job cement. After the surface has been thoroughly wetted and allowed to approach surface dryness, the mortar shall be vigorously applied to the area by clean burlap pads or by cork or wood-floating, to completely fill all surface voids. Excess grout shall be scraped off with a trowel. As soon as it can be accomplished without pulling the mortar from the voids, the area shall be rubbed with burlap pads until all visible grout film is removed. The rubbing pads shall have on their surfaces the same sand-cement mix specified above but without any mixing water. The finish of any area shall be completed in the same day, and the limits of a finished area shall be made at natural breaks in the surface. The surface shall be continuously moist cured for 48 hours. The temperature of the air adjacent to the surface shall be not less than 50 degrees F for 24 hours prior to, and 48 hours after, the application. In hot, dry weather the smooth finish shall be applied in shaded areas.

3. Class B Finish: Where a Class B finish is indicated, fins shall be removed. Concrete surface shall be smooth with a texture at least equal to that obtained through the use of Grade B-B plywood forms.
4. Class C Finish: Where a Class C finish is indicated, fins shall be removed. Concrete surfaces shall be relatively smooth with a texture imparted by the forms used.
5. Class D Finish: Where a Class D finish is indicated, fins exceeding 1/4 inch in height shall be chipped or rubbed off. Concrete surfaces shall be left with the texture imparted by the forms used.
6. See Specification Section 09 91 00 Painting and Finishes for required finishes.

B. Unformed Surfaces: In cold weather, the air temperature in areas where concrete is being finished shall not be less than 50 degrees F in accordance with ACI 306R. In hot windy weather when the rate of evaporation of surface moisture, as determined by methodology presented in ACI 305R, may reasonably be expected to exceed 0.2 pounds per square foot per hour; coverings, windbreaks, or fog sprays shall be provided as necessary to prevent premature setting and drying of the surface. The dusting of surfaces with dry materials or the addition of water during finishing will not be permitted. Finished surfaces shall be plane, with no deviation greater than 5/16-inch when tested with a 10-foot straightedge. Surfaces shall be pitched to drains.

1. Rough-Slab Finish: Slabs to receive fill or mortar setting beds shall be screened with straightedges immediately after consolidation to bring the surface to the required finish level with no coarse aggregate visible.
2. Float Finish: Slabs to receive a steel trowel finish and slabs where indicated shall be given a float finish. Screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. After the concrete has stiffened to permit the operation and the water sheen has disappeared, it shall be wood floated. Concrete that portrays stickiness shall be finished with a magnesium float in lieu of a wood float, and left free of ridges and other projections. Float finish is normally specified for surfaces that will receive other treatment such as built-up roofing, nonslip surfacing material. Float Finish shall not be used on wearing surfaces.
3. Trowel Finish: Slabs where indicated, shall be given a trowel finish immediately following floating. Surfaces shall be trowelled to produce smooth, dense slabs free from blemishes including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. A final hard steel troweling shall be done by hand. Trowel finish shall be used on wearing surfaces and where a smooth finish is required.

4. Broom Finish: After floating, slabs where indicated, shall be lightly troweled, and then broomed with a fiber-bristle brush in a direction transverse to that of the main traffic.
5. See Specification Section 09 91 00 Painting and Finishes for required finishes.

3.10 CURING AND PROTECTION

- A. General: All concrete shall be cured by an approved method for the period of time given below:

Concrete with Type III cement	3 days
Concrete with Type II or IIA, or V, low alkali cement	7 days
Concrete with Type IP-A(MS) cement blended with pozzolan	10 days

- B. Immediately after placement, concrete shall be protected from premature drying extremes in temperatures, rapid temperature change, mechanical injury and injury from rain and flowing water. Air and forms in contact with concrete shall be maintained at a temperature above 50 degrees F for the first 3 days and at a temperature above 32 degrees F for the remainder of the specified curing period. Exhaust fumes from combustion heating units shall be vented to the outside of the enclosure and heaters and ducts shall be placed and directed so as not to cause areas of overheating and drying of concrete surfaces or to create fire hazards. All materials and equipment needed for adequate curing and protection shall be available and at the site prior to placing concrete. No fire or excessive heat shall be permitted near or in direct contact with the concrete at any time. Curing shall be accomplished by any of the following methods, or combination thereof, as approved.
- C. Moist Curing: Concrete to be moist-cured shall be maintained continuously wet for the entire curing period. If water or curing materials used stains or discolors concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned. When wooden forms are left in place during curing, they shall be kept wet at all times. If the forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Horizontal surfaces shall be cured by ponding, by covering with a 2-inch minimum thickness of continuously saturated sand, or by covering with waterproof paper, polyethylene sheet, polyethylene-coated burlap or saturated burlap. Once the moist curing has started the concrete surface must not be allowed to become surface dry for the entire curing period.
- D. Membrane Curing:
1. Normal membrane curing compound shall not be used on surfaces that are to receive any subsequent treatment depending on adhesion or bonding to the concrete. Use a Dissipating curing compound for surfaces which are to be painted or are to receive bituminous roofing or waterproofing, or floors that are to receive adhesive applications of resilient flooring.
 2. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing or flooring specified. Membrane curing compound shall not be used on surfaces that are maintained at curing temperatures with free steam.
 3. Curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning

- of loose sand, mortar, and debris from the surface.
4. Surfaces shall be thoroughly moistened with water and the curing compound shall be applied to slab surfaces as soon as the bleeding water has disappeared, with the tops of joints being temporarily sealed to prevent entry of the compound and to prevent moisture loss during the curing period.
 5. Compound shall be applied in a one-coat continuous operation by mechanical spraying equipment, at a uniform coverage in accordance with the manufacturer's printed instructions.
 6. Concrete surfaces which have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage specified.
 7. On surfaces permanently exposed to view, the surface shall be shaded from direct rays of the sun for the duration of the curing period.
 8. Surfaces coated with curing compound shall be kept free of foot and vehicular traffic, and from other sources of abrasion and contamination during the curing period.

3.11 QUALITY CONTROL TESTING

- A. Quality Control Testing shall be in accordance with Section 01 45 00 – Quality Control and Material Testing.

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SECTION 03 31 05
CONTROLLED LOW STRENGTH MATERIAL

PART 1 GENERAL

1.1 REQUIREMENTS

- A. CONTRACTOR shall provide Controlled Low Strength Material (CLSM), complete and in place, in accordance with the Contract Documents.
- B. CLSM shall be placed where indicated and may be used, if ENGINEER approves, for the following purposes:
 - 1. Normal CLSM with high slump, non-segregating consistency that readily flows and fills voids and difficult to reach places: pipe zone fill, trench zone fill, pipe abandonment, structure backfill, and structure cavity fill.
 - 2. Foundation CLSM is used where higher early strengths are required and future excavation is not likely to be required.

1.2 RELATED WORK

- A. Related work in other sections includes, but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 31 23 15 Excavation and Backfill for Buried Pipelines

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM C 33 Standard Specification for Concrete Aggregates
 - 2. ASTM C 94 Standard Specification for Ready-Mixed Concrete
 - 3. ASTM C 138 Standard Test Method for Density (Unit Weight), Yield and Air Content (Gravimetric) of Concrete
 - 4. ASTM C 150 Standard Specification for Portland Cement
 - 5. ASTM C 260 Standard Specification for Air-Entraining Admixtures for Concrete.
 - 6. ASTM C 403 Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
 - 7. ASTM C 494 Standard Specification for Chemical Admixtures for Concrete
 - 8. ASTM C 595 Standard Specification for Blended Hydraulic Cements
 - 9. ASTM C 618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
 - 10. ASTM C 803 Standard Test Method for Penetration Resistance of Hardened Concrete
 - 11. ASTM C 1157 Standard Performance Specification for Hydraulic Cement
 - 12. ASTM D 4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
 - 13. ASTM D 4832 Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

1.4 SUBMITTALS

- A. Submittals shall be furnished in accordance with Section 01 33 00 – Submittal Procedures.
- B. Shop Drawings:
 - 1. CLSM mix designs which show the proportions and gradations of all materials proposed for each type of CLSM indicated. Each mix design shall be accompanied by independent laboratory test results of the indicated properties.
 - 2. If Contractor proposes to provide lower strength CLSM with aggregates that do not conform to ASTM C 33, Shop Drawings shall include a testing program that will be used to control the variability of the aggregates. The testing program shall be acceptable to ENGINEER.

1.5 QUALITY ASSURANCE:

- A. All testing will be done by a testing laboratory at CONTRACTOR'S expense, except as otherwise indicated.
- B. If tests of the CLSM show non-compliance with the specifications, CONTRACTOR shall make changes as may be required to achieve compliance. Performing and paying for subsequent testing to show compliance shall be CONTRACTOR's responsibility.
- C. Correlation Tests
 - 1. CONTRACTOR shall perform a field correlation test for each mix of CLSM used in pipe zone, trench zone, or backfill used in amounts greater than 100 cubic yards or when CLSM is required to support traffic or other live loads on the fill less than 7 days.
 - 2. Field correlation tests shall be performed in a test pit similar in cross section to the WORK and at least 10-feet long at a location near the WORK. The proposed location shall be acceptable to ENGINEER.
 - 3. Laboratory and field tests shall be performed on samples taken from the same CLSM batch mix. All tests shall be performed by a laboratory at CONTRACTOR's expense.
 - 4. Testing shall be performed once each 2-hours during the first 8 hours, once each 8-hours during the first week, and once each 24-hours until the CLSM mix reaches the maximum design strength.
 - a. Compression testing shall be in accordance with ASTM D 4832.
 - b. Setting test shall be in accordance with ASTM C 403.
 - c. Density tests shall be in accordance with ASTM C 138.

PART 2 PRODUCTS

2.1 CONTROLLED LOW STRENGTH MATERIAL

- A. CLSM shall be a mixture of cement, pozzolan, coarse and fine aggregate, admixtures, and water, mixed in accordance with ASTM C 94.
- B. Composition: The following parameters shall be within the indicated limits and as necessary to produce the indicated compressive strengths.

1. The actual mix proportions and flow characteristics shall be determined by the producer of the CLSM to meet requirements for compressive strength as specified for Normal CLSM or Foundation CLSM.
2. Entrained air content shall be between 15 percent minimum and 30 percent maximum.
3. Water reducing agent content as necessary.

C. Properties

1. Density shall be between 120 PCF minimum and 145 PCF maximum.
2. Slump shall be as required by CONTRACTOR methods but shall not promote segregation. Slump shall be 8 – 10 inches.
3. Compressive strength at 28 days:
 - a. Normal CLSM: Between 50 psi minimum and 150 psi maximum. Unless specifically indicated otherwise, all CLSM shall be Normal CLSM.
 - b. Foundation CLSM: 1,000 psi minimum.

2.2 CEMENT

- A. Cement shall be Type II in accordance with ASTM C 150 or Type IP(10)-MS or Type IL(10)-MS per ASTM C 595 and ASTM C 1157. and come from a source on the UDOT Materials Quality Assurance List. Minimum Portland Cement content shall be 50 lbs/cubic yard.

2.3 POZZOLAN

- A. Pozzolan shall be Class F in accordance with ASTM C 618. Pozzolan content, by weight, in Normal CLSM shall not be less than 300 lbs/cubic yard.

2.4 AGGREGATE

- A. Course and fine aggregate shall consist of a well graded mixture of natural sand consisting of mineral aggregate particles. One hundred percent shall pass the 3/4 inch sieve; no more than 30 percent shall be retained on the 3/8-inch sieve; and no more than 10 percent shall pass the number 200 sieve. If more than 5 percent of the aggregate passes the number 200 sieve, the material passing the number 200 sieve shall have a plasticity index of less than 0.73 (liquid limit-20), when tested in accordance with ASTM D 4318. All aggregate shall be free from organic matter and shall not contain more alkali, sulfates, or salts than the native materials at the Site.

2.5 ADMIXTURES

- A. Air entraining admixtures shall be in accordance with ASTM C 260.
- B. Water reducing admixtures shall be in accordance with ASTM C 494.

2.6 WATER

- A. Water shall be potable, clean, and free from objectionable quantities of silt, organic matter, alkali, salt, and other impurities.

PART 3 EXECUTION

3.1 PREPARATION

- A. Subgrade and compacted fill to receive CLSM shall be prepared according to Section 31 23 15 Excavation and Backfill for Buried Pipelines.

3.2 BATCHING, MIXING AND DELIVERY

- A. Batching, mixing, and delivery of CLSM shall conform to ASTM C 94. CLSM shall be mixed at a batch plant acceptable to ENGINEER and shall be delivered in standard transit mix trucks.

3.3 PLACEMENT

- A. CLSM shall be placed by tailgate discharge, conveyor belts, pumped, or other means acceptable to ENGINEER. CLSM shall be directed in place by vibrator, shovel, or rod to fill all crevices and pockets. Avoid over-consolidation which causes separation of aggregate sizes.
- B. CLSM shall be continuously placed against fresh material unless otherwise approved by ENGINEER. When new material is placed against existing CLSM, the placement area shall be free from all loose and foreign material. The surface of the existing material shall be soaked for a minimum of one hour before placement of fresh material but no standing water shall be allowed when placement begins.
- C. CLSM placement for piping. Pipe shall be placed on soil pads and bedding placed under the pipe from one side and vibrated, as necessary, so that the CLSM flows to the opposite side. CLSM shall then be added to both sides of the pipe and vibrated until it fills the space between the pipe and the excavated trench bottom. CLSM shall be deposited in such a manner as to avoid uplift and deposited in its final position to avoid disturbing the pipe trench causing foreign material to mix with the cement slurry.
- D. Pipe zone backfill shall not be placed or compacted until the CLSM has reached the initial set. Pipes placed on steep slopes may require a stiffer mix to prevent CLSM from flowing down the trench. Vibration may be required to ensure that the CLSM fills all voids.
- E. Temperature of the CLSM shall be between 50- and 90-degrees F, when placed. CLSM shall not be placed when the air temperature is below 40 degrees F. No CLSM shall be placed against frozen subgrade or other materials having temperature less than 32 degrees F.

3.4 FINISHING

- A. The finish surface shall be smooth and to the grade indicated or directed by ENGINEER. Surfaces shall be free from fins, bulges, ridges, offsets, and honeycombing. Finishing by wood float, steel trowel, or similar methods is not required.

3.5 CURING

- A. CLSM shall be kept damp for a minimum of 7 days or until final backfill is placed.

3.6 PROTECTION

- A. CLSM shall be protected from freezing for 72 hours after placement.
- B. No fill or loading shall be placed on CLSM until probe penetration resistance, as measured in accordance with ASTM C 803 exceeds 650 psi.
- C. CLSM shall be protected from running water, rain, and other damage until the Material has been accepted and final fill completed.

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SECTION 03 60 00
GROUT

PART 1 GENERAL

1.1 REQUIREMENTS

- A. CONTRACTOR shall provide grout, complete and in place, in accordance with the Contract Documents.
- B. Unless indicated otherwise, grout shall be provided as listed in this Section whether indicated on the Contract Drawings or not.
- C. The following types of grouts are covered in this Section:
 - 1. Cement Grout
 - 2. Non-Shrink Grout – Class I (cement based)
 - 3. Non-Shrink Grout – Class II (cement based)
 - 4. Non-Shrink Epoxy Grout
 - 5. Epoxy Anchor Grout for Adhesive Anchors
 - 6. Topping Grout and Concrete/Grout Fill

1.2 RELATED WORK

- A. Related Work specified in other Sections includes, but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 01 60 00 Product Requirements
 - 3. Section 03 30 00 Cast-in-Place Concrete

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. American Society for Testing Materials (ASTM)
 - 1. ASTM C 33 Standard Specification for Concrete Aggregates
 - 2. ASTM C 136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - 3. ASTM C 150 Standard Specification for Portland Cement
 - 4. ASTM C 307 Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing
 - 5. ASTM C 494 Standard Specification for Chemical Admixtures for Concrete
 - 6. ASTM C 496 Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
 - 7. ASTM C 531 Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
 - 8. ASTM C 579 Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes

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| 9. | ASTM C 580 | Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes |
| 10. | ASTM C 595 | Standard Specification for Blended Hydraulic Cements |
| 11. | ASTM C 827 | Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures |
| 12. | ASTM C 881 | Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete |
| 13. | ASTM C 882 | Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear |
| 14. | ASTM C 939 | Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method) |
| 15. | ASTM C 942 | Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory |
| 16. | ASTM C 1090 | Standard Test Method for Measuring Changes in Height of Cylindrical Specimens of Hydraulic-Cement Grout |
| 17. | ASTM C 1107 | Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) |
| 18. | ASTM C 1157 | Standard Performance Specification for Hydraulic Cement |
| 19. | ASTM C 1339 | Standard Test Method for Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Grouts |
| 20. | ASTM D 648 | Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position |
| 21. | ASTM D 695 | Standard Test Method for Compressive Properties of Rigid Plastics |

1.4 CONTRACTOR SUBMITTALS

- A. Submittals shall be furnished in accordance with Section 01 33 00 – Submittal Procedures.
- B. Provide the following submittals for each type of grout used on the project:
 1. Test reports accompanied by a manufacturer's statement that previously tested material is of similar type, quality, and manufacture as that which is proposed for use on this project shall be submitted for:
 - a. Cement
 - b. Aggregates
 - c. Retardants
 - d. Bonding compounds
 - e. Epoxy Resin
 2. Certifications that grout used on the project contain no chlorides or other chemicals that cause corrosion.
 3. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each type of grout used in the WORK, and location of use. ICBO/ES report shall be submitted for epoxy anchor grout for adhesive anchors.
 4. Manufacturer's certification that non-shrink grout does not contain aluminum, zinc, or magnesium powders as a method of expansion.
 5. Submit manufacturer's written warranty as indicated herein.

6. Name and telephone number of grout manufacturer's representative who will give on-Site service. The representative shall have at least one year of experience with the indicated grout.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Grout and grout materials shall be stored in a dry shelter, protected from moisture, and for prepackaged grout, maintained in accordance with the manufacturer's recommendations.

1.6 QUALITY ASSURANCE

- A. The work shall be always subject to inspection by OWNER and ENGINEER for the purpose of determining that the work is properly executed in accordance with this specification. Failure to detect defective workmanship or material during any interim inspection shall not constitute acceptance of workmanship and materials.
- B. All testing will be done by a testing laboratory at CONTRACTOR'S expense, except as otherwise indicated.
- C. Field Tests
 1. Compression test specimens will be taken from the first placement of each type of grout, and at intervals thereafter selected by ENGINEER.
 2. Compression tests and fabrication of specimens for cement grout and cement based non-shrink grout will be performed in accordance with ASTM C 1107, at intervals during construction selected by ENGINEER. A set of 3 specimens will be made for testing at 7 Days, 28 Days, and each additional time period as appropriate.
 3. Compression tests and fabrication of specimens for topping grout and concrete/grout fill will be performed in accordance with Section 03 31 00 - Cast-in-Place Concrete, at intervals during construction selected by ENGINEER.
 4. Compression tests and fabrication of specimens for epoxy grouts will be performed in accordance with ASTM C 579, Method B, at intervals during construction selected by ENGINEER. A set of 3 specimens will be made for testing at 7 Days and each earlier time period as appropriate.
- D. Construction tolerances shall be as indicated in Section 03 30 00 Cast-in-Place Concrete unless noted otherwise.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Cement: Portland cement shall be Type II or Type V per ASTM C 150 or Type IL(10)-MS or HS per ASTM C 595 and ASTM C 1157.
- B. Aggregate:

1. General: Aggregate shall be non-reactive and shall be washed before use. When sources of aggregate are changed, test reports shall be provided for the material from the new source prior to commencing grout work.
2. Fine Aggregate: Fine aggregate shall be sand or crush stone conforming to ASTM C 33 as modified herein. When tested in accordance with ASTM C 136, gradation shall be such that 100 percent by weight passes a No. 8 sieve and not less than 45 percent by weight passes a standard No. 40 sieve. Variation from the specified gradation in individual tests will be accepted if the average of three consecutive tests is within the following variation:

Standard Sieve	Permissible Variation in Individual Test
No. 30 or coarser	2% by weight
No. 50 or finer	0.5% by weight

C. Admixtures

1. General: Admixtures shall be compatible with the grout and shall comply with the manufacturer's recommendations. Admixtures shall be added to the grout mix separately.
2. Water Reducing Retarder: Water reducing retarder shall comply with ASTM C 494, Type D and shall be **Master Builders (BASF) MasterSet R 300, Sika Corporation Plastiment**, or approved equal.
3. Lubricant: Lubricant additive for cement pressure grouting shall be **Sika Intraplast**, or approved equal.

D. Water:

1. Water for washing aggregate, for mixing and for curing shall be potable, shall not contain more than 1,000 mg/L of chlorides as Cl, nor more than 1,300 mg/L of sulfates as SO₄, and shall not contain impurities which may change the setting time by more than 25 percent or a reduction of more than 5 percent of the compressive strength of the grout at 14 days when compared to the results for grout made with distilled water.

2.2 CEMENT GROUT

- A. Application: Surface repairs of concrete.
- B. Cement grout shall be composed of one part cement, 3 parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white Portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 Days shall be 4000 psi.
- C. Cement grout materials shall be as indicated in Section 03 30 00 Cast-in-Place Concrete.

2.3 NON-SHRINK GROUT

A. General

1. Non-shrink cementitious grout shall be a flowable, prepackaged, inorganic, non-metallic, cement type grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used. The manufacturer shall

- have at least 10 years' experience in the manufacture of cement-based grouts. The manufacturer shall provide technical services and provide a representative at the jobsite for product training prior to product installation.
2. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout shall be as recommended by the manufacturer for the application.
 3. Grout shall not contain chlorides or additives that may contribute to corrosion.
 4. Grout shall be formulated to be used at any consistency from fluid to plastic.
 5. Cement-based non-shrink grout shall have the following minimum properties when tested at a fluid consistency, at 28 Days:
 - a. Minimum tensile splitting strength of 500 psi per ASTM C 496.
 - b. Minimum flexural strength of 1,000 psi per ASTM C 580.
 - c. Minimum bond strength (concrete to grout) of 1,900 psi per modified ASTM C 882.
 - d. Grout shall be certified for use in freeze/thaw environments.

B. Class I Non-Shrink Grout

1. Application: Anchor bolts and reinforcing steel required to be set in grout in which the average working or operating temperature will be over 100 degrees F or in high fire risk areas; Beam and column (1 or 2 story) base plates less than 16-inches in the least dimension; Storage tanks and other non-motorized equipment and machinery under 30 horsepower; Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.; Repair of holes and defects in concrete members which are not water bearing and not in contact with soil or other fill material; and any other location not specifically listed in this Section or on the Contract Drawings.
2. Class I non-shrink grout shall have a minimum 28 Day compressive strength of 5,000 psi when mixed at a fluid consistency.
3. Class I non-shrink grout shall meet the requirements of ASTM C 1107, Grade B or C, when mixed to fluid, flowable, and plastic consistencies.
4. Grout shall have a maximum early age height change of 4.0% expansion and shall have no shrinkage (0.0%) in accordance with ASTM C 827. The grout when tested shall not bleed or segregate at maximum allowed water.
5. Grout shall have no shrinkage (0.0%) and a maximum of 0.3% expansion in the hardened state when tested in accordance with ASTM C 1090.
6. Furnish certification that the non-shrink property of grout is not based on gas production or gypsum expansion.
7. Class I Non-Shrink Grout shall be **Five Star Grout by Five Star Products, Sikagrout 212 by Sika Corporation, CB-G PG by Hilti**, or equal.

C. Class II Non-Shrink Grout

1. Application: Column base plates (greater than 2 story or larger than 16-inches in the least dimension); under precast concrete elements; and repair of holes and defects in concrete members which are water bearing or in contact with soil or other fill materials.
2. Class II non-shrink grout shall be a high precision, fluid, extended working time, grout. The minimum 28-Day compressive strength shall be 7,500 psi, when mixed at a fluid consistency.
3. Grout shall have a maximum early age height change of 4.0% expansion and shall have no shrinkage (0.0%) in accordance with ASTM C 827.
4. Grout shall have no shrinkage (0.0%) and a maximum of 0.3% expansion in the hardened state when tested in accordance with ASTM C 1090.

5. Class II non-shrink grout shall have an extended working time of 30 minutes minimum when mixed to a fluid consistency as defined in ASTM C 827 at temperature extremes of 45 to 90 degrees F in accordance with ASTM C 1107.
6. Class II non-shrink grout shall meet the requirements of ASTM C 1107, Grade B or C when tested using the amount of water needed to achieve fluid consistency per ASTM C 939.
7. The grout when tested shall not bleed or segregate at maximum allowed water content.
8. Provide certification that its non-shrink property is not based on gas production or gypsum expansion.
9. Class II non-shrink grout shall be **Five Star Fluid Grout 100 by Five Star Products, Crystex by L&M Construction Chemicals**, or equal.

2.4 NON-SHRINK EPOXY GROUT

- A. Application: Pumps over 1,000 horsepower, unless indicated otherwise.
- B. Non-shrink epoxy grout shall be a flowable, non-shrink, 100 percent solids system. The epoxy grout system shall have 3 components: resin, hardener, and specially blended aggregate, each premeasured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged.
- C. Epoxy grout shall have a maximum early age height change of 4.0% expansion and shall have no shrinkage (0.0%) in accordance with ASTM C 827, (modified for epoxy grouts by using an indicator ball with a specific gravity between 0.9 and 1.1).
- D. Epoxy grout shall have a negligible (less than 0.0006 in/in) length change after hardening, and a coefficient of thermal expansion less than 18×10^{-6} in/in F when tested according to ASTM C 531.
- E. The epoxy grout shall develop a minimum compressive strength of 9,000 psi in 24 hours and 13,000 psi in seven days when tested in accordance with ASTM C 579, method B.
- F. The mixed epoxy grout shall have a minimum working life of 90 to 120 minutes at 70 degrees F.
- G. The effective bearing area shall be a minimum of 95 percent EBA in accordance with ASTM C 1339.
- H. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the application. Do not reduce aggregate loading or add solvents to increase flowability.
- I. Non-shrink epoxy grout shall have the following minimum properties when tested at 7 Days:
 1. Minimum bond strength to concrete of 3,000 psi per ASTM C 882 modified.
 2. Minimum bond strength to steel of 1,700 psi per ASTM C 882 modified.
 3. Minimum flexural strength of 2,500 psi per ASTM C 580.
 4. Minimum tensile strength of 2,000 psi per ASTM C 307.

- J. Non-shrink epoxy grout shall be **Five Star DP Epoxy Grout by Five Star Products, Inc., Sikadur 42 Grout-Pak by Sika Corporation**, or equal.

2.5 EPOXY ANCHOR GROUT

- A. Application: Anchor bolts and reinforcing steel required to be set in grout that is not in high temperature or high fire risk areas.
- B. Epoxy anchor grout shall conform to ASTM C 881, Type IV, Class A, B, and C, Grade 3 with the exception of gel time.
- C. Heat deflection temperature shall be a minimum of 139 °F per ASTM D 648.
- D. Manufacturer shall certify that the epoxy anchor grout will maintain 90 percent of its strength up to a temperature of 125 °F.
- E. Grout shall come in a 2 chambered cartridge with a metering system that provides the proper ratio of hardener and resin. The grout shall also come with a static mixer nozzle to thoroughly mix the hardener and resin together.
- F. Epoxy anchor grout shall be capable of being used in submersed applications once cured.
- G. Minimum compressive strength shall be 12,000 psi per ASTM D 695.
- H. Overhead anchors and anchors in fire-resistive construction shall be cast-in anchors.
- I. Embedment of adhesive anchors/rebar shall be deep enough to develop the anchor/rebar. Embedment shall not exceed 67 percent of the member depth.
- J. Epoxy anchor grout shall be **Epcon C6+ by ITW Ramset/Red Head, Power-Fast Epoxy Injection Gel by Powers Fasteners, RE 500 by Hilti**, or equal.

2.6 TOPPING GROUT AND CONCRETE/GROUT FILL

- A. Where fill is thicker than 3-inches, structural concrete as indicated in Section 03 31 00 - Cast-in-Place Concrete, may be used when accepted by ENGINEER.
- B. Grout for topping of slabs and concrete/grout fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and be mixed as indicated. Materials and procedures indicated for normal concrete in Section 03 31 00 - Cast-in-Place Concrete, shall apply unless indicated otherwise.
- C. Topping grout and concrete/grout fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water cement ratio of 0.45. Topping grout in clarifiers shall contain between 750 and 800 pounds of cement per cubic yard with a maximum water cement ratio of 0.42.

D. Coarse aggregate shall be graded as follows:

U.S. Standard Sieve Size	Percent By Weight Passing
1/2 in	100
3/8 in	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 30	0

E. Final mix design shall be as determined by trial mix design as indicated in Section 03 30 00 - Cast-in-Place Concrete.

F. Topping grout and concrete grout/fill shall contain air-entraining agent per Section 03 30 00 – Cast-in-Place Concrete.

G. **Strength:** Minimum compressive strength of topping grout and concrete/grout fill at 28 Days shall be 4,000 psi.

2.7 CONSISTENCY

A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the application. Dry pack consistency is defined such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the application.

B. The slump for topping grout and concrete/grout fill shall be adjusted to match placement and finishing conditions but shall not exceed 4-inches.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove defective concrete, laitance, dirt, oil, grease, and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until sound, clean concrete surface is achieved.

B. Rough concrete lightly, but not enough to interfere with placement of grout.

C. Remove foreign materials from metal surfaces in contact with grout.

D. Align, level, and maintain final positioning of components to be grouted.

3.2 GENERAL

A. CONTRACTOR shall arrange for the manufacturer of prepackaged grouts to provide on-Site technical assistance within 72 hours of request, as part of the WORK.

B. Grout shall not be placed until base concrete or masonry has attained its design strength, unless authorized otherwise by ENGINEER.

- C. When cementitious grouts are used on concrete surfaces, the concrete surface shall be saturated with water for 24 hours prior to placement. Upon completion of the saturation period, excess water shall be removed. Concrete substrate shall not be wet prior to placement of epoxy grouts.
- D. Surface preparation, curing, and protection of cement grout shall be in accordance with Section 03 30 00 – Cast-in-Place Concrete. The finish of the grout surface shall match that of the adjacent concrete unless otherwise indicated.
- E. Surfaces that will be in contact with grout shall be free of dirt, loose rust, oil, wax, grease, curing compounds, laitance, loose concrete, and other deleterious materials.
- F. Shade the WORK from sunlight for at least 24 hours before and 48 hours after grouting.
- G. Contact the grout manufacturer's representative for assistance with hot and cold weather grouting techniques and precautions if applicable.

3.3 GROUTING PROCEDURES

- A. **General:** Mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.
- B. Structural, equipment, tank, and piping support bases shall be grouted, unless indicated otherwise.
 - 1. The original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum one-inch thickness of grout or other thickness if indicated.
 - 2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout through a headbox of appropriate size. The mixture shall be of a fluid consistency and poured continuously into the space between the plate and the base concrete. Forms for grout shall be tight against retaining surfaces, and joints shall be sealed as recommended by the grout manufacturer to be liquid tight. Forms shall be coated as recommended by the grout manufacturer for easy form release. Where this method of placement is not practical or where required by ENGINEER, alternative grouting methods shall be submitted for acceptance by ENGINEER.
 - 3. Concrete equipment pads for equipment bases that will be epoxy-grouted shall be sized so that, when the equipment base is fully grouted, the epoxy grout is stopped not less than 4-inches from the edge of the pad.
- C. Drilled Anchors and Reinforcing Bars
 - 1. General
 - a. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions. Holes shall be roughened with a brush on a power drill and cleaned. Drilled anchors shall not be installed until the concrete has reached the required 28 Day compressive strength. Anchors shall not be loaded until the grout has reached its indicated strength in accordance with the manufacturer's instructions.

- b. CONTRACTOR shall identify the position of reinforcing steel and other embedded items prior to drilling holes. Care shall be exercised in coring and drilling to avoid damaging existing reinforcing or embedded items. Notify ENGINEER if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and communications conduit, and piping.
- 2. Epoxy Adhesive Anchors
 - a. Grout shall be proportioned and mixed with automatic equipment.
 - b. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor or reinforcing bar per the manufacturer's ICBO/ES report but shall not be less than 8 diameters for threaded rod or 12 diameters for reinforcing or smooth bars.
 - c. Holes required for grouting shall be blown or vacuumed clean and are to be free of dust and standing water. Horizontal holes for grouting are to be drilled at a slight downward angle and with the inserted dowel or bolt bent to match.
 - 3. Cement Based Non-Shrink Grout
 - a. In places of high temperature or fire hazard, anchor bolts shall be grouted using cement based non-shrink grout, Class I.
 - b. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor or reinforcing bar per the manufacturer's ICBO/ES report but shall not be less than 16 diameters for threaded rod or 24 diameters for reinforcing or smooth bars.
 - c. When the bolt diameter is one-inch or less, the hole diameter should be a minimum of 2-inches. When the bolt diameter is greater than one inch, the hole diameter should be at least twice the bolt diameter.
 - d. Drilled holes shall be saturated with water for not less than 24 hours before installation of anchor/rod/rebar.
 - e. The non-shrink grout should be placed in the holes in a non-sag (trowelable) consistency. The grout should be placed in the holes before the anchor and then the anchor inserted and vibrated to ensure proper coverage.

D. Topping Grout and Concrete/Grout Fill

- 1. Mechanical, electrical, and finish Work shall be completed prior to placement of topping or concrete/grout fill. To ensure bonding to the base slab, the base slab shall be given an exposed aggregate finish. Alternatively, where accepted by ENGINEER, the base slab shall be given a roughened textured surface by a close-spaced rake while the surface is green. After curing, high-pressure washing shall expose the aggregates and produce not less than a 3/16-inch amplitude roughness. Jackhammers or chipping hammers shall not be used.
- 2. The minimum thickness of grout topping and concrete/grout fill shall be one-inch. Where the finished surface of concrete/grout fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2 inches wide by 1-1/2 inches deep.
- 3. The base slab shall be thoroughly cleaned and wetted to saturated surface dry (SSD) condition per the International Concrete Repair Institute (ICRI) -- Technical Guide for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays, prior to placing topping and fill. No topping concrete shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat cement grout shall be broomed into the surface of the slab just before topping or

- fill placement. The neat cement grout shall not be allowed to dry before topping placement. If it does dry, it must be immediately removed using wet stiff brooms and reapplied. The topping and fill shall be compacted by rolling or thorough tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade. Coat surface with evaporation retardant as needed to prevent plastic shrinkage cracks.
4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.
 5. The surface shall be tested with a straight edge to detect high and low spots that shall be immediately eliminated. When the topping or fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement, or mixture of dry cement and sand shall be applied to the surface.
 6. As soon as topping or fill finishing is completed, coat surface with curing compound. After the topping is set and sufficiently hard in clarifiers and where required by ENGINEER, the tank shall be filled with sufficient water to cover the entire floor for 14 days.

3.4 CONSOLIDATION

- A. Grout shall be placed in such a manner, for the consistency necessary for each application, to assure that the space to be grouted is completely filled.

3.5 CURING

- A. Cement based grouts shall be cured per 03 30 00 – Cast-in-Place Concrete and per the manufacturer's recommendations.

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SECTION 04 21 13
HOLLOW LOAD BEARING BRICK MASONRY

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers structural Hollow Load Bearing Brick Masonry (HBM) units and appurtenant work.

1.2 RELATED WORK

- A. Related Work in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
 2. Section 03 20 00 Concrete Reinforcement
 3. Section 03 30 00 Cast-in-place Concrete
 4. Section 07 21 00 Insulation
 5. Section 09 90 00 Painting and Finishes

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. AMERICA CONCRETE INSTITUTE (ACI)

1. ACI SP-66 ACI Detailing Manual
2. ACI 530 Building Code Requirements for Masonry Structures
3. ACI 530.1 Specifications for Masonry Structures

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
2. ASTM A 951 Standard Specification for Steel Wire for Masonry Joint Reinforcement
3. ASTM A 1064 Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
4. ASTM C 67 Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
5. ASTM C 144 Standard Specification for Aggregate for Masonry Mortar
6. ASTM C 150 Standard Specification for Portland Cement
7. ASTM C 207 Standard Specification for Hydrated Lime for Masonry Purposes
8. ASTM C 270 Standard Specification for Mortar for Unit Masonry
9. ASTM C 404 Standard Specification for Aggregates for Masonry Grout
10. ASTM C 476 Standard Specification for Grout for Masonry
11. ASTM C 578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
12. ASTM C 652 Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale)
13. ASTM C 1019 Standard Test Method for Sampling and Testing Grout

- 14. ASTM C 1314 Standard Test Method for Compressive Strength of Masonry Prisms
- 15. ASTM C 1384 Standard Specification for Admixtures for Masonry Mortars
- 16. ASTM D 226 Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
- 17. ASTM D 2000 Standard Classification System for Rubber Products in Automotive Applications
- 18. ASTM D 2287 Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
- 19. ASTM E 514 Standard Test Method for Water Penetration and Leakage Through Masonry
- 20. ASTM E 518 Standard Test Methods for Flexural Bond Strength of Masonry

D. THE MASONRY SOCIETY (TMS)

- 1. TMS 402/602 Building Code Requirements and Specifications for Masonry Structures

1.4 SUBMITTALS

- A. CONTRACTOR shall provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product Data: Submit manufacturer's product data for each type of structural brick unit, accessory, and other manufactured products, including certifications that each type complies with specified requirements and color samples. Submit certificates showing compliance to the specifications for reinforcing steel, manufacturer's literature for anchor ties and any other accessories used, grout and mortar mix design, samples for mortar color selection, and manufacturer's literature for mortar and grout admixtures used along with CONTRACTOR's proposed usage details.
- C. Submit the following test reports:
 - 1. Compressive strength
 - 2. 24 hours cold water absorption
 - 3. Initial Rate of Absorption (I.R.A.)
 - 4. Efflorescence
 - 5. Weather classification
- D. Three sample specimens of the masonry units proposed for incorporation into the project shall be submitted to ENGINEER.
- E. Shop Drawings: Submit shop drawings showing elevations of each wall indicating type, layout of units, and location of control joints. Submit shop drawings showing fabrication, bending, and placement of reinforcement bars, complying with ACI SP-66. Show bar schedules, diagrams of bent bars, stirrup, spacing, lateral ties, and other components required for fabrication and placement of masonry reinforcement.
- F. Submit mix designs and test data for mortar and grout.
- G. Submit product data for premolded control joint strips and joint sealant and insulation material.

- H. A minimum 4-ft square free-standing mock-up sample panel shall be prepared for approval before starting masonry work. Masonry construction may not proceed until ENGINEER and OWNER approves the mock-up. The panel shall remain at the site for reference until masonry work is completed. Upon completion and acceptance of the Project, CONTRACTOR shall demolish and dispose of the mock-up offsite at an approved facility.

1.5 QUALITY ASSURANCE

- A. Hollow Load Bearing Brick Masonry (HBM) units shall be sampled and tested in accordance with ASTM C 67.
- B. CONTRACTOR shall have mortar and grout tested to assure compliance with the Specifications and the governing codes by a testing laboratory approved by ENGINEER. The test reports shall be submitted to ENGINEER.
 - 1. Tests shall be taken at the following times:
 - a. At commencement of masonry work, at least 2 samples each of mortar and grout shall be taken.
 - b. At any change in materials or job conditions, at least 2 samples of each modified material, grout and mortar, shall be tested.
 - c. The costs of tests shall be paid by CONTRACTOR as part of the work. The costs of additional tests, when required to verify compliance when requested by OWNER or ENGINEER, will be paid by OWNER. When tests do not verify compliance, the cost of additional tests shall be paid by CONTRACTOR.
 - 2. Samples shall be stored in a moist environment until tested, unless directed otherwise by ENGINEER or the testing laboratory. Testing for mortar shall be in accordance with ASTM C 270. Testing for grout shall be in accordance with ASTM C 1019.
- C. CONTRACTOR shall test the HBM units to assure compliance with the specifications and governing codes. Testing will be by a laboratory approved by ENGINEER.
 - 1. Testing will be made of the following items:
 - a. At the time of the construction of the sample panel, at least 2 masonry units shall be tested for each type of block, except separate tests are not required for block which only varies by texture.
 - b. At any change in materials during construction, at least 2 masonry units shall be tested.
 - c. CONTRACTOR shall submit a letter of certification from the masonry unit supplier at the time of, or prior to, delivery of the materials to the site that the materials used in construction are representative of the materials used to construct the prisms.
- D. Whenever required under the provisions of the Building Code, the work shall be subject to inspection by a Special Inspector selected by OWNER and approved by the local building code representative having jurisdiction. The costs of such inspections will be paid by OWNER. The Special Inspector will work under the supervision of ENGINEER.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. CONTRACTOR shall be responsible to deliver, handle, and store masonry units by means which will prevent mechanical damage and deterioration due to moisture, temperature changes, and corrosion. CONTRACTOR shall provide protection which will limit moisture

absorption of structural brick masonry units to the maximum percentage specified for Type I units for the average relative humidity at the project site, as reported by the nearest National Weather Service station.

- B. Cementitious materials shall be stored off the ground and protected from moisture.
- C. Aggregates shall be stored in a manner which will preserve grading characteristics.
- D. Masonry accessories shall be stored to prevent corrosion, dirt accumulation, and other deterioration.

1.7 PROJECT CONDITIONS

- A. Cold Weather Protection: Installation shall be in accordance with TMS 602 Section 1.8.C. Do not lay masonry units when the outside air temperature is below 40 degrees F.
 - 1. Grouted construction: On any day when the minimum anticipated nighttime temperature is 32 degrees F or less, in addition to complying with general procedures above, grout materials shall be heated to 90 degrees F to produce an in-place grout temperature of not less than 70 degrees F at end of workday. Protective blankets or enclosures shall remain in place for not less than 48 hours after placement of masonry units.
 - 2. Water: Water for mortar or grout shall not be heated to more than 160 degrees F.
- B. Hot-Weather Protection: Installation shall be in accordance with TMS 602 Section 1.8.C. Cover or shade masonry units and mortar materials and use cool water for mortar whenever ambient air temperature is 90 degrees F or greater. At air temperatures of 85 degrees F or above, if relative humidity is less than 30 percent or wind is in excess of 8 miles per hour, provide protection by immediately covering newly constructed walls by providing windbreaks, or by using fog spray to reduce rate of evaporation.
 - 1. Wet mortar board before loading and cover mortar to retard drying when not being used.
 - 2. Do not spread mortar beds more than 48 inches ahead of placing masonry units.
 - 3. Place masonry units within one minute of spreading mortar.
 - 4. Wetting of Brick: shall be required at the time of laying if the unit's initial rate of absorption (IRA) exceeds 30 grams per 30 square inches per minute or 1 g/ 645mm².

PART 2 PRODUCTS

2.1 STRUCTURAL HOLLOW LOAD BEARING BRICK MASONRY (HBM) UNITS

- A. Structural HBM Units: Comply with referenced standards for types required, and as follows:
 - 1. Unit, Grade and Type: Masonry units shall conform to the requirements of the following table:

Unit	ASTM	Grade	Type	Minimum Compressive Strength (psi)
Hollow Brick Masonry	C 652	SW	HBS	6,000

2. Size: The size of masonry units shall be as indicated on the Contract Drawings. Special shapes and sizes shall be provided as required, whether or not specifically indicated on the Contract Drawings as special.
3. Surfaces: Special surface texture or architectural faces shall be provided where indicated on the Contract Drawings.
4. Color: Where the finished surface will be visible, masonry units shall have colors as indicated on the Contract Drawings. Where colors are not specified, OWNER shall determine colors to be provided.

2.2 MATERIALS

- A. Portland Cement: ASTM C 150, Type II or IIA.
 1. Type III may be substituted during cold-weather construction.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Aggregate for Mortar: Sand conforming to ASTM C 144.
- D. Aggregate for Grout: ASTM C 404.
- E. Admixture for grout, if used, shall be **Sika Grout Aid by Sika Corp.**, or approved equal.
- F. Water: Clean and potable.
- G. Masonry cleaner shall be a non-acidic cleaner, **EaCO Chem, Sure Klean**, or approved equal.
- H. Accelerating Admixture: Non-chloride admixture for use in mortar mixes during cold weather, proportioned and mixed to comply with directions of manufacturer.
 1. Products: The following products, provided they comply with the requirements of ASTM C 1384 and the contract documents, will be among those considered acceptable.
 - a. MORSET by Grace Construction Products
 - b. or approved equal
- I. Water-repellant and efflorescence control admixture.
 1. All exterior masonry units shall utilize a water-repellant and efflorescence control admixture as recommended by the manufacturer to obtain ASTM E 514 test extended to 72 hours, class E rating.
 2. Admixtures shall be **MasterPel 240 (Rheopel Plus) by BASF, Eucon Blocktite by Euclid Chemical Company**, or approved equal.

- J. Integral water repellent admixture is required for mortar for exterior masonry units and shall be **MasterPel 240MA (Rheopel Plus Mortar Admixture) by BASF, Blocktite Mortar Admixture by Euclid Chemical Company**, or approved equal.

2.3 REINFORCEMENT AND ANCHORAGE

- A. Reinforcing Bars shall be in accordance with Section 03 20 00 – Concrete Reinforcement.
- B. Joint Reinforcement and Anchorage Materials: shall comply with ASTM A 951 and the following general requirements for materials required in joint reinforcement and anchorage devices.
 - 1. Steel wire: ASTM A 1064.
 - a. Zinc coating: ASTM A 641 Class 1.
 - b. Application: Use at interior locations.
- C. Joint Reinforcement: Provide welded-wire units prefabricated into straight lengths of not less than 10 feet, with deformed continuous side rods and plain cross rods, and as follows:
 - 1. Width: Approximately 1-1/2 inches less than nominal wall width, providing not less than 1/2-inch mortar coverage on each exposure.
 - 2. Wire sizes:
 - a. Side rod diameter: 0.1483 inch.
 - b. Cross rod diameter: 0.1483 inch.
 - 3. Configuration:
 - a. Applications of single unit width: Ladder design, cross rods at not more than 16 inches on center.
 - b. Corners: Provide prefabricated L- and T-shaped units.

2.4 MISCELLANEOUS MASONRY ACCESSORIES

- A. Premolded Control Joints Strips: Joints designed to fit standard sash block and to maintain lateral stability in masonry wall, of size and configuration indicated or as required for conditions, and as follows:
 - 1. Either styrene-butadiene rubber compound complying with ASTM D 2000, 2AA-805; or
 - 2. Polyvinyl chloride complying with ASTM D 2287, Type PVC 654-4
- B. Bond Breaker Strips: Asphalt-saturated organic roofing felt complying with ASTM D 226, Type 1 (No. 15 asphalt).

2.5 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures unless indicated and approved by ENGINEER. Do not use calcium chloride in mortar or grout mixture.
- B. Mixing: Combine and thoroughly mix ingredients in a mechanical batch mixer; comply with referenced ASTM standards for mixing time and water content.
- C. Mortar for Unit Masonry: Comply with ASTM C 270 and IBC Section 2103.7, Proportion Specification, for types of mortar required, unless otherwise indicated.

1. Limit cementitious materials in mortar to Portland cement and lime.
 2. Use Type S mortar for reinforced masonry. Compressive strength: 1800 psi @ 28 days.
 3. Mortar for use with colored masonry units shall have the integral color as approved by OWNER.
- D. Grout: Comply with ASTM C 476 and IBC 2103.10 for grout used in construction of unit masonry elements. Use grout of consistency indicated or as required at time of placement to fill completely all spaces intended to receive grout. Compressive strength: 2,000 psi @ 28 days.
1. Use fine grout in spaces less than 2 inches in least horizontal dimension, unless otherwise indicated.
 2. Use coarse grout in spaces 2 inches or more in least horizontal dimension, unless otherwise indicated.

2.6 MASONRY SEALERS (WATER RETARDENT)

- A. Sealers shall be as specified in Section 09 91 00 - Painting and Finishes.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION PROCEDURES

- A. Protect adjacent construction with appropriate means from mortar droppings and other effects of laying of brick masonry units.
- B. Thoroughly clean foundations of laitance, grease, oil, mud, dirt, mortar droppings, and other objectionable matter.
- C. Review brick material prior to installation and report any unsatisfactory units to the manufacturer. Set aside all units deemed unsatisfactory for further review by the testing agency and/or brick manufacturer's representative.
- D. Structural Hollow Load Bearing Brick Masonry Units: Do not wet brick masonry units prior to laying, unless required for hot weather placement.
- E. Measurements for mortar and grout shall be accurately made. Shovel measurements are not acceptable. Mortar proportions shall be accurately controlled and maintained.
- F. Reinforcing: Before placing masonry reinforcing, remove loose rust, dirt, and other coatings.
- G. Masonry Thickness: Build masonry elements to full thickness shown.
1. Build single-wythe walls to actual thickness of masonry units, using units of size indicated.
- H. Chases and Recesses: Build masonry to accommodate the work of other trades, including chases and recesses as shown or required. Provide not less than 8 inches of masonry between jambs of openings and chases and recesses.

- I. Leave openings for equipment to be installed in masonry. After installation of equipment, complete masonry work to match work immediately adjacent to opening.
- J. Cutting Masonry Units: Use motor-driven saws with carborundum or diamond disc blade to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining work. Use dry cutting saws to cut brick masonry units.
- K. Add insulation to open cells if required on the Contract Drawings. See Section 07 21 00 - Insulation. Perlite or similar loose-fill materials will NOT be permitted. Do not lay units more than 4 feet vertically ahead of units filled with insulation.
- L. Work shall be performed in accordance with ACI 530 and ACI 530.1, the latest edition of the IBC, TMS 402/602, and local governing codes for reinforced structural brick masonry.
- M. CONTRACTOR shall set or embed anchors, bolts, reglets, sleeves, conduits, and other items as required.

3.2 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: Do not exceed the following construction tolerances in vertical elements, including surfaces of walls, columns, and arises:
 - 1. 1/4 inch to 10 feet
 - 2. 3/8 inch to one story height, or 20 feet, whichever is less, except 1/4 inch for external corners, expansion joints, and other highly conspicuous vertical elements.
 - 3. 1/2 inch for 40 feet or more
 - 4. Plus or minus 1/4 inch in 10 feet, 1/2 inch maximum, for vertical alignment of head joints.
- B. Variation from Level: Do not exceed the following construction tolerances for bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous horizontal elements:
 - 1. 1/4 inch in one bay or in 20 feet maximum
 - 2. 1/2 inch in 40 feet or more
- C. Variation from Plan Lines: Do not exceed the following horizontal construction tolerances for related portions of columns, walls, and partitions:
 - 1. 3/8 inch in any bay of 16 feet maximum
 - 2. 1/2 inch in 32 feet or more
- D. Variation in Cross Section: Do not exceed the following masonry elements:
 - 1. Minus 1/4 inch
 - 2. Plus 1/2 inch
- E. Variation in Mortar Joint Thickness: Do not exceed the following construction tolerances for thickness of mortar joints:
 - 1. Bed joints: Plus or minus 1/8 inch.
 - 2. Head joints: Plus or minus 1/8 inch.

3.3 MASONRY CONSTRUCTION - GENERAL

- A. Layout: Lay out masonry for accurate pattern bond, for uniform joint widths, and for accurate location of specific features before beginning actual construction. Avoid use of masonry units of less than 1/2 size. Do not use units with less than nominal 4 inch horizontal face dimensions at corners and jambs.
- B. Pattern Bond: Lay exposed masonry in 1/2 running bond with vertical joints in each course centered on units in course above and below except where other bonds are indicated at special features.
 - 1. Lay concealed masonry with all units in a wythe in running bond.
 - 2. Bond and interlock each course of each wythe at corners.
- C. Structural Brick Unit Masonry: Maintain vertical continuity of core or cell cavities. Keep cavities clear of mortar, including bed area of first course, to provide minimum clear dimension indicated, to provide minimum clearance and grout coverage for vertical reinforcement bars, and to provide direct grout contact with supporting surfaces.
- D. Stopping and Resuming Work: Lay masonry in proper sequence to avoid toothing. Rack walls back in each course at end of each day. Before resuming, clean exposed surfaces and remove loose masonry units and mortar.
- E. Built-in Work: As work progresses, build in items indicated for installation in masonry, filling around built-in items solidly with masonry.
 - 1. Fill spaces between metal frames and masonry elements solidly with mortar, unless otherwise indicated.
- F. Install lintels of types indicated at all openings.
 - 1. Bearing: Provide not less than 8 inches of bearing at each jamb unless otherwise indicated.
 - 2. Reinforcement: At masonry openings greater than one foot in width, install horizontal joint reinforcement in 2 horizontal joints approximately 8 inches apart immediately above lintel and immediately below sill. Extend reinforcement which is in addition to required continuous joint reinforcement not less than 24 inches beyond jambs of the opening, except at control joints.
- G. Formwork: Provide temporary formwork and shores as required for temporary support of reinforced masonry elements. Construct formwork to shape line, and dimensions shown. Make sufficiently tight to avoid leakage of mortar and grout.
 - 1. Brace, tie, and support as required to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other reasonable temporary loads that may be placed on them during construction.

3.4 MORTAR BEDDING AND JOINTING

- A. Lay brick masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be grouted or filled with concrete.
- B. Maintain joint widths indicated, except for minor variations required to maintain bond alignment. Except as otherwise indicated, maintain joint widths of 3/8 inch.
- C. Cut joints flush for masonry walls which are concealed or covered by other materials, unless otherwise indicated.
- D. Tool exposed joints slightly concave, using a jointer larger than joint thickness unless otherwise indicated.
- E. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners of jambs to shift adjacent stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar, and reset in fresh mortar.

3.5 CONTROL JOINTS/EXPANSION JOINTS

- A. Provide control joints or expansion joints in masonry walls where shown on the Contract Drawings.
- B. Joints shall be full height and continuous in appearance.
- C. Run bond beams and bond beam reinforcing bars continuously through control joints. Stop horizontal reinforcing at expansion joints.
- D. Insert control joint filler in joints as wall is constructed.
- E. Insert 50% (or higher) compressible neoprene expansion joint material in expansion joints.

3.6 HORIZONTAL JOINT REINFORCEMENT OF SINGLE-WYTHE WALLS

- A. General: Provide continuous horizontal joint reinforcement for all single-wythe masonry walls, unless otherwise indicated. Lap reinforcing a minimum of 6 inches.
- B. Install joint reinforcing in mortar joints at not more than 16 inches on center vertically.
- C. Cut or interrupt joint reinforcement at expansion joints.
- D. Provide continuity at corners and wall intersections by means of prefabricated L- and T-shaped sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 INSTALLATION OF REINFORCEMENT

- A. Preparation: Do not use reinforcement bars with kinks or bends not shown on the Contract Drawings or final shop drawings. Do not use bars with cross section reduced due to excessive rusting and other causes.

- B. Placement: Position reinforcement bars accurately at spacings indicated. Support and secure vertical bars against displacement. Horizontal bars may be placed as the work progresses. Provide not less than the greater of either the bar diameter or 1 inch clear between bars. For columns, piers, and pilasters, provide a clear distance between vertical bars as indicated, but not less than 1-1/2 times the nominal bar diameter or 1-1/2 inches, whichever is greater.
- C. Splicing: Provide lapped splices at locations shown; do not splice at other points or by other methods, unless approved by ENGINEER. Provide not less than the minimum lap indicated, or as required by governing code.

3.8 GROUTING

A. Grouting Technique:

1. Provide minimum clear dimension of 2 inches and minimum clear area of 8 square inches in vertical cores to be grouted. Place vertical reinforcement prior to laying brick masonry units, extending above elevation of maximum pour height as required for splicing. Support in position at vertical intervals not exceeding 192 bar diameters or 10 feet, whichever is less.
2. Grout shall be placed in all open areas of the masonry block as specified herein.
3. Lay masonry units to maximum pour height, not to exceed 4 feet.
4. Pour grout using chute or container with spout. Vibrate grout during placement. Place grout continuously; do not interrupt pouring operation for more than 1 hour. Terminate pour 1-1/2 inches below top of highest course in pour, except at tops of walls.
5. Stop grout in vertical cells 1-1/2 inches below bond beam course. Place horizontal reinforcement in bond beams; lap at corners and intersections as shown. Place grout in bond beam course before filling vertical cores above bond beams.

3.9 REPAIR AND POINTING

- A. Repair: Remove and replace masonry units which are loose, chipped, broken, stained, or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units, and install in fresh mortar or grout pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of mortar joints, enlarge any holes or voids except weep holes and completely fill with mortar. Point up all joints, including corners, openings, and adjacent work, to provide a neat and uniform appearance.

3.10 CLEANING AND PROTECTION

A. Clean masonry as follows after mortar is thoroughly set and cured:

1. Remove large mortar particles by hand, using wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel, leaving half of panel uncleaned for comparison.
3. Clean brick unit masonry to comply with directions of masonry manufacturer and as recommended by NCMA in Tek Bulletin No. 45.

- B. Protection: CONTRACTOR shall protect all masonry until such time as the Work is completed and accepted by ENGINEER.

3.11 FINISH

- A. Brick shall be finished as per Section 09 91 00 - Painting and Finishes.

- END OF SECTION -

SECTION 05 45 00
MECHANICAL METAL SUPPORTS (PIPE SUPPORTS)

PART 1 GENERAL

1.1 DESCRIPTION

- A. This Section covers materials and installation of mechanical metal supports, pipe supports, hangers, guides, anchors and appurtenances as specified and indicated.
- B. CONTRACTOR shall provide mechanical metal supports in accordance with this Section whether shown on the Contract Drawings or not.

1.2 RELATED WORK

- A. Related Work specified in other Sections includes, but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 05 50 00 Miscellaneous Metals
 - 3. Section 09 90 00 Painting and Finishes
 - 4. Section 33 05 05 Ductile Iron Pipe
 - 5. Section 33 05 07.1 PVC Pressure Pipe (ASMT 1785)
 - 6. Section 33 12 00 Mechanical Appurtenances

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTING INDUSTRY (MSS)
 - 1. MSS SP-58 Pipe Hangers and Supports – Materials Design and Manufacture
 - 2. MSS SP-69 Pipe Hangers and Supports – Selection and Application
 - 3. MSS SP-89 Pipe Hangers and Supports – Fabrication and Installation Practices
 - 4. MSS SP-127 Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application
- C. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
 - 1. ASME B 31.1 Power Piping
- D. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM A 36 Standard Specification for Carbon Structural Steel
 - 2. ASTM A 47 Standard Specification for Ferritic Malleable Iron Castings
 - 3. ASTM A 48 Standard Specification for Gray Iron Castings
 - 4. ASTM A 123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 5. ASTM A 153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 6. ASTM A 575 Standard Specification for Steel Bars, Carbon, Merchant Quality,

7. ASTM A 576 M-Grades
Standard Specification for Steel Bars, Carbon, Hot-Wrought,
Special Quality

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. CONTRACTOR shall submit complete shop drawings of mechanical supports, pipe supports, hangers and guides. Provide scaled shop drawings showing locations of the supports and detailed drawings for each support. Identify each type of hanger or support by the manufacturer's part number of figure on the drawing.
- C. Provide installation drawings and manufacturer's catalog information on each type of hanger and support.
- D. Provide structural calculations for special supports and anchors, stamped and signed by a professional engineer registered in the State of Utah.

PART 2 MATERIALS

2.1 GENERAL

- A. All pipe hangers and supports shall be manufactured to comply with MSS-SP-58, MSS-SP-569, MSS-SP-89 except as modified herein. Where applicable, design and manufacture must also conform to ANSI/ASME B31.1. Supports for plumbing or fire piping shall be in accordance with the latest edition of the applicable plumbing or fire code and the requirements of the local jurisdiction.
- B. Hangers, supports, anchors and restraints must be designed in accordance with MSS-SP-127 to withstand all static and dynamic loading conditions which act upon the piping system and associated equipment. Piping supports and equipment must be considered as a total system and appropriate balance calculations made to determine load forces at critical stress points. Loading conditions to be considered may include, but are not limited to:
 - 1. The total load of pipe, fittings, valves, insulation and any expected contents of the pipe.
 - 2. Thermal expansion and contraction.
 - 3. Stress from cycling of equipment or process.
 - 4. Vibration transmitted to or from equipment or terminal connection.
 - 5. Wind, snow or ice loading on outdoor piping.
 - 6. Loading due to seismic forces.
- C. Static and dynamic forces at points of attachments must be considered to help ensure structural integrity of buildings or equipment. Hangers and supports must be selected so as to minimize the effect of piping system loading on the structure.
- D. In general, piping shall be supported from structural members, such as walls, beams, columns and slabs, using approved structural attachments. In situations where approved attachments cannot be used, alternative attachments or substructure assemblies must receive approval by ENGINEER prior to installation. Prior approval by ENGINEER must be given before any cutting or drilling of building structural steel. Damage to the structure

through welding, cutting or drilling will not be permitted if it reduces the structure's strength below the established safety factor for the structure. Any additional structural steel required to properly support piping or equipment shall be furnished and installed by CONTRACTOR at no additional cost to OWNER.

2.2 SUPPORT MATERIALS

- A. Pipe supports, hangers, guides, etc. shall be hot-dip galvanized carbon steel, unless noted otherwise on the Drawings. Steel shall be in accordance with ASTM A 36, ASTM A 575, or ASTM A 576. Hot-dip galvanizing shall be in accordance with ASTM A 123 or ASTM A 153. Bases, rollers, and anchors shall be steel as described above or may be cast iron conforming to ASTM A 48. Pipe clamps shall be steel as described above or may be malleable iron conforming to ASTM A 47.
- B. Submerged supports, as well as piping in hydraulic structures within 24 inches of the high-water level, shall have supports, including hardware and anchors constructed of Type 316 stainless steel, unless noted otherwise on the Drawings.
- C. Piping in chemical or corrosive areas shall have supports, including hardware and anchors constructed of Type 316 stainless steel or fiberglass reinforced plastic (FRP), unless noted otherwise on the Drawings.
- D. Supports fabricated from other materials specified on the Drawings shall have a protective coating in accordance with the requirements of Section 09 90 00 – Painting and Coatings.

2.3 FLOOR MOUNTED SUPPORTS

- A. Floor mounted pipe supports shall include the manufacturer's recommended pipe stanchion and base plate. Base plates shall be anchored to the floor with bolts and provided with a 1-inch-thick grout pad.

2.4 SPRING-TYPE HANGERS

- A. Spring-type hangers shall be provided for piping subject to vibration or vertical expansion/contraction such as engine exhaust piping. Design the spring-type hangers per the manufacturer's recommendations.

2.5 CONCENTRATED LOADS

- A. Concentrated loads, such as meters, valves, and equipment, on PVC piping systems shall have supports on each side of the concentrated load.

2.6 CONCRETE ANCHORS

- A. Anchors shall be in accordance with Section 05 50 00 – Miscellaneous Metals.

2.7 MANUFACTURERS

- A. Mechanical Metal Support (pipe support) manufacturers shall be **Anvil International Inc., B-Line by Eaton (Cooper Industries), Utility Coatings & Fabrication**, or approved equal.

PART 3 EXECUTION

3.1 GENERAL

- A. Mechanical metal supports, pipe supports, hangers, guides, etc. shall be installed per the manufacturer's instructions and ASME B31.1 – Power Piping.
- B. Pipe supports shall be positioned in order to produce an orderly, neat piping system. Hanger rods shall be vertical without offsets.
- C. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting as close to ceilings or roods as possible and without interference with other work.
- D. Hangers shall be installed in a manner to prevent obstructing ladders, manhole covers, and access hatches.
- E. Set embedded inserts accurately in position and support them rigidly before concrete is placed and prevent displacement during and after placement of concrete.
- F. Provide separate hangers or supports at valves, meters, elbows, tees, and other equipment. Provide separate hangers on each both sides of each non-rigid joint or flexible coupling.
- G. Install piping without springing, forcing, or stressing the pipe or any connecting valves, pumps, or other pipe to which the pipe is connected.
- H. Hangers and supports for rigid plastic pipe shall be provided with a support shield to spread the load bearing surface.
- I. Use of wire hangers, perforated strap, hanging from unreinforced metal deck and cellular roof deck are not permitted.
- J. Repair or replace metal items damaged during installation. Follow the manufacturer's procedures for repairing damaged surfaces.
- K. Galvanizing Field Repairs
 1. Surface preparation shall consist of removing oil, grease, soil, and soluble material by cleaning with water and detergent (SSPC SP1) followed by brush-off blast cleaning (SSPC SP7) over an area extending at least 4 inches into the undamaged area.
 2. The coating shall be applied to at least 3 mils dry film thickness and shall be **Zinc-Clad XI by Sherwin-Williams, Galvax by Alvin Products, Galvite by ZRC Worldwide**, or approved equal.

3.2 SUPPORT LOCATION AND SPACING

- A. Supports for horizontal piping shall be spaced to prevent excessive sag, bending and stresses in the piping. Spacing shall not exceed the maximum indicated spans.
- B. Maximum spans indicated in the tables below are for ambient temperatures or the temperatures listed for the materials and pipe wall thicknesses shown. Adjust the span spacing for different temperatures and/or pipe wall thicknesses per the manufacturer's recommendations.

- C. Install pipe supports on horizontal and vertical runs at the spacing shown or detailed on the Drawings. If no spacing or rod sizes are given on the Drawings or in the specifications for a particular piping system, use the following tables or the recommendations of the support or pipe manufacturer.

1. Support Spacing for Steel Pipe (Section 40 05 13.13 – Steel Process Piping) Schedule 40 and Schedule 80:

Pipe Size (inches)	Maximum Span Water Service (feet)	Maximum Span Vapor Service (feet)	Minimum Hanger Rod Size (inches)
3/8 and smaller	4	5	3/8
1/2 through 1	6	8	3/8
1-1/4 through 2	8	10	3/8
2-1/2 through 3	10	14	1/2
3-1/2 through 4	10	15	5/8
6	12	20	3/4
8	12	24	3/4

Note: These spacings do not apply where span calculations are made or where there are concentrated loads between supports such as flanges, valves, specialties, etc. or changes in direction requiring additional supports.

2. Support Spacing for Copper Pipe (Section 33 05 03 – Copper Pipe) per MSS-SP-69, Table 3:

Pipe Size (inches)	Maximum Span Water Service (feet)	Maximum Span Vapor Service (feet)	Minimum Rod Size (inches)
1/2	5	6	3/8
3/4	5	7	3/8
1	6	8	3/8
1-1/4	7	9	3/8
1-1/2	8	10	3/8
2	8	11	3/8
2-1/2	9	12	1/2
3	10	14	1/2
3-1/2	11	15	1/2
4	12	16	5/8

Note: These spacings do not apply where span calculations are made or where there are concentrated loads between supports such as flanges, valves, specialties, etc. or changes in direction requiring additional supports.

3. Support Spacing for PVC Pipe (Section 33 05 07.1 – Polyvinyl Chloride Pipe) Schedule 40 and Schedule 80. The table below is meant as a general guideline and it is recommended that the pipe manufacturer be consulted for specific spacing recommendations relating to their pipe, load conditions, operating temperatures, and service conditions.

Pipe Size (inches)	Maximum Span Schedule 40 (feet)				Maximum Span Schedule 80 (feet)			
	60°F	80°F	100°F	120°F	60°F	80°F	100°F	120°F
1/2	4.5	4.5	4	2.5	5	4.5	4.5	3
3/4	5	4.5	4	2.5	5.5	5	4.5	3
1	5.5	5	4.5	3	6	5.5	5	3.5
1-1/4	5.5	5.5	5	3	6	6	5.5	3.5
1-1/2	6	5.5	5	3.5	6.5	6	5.5	3.5
2	6	5.5	5	3.5	7	6.5	6	4
2-1/2	7	6.5	6	4	7.5	7.5	6.5	4.5
3	7	7	6	4	8	7.5	7	4.5
4	7.5	7	6.5	4.5	9	8.5	7.5	5
6	8.5	8	7.5	5	10	9.5	9	6
8	9	8.5	8	5	11	10.5	9.5	6.5
10	10	9	8.5	5.5	12	11	10	7
12	11.5	10.5	9.5	6.5	13	12	10.5	7.5
Note: These spacings do not apply where span calculations are made or where there are concentrated loads between supports such as flanges, valves, specialties, etc. or changes in direction requiring additional supports.								
Data taken from Anvil International, Inc. Catalog PH-2006, page PH-213 and is based on continuous span and for un-insulated line carrying fluids of specific gravity up to 1.00.								

4. Supports for Ductile Iron Pipe (Section 33 05 05 – Ductile Iron Pipe) should be installed in locations shown on the Drawings with a minimum of one support per 20-foot length of pipe. If longer spans are required, the supports should be designed in accordance with DIPRA – Design of Ductile Iron Pipe on Supports and the pipe manufacturer’s recommendations. Supports should be cradle type with a saddle angle of 120 degrees. The table below shows the recommended maximum spans per US Pipe – Long Span and Bridge Crossing Pipe guidelines.

Pipe Size (inches)	Maximum Span Water Service (feet)
6	28
8	30
10	30
12	35
14	35
16	40
18	42
20 to 64	45
Note: These spacings do not apply where span calculations are made or where there are concentrated loads between supports such as flanges, valves, specialties, etc. or changes in direction requiring additional supports.	

5. Support Spacing for ABS Pipe (Section 33 05 01 – ABS Pipe) Schedule 40. The table

below is meant as a general guideline and it is recommended that the pipe manufacturer be consulted for specific spacing recommendations relating to their pipe, load conditions, operating temperatures, and service conditions.

Pipe Size (inches)	Maximum Span Schedule 40 (feet)				
	60°F	80°F	100°F	120°F	140°F
1-1/2	6	6	5.5	3.5	3
2	6	6	5.5	3.5	3
3	7	7	7	4	3.5
4	7.5	7.5	7	4.5	4
6	8.5	8.5	8	5	4.5
Note: Plumbing code may require a maximum horizontal spacing of 4 feet for all pipe sizes. Verify requirement with the local governing agency.					

6. Support spacing for other pipe materials shall be based on recommendations from the pipe manufacturer.
7. Provide sway bracing for hangers where shown on the Drawings. If no bracing is shown, provide bracing at 10-foot maximum center-to-center intervals.

- END OF SECTION -

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SECTION 05 50 00
MISCELLANEOUS SPECIALTIES

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers materials, fabrication, and installation of miscellaneous metals and appurtenances as specified and indicated.

1.2 RELATED WORK

- A. Related Work in other Sections includes, but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 09 91 00 Painting and Finishes

1.3 RELATED SPECIFICATIONS

- A. Fabrication and erection of the platforms, ladders and stairs shall be in accordance with the Specification for the Design, Fabrication and Creation of Structural Steel for Buildings of the latest edition of the A.I.S.C. Manual, and Section 1910.27 of the latest edition of the OSHA standards, except as specified herein.

1.4 REFERENCES

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
 - 1. Manual of Steel Construction
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM A 36 Standard Specification for Carbon Structural Steel
 - 2. ASTM A 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 3. ASTM A 123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 4. ASMT A 153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 5. ASTM A 276 Standard Specification for Stainless Steel Bars and Shapes
 - 6. ASTM A 307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength
 - 7. ASTM A 615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - 8. ASTM F 593 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
 - 9. ASTM F 594 Standard Specification for Stainless Steel Nuts
- D. NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

- E. AMP 510 Metal Stairs Manual

1.5 RELATED WORK

- A. Related work in other sections includes but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 09 91 00 Painting and Finishes

1.6 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. CONTRACTOR shall submit complete shop drawings of fabricated items, such as vents, ladders, stairs, platforms, beams, pipe supports, and miscellaneous metals for approval to ENGINEER.
- C. Shop drawings shall conform to AISC recommendations and specifications, and shall show holes, and the like, as may be required for other parts of the work.
- D. Shop drawings shall include complete details of members and connections, anchor bolt layouts, schedules for fabrication procedures, and diagrams for the sequence of erection.
- E. Submit manufacturer's catalog data and dimensional drawings for lifting eyebolts and inserts; ladder safety posts, manhole covers and frames, and anchor bolts.
- F. Submit ICC ES Evaluation Reports for adhesive and wedge anchors and installer qualifications and procedures.

PART 2 MATERIALS

2.1 CARBON STEEL

- A. Materials for bolted or welded steel construction shall conform to ASTM A 36.

2.2 STAINLESS STEEL

- A. All bolts, expansion bolts, nuts, washers, and expansion sleeve inserts used to attach metal supports shall be stainless steel Type 316.
- B. All interior tank ladders, wall conduits, louvers, and other items required shall be stainless steel unless noted otherwise.

2.3 HOT-DIPPED GALVANIZED

- A. All vents, stairs, vault ladders, handrail, stringers, beams, and miscellaneous items shall be galvanized (zinc coated) unless noted otherwise.
- B. Zinc coating for plates, bolts, anchor bolts, and threaded parts shall in in accordance with ASTM A 153. Structural steel shall be zinc coated in accordance with ASTM A 123.

2.4 BOLTS

- A. Steel anchor and connection bolts for non-corrosive service shall conform to ASTM A 307, Grade A or B, unless otherwise noted. Bolts shall be hot-dip galvanized and provided with self-locking nuts or lock washers and plain nuts.
- B. Steel anchor and connection bolts for corrosive service shall be fabricated from stainless steel, unless indicated otherwise in the specifications or on the Drawings. Corrosive service locations are as listed below.
 - 1. Buried locations
 - 2. Submerged locations
 - 3. Locations subject to occasional flooding
 - 4. Inside hydraulic structures
 - 5. Chemical handling areas
 - 6. Inside buried manholes, vaults, and structures that do not have a gravity drain or sump pump
 - 7. Inside trenches, containment walls, and curbed areas.
- C. The nuts shall be capable of developing the full strength of the bolts. Bolts and cap screws shall have hexagon heads and nuts shall be heavy hexagon series. Bolts and nuts shall be installed with washers from material matching the base material of bolts. Lock washers fabricated from the material matching the bolts shall be installed where indicated.
- D. The length of the bolts shall be such that the bolt extends at least 1/8 inch beyond the outside face of the nut before tightening, except for anchor bolts which shall be flush with the face of the nut before tightening.

2.5 LIFTING EYEBOLTS

- A. Locate eyebolts and inserts over the centerline of the piping at locations shown on the Drawings. Eyebolts and inserts shall have a minimum safety factor of 3 and be rated for a working load of 3,000 pounds.
- B. Provide inserts of the ferrule wing nut design with threads to match the eyebolts. Cast inserts in the roof slab of the vault at the locations identified on the Drawings.

2.6 THREADED INSERTS

- A. Threaded inserts shall be of ductile iron construction with standard N.C. threads. Inserts shall be cast-in-place at the locations shown on the Drawings. Inserts shall be fabricated by **Meadow Burke**, or approved equal.

2.7 ADHESIVE ANCHORS

- A. Unless otherwise indicated, drilled concrete or masonry anchors shall be adhesive anchors. No substitutions will be considered without an ICC ES Report verifying strength and material equivalency.
- B. Adhesive anchors shall be a two-component system consisting of an al- threaded anchor rod with nut and washer, and the adhesive capsule. Anchor rods shall be Type 304

stainless steel conforming to ASTM F 593 with nuts conforming to ASTM F 594. The adhesive capsules shall contain a polyvinyl or urethane methacrylate-based resin and accelerator within a sealed dual chamber foil capsule. Adhesive anchors shall be **Hilti HVA Capsule Adhesive Anchoring System**, or approved equal.

2.8 WEDGE ANCHORS

- A. Wedge type anchors shall be used only where indicated on the Drawings. Wedge anchors shall be a stud type expansion anchor, torque controlled, with impact section to prevent thread damage. Stud and wedge shall be Type 304 or Type 316 stainless steel conforming to ASTM A 276. Nut shall be Type 304 or Type 316 stainless steel conforming to ASTM F 594 with washer of similar material. Wedge anchor bolts shall be **Hilti Kwik Bolt 3** or approved equal. Anchors installed in non-submerged or non-corrosive environments may be carbon steel and shall be **Simpson Strong-Tie Strong Bolt**, or approved equal.

2.9 STEEL PIPE

- A. Pipe for guard posts shall be Schedule 40 and pipe for vault vents shall be Schedule 10 conforming to ASTM A 53, unless noted otherwise on the Drawings, and shall be hot-dip galvanized.

2.10 LADDERS

- A. Ladders which may be partially or fully submerged or located inside a manhole or vault without a gravity drain or sump pump shall be fabricated entirely of Type 316 stainless steel. All ladder hardware and supports shall be Type 316 stainless steel. Ladders and hardware fully submerged or located inside a manholes or vault for wastewater facilities shall be Type 316 stainless steel.
- B. Other ladders shall be fabricated from carbon steel and hot dip galvanized after fabrication unless noted otherwise on the Drawings. All ladder hardware and supports shall be the same material as the ladder.
- C. All ladders without a permanently mounted exterior ladder extension shall be provided with a telescoping safety post. The post shall be fabricated of steel with telescoping tubular section that locks automatically when fully extended. The upward and downward movement shall be controlled by a stainless-steel spring balancing mechanism. The telescoping safety post shall be fabricated from the same material and finish as the ladder. If required, telescoping posts shall be **LadderUP Safety Post by Bilco**, or approved equal.

2.11 VAULT VENTS

- A. Fabricate vault vents as shown on the Drawings. Vault vents shall be welded steel construction and hot dip galvanized after fabrication. Coating shall be in accordance with Section 09 91 00 – Painting and Finishes.

2.12 COVERS AND FRAMES

- A. Manhole covers and frames shall be cast iron and designed for AASHTO HS-20 loading, unless otherwise indicated. Castings shall be smooth, clean and free from blisters,

blowholes, and shrinkage. Covers shall seat firmly into the frames without rocking. Covers and frames shall fit together evenly such that the cover fits flush with the surrounding finished surface.

2.13 POLYPROPYLENE STEPS

- A. Polypropylene steps shall have a 1/2-inch ASTM A 615 grade 60 steel reinforcement rod encased in polypropylene copolymer plastic. Steps shall have a tread width of 14-inches nominal.
- B. Steps shall be manufactured by **American Step Company, Inc., M.A. Industries, D & L Supply No. F-1981**, or approved equal.

2.14 FRP GRATING

- A. Grating shall be supported around all sides of an opening with support members. Unless otherwise indicated, grating supported on concrete shall have embedded FRP angles (FIBERGRATE E-Z Angle PN#16179900).
- B. The grating shall be a molded once piece square mesh pattern providing bidirectional strength. Gratings shall be reinforced with rovings of equal number of layers in each direction. The top layer of reinforcement shall be no more than 3/16-inch below the top surface of the grating so as to provide maximum stiffness and prevent resin chipping of unreinforced surfaces. Percentage of glass (by weight) shall not exceed 40% so as to achieve maximum corrosion resistance, and as required to maintain the structural requirements.
- C. Non-slip surfacing: Grating shall be manufactured with a secondarily applied grit on the top of each bar providing excellent slip resistance.
- D. Fire rating: Grating shall be fire retardant with a tested flame spread rating of 25 or less when tested in accordance with ASTM E 84. Certifications shall be dated within the past two years and test data performed only on the resin shall not be acceptable.
- E. Resin system: Manufacturer may be required to submit corrosion data from tests performed on actual grating products in standard chemical environments. Corrosion resistance data of the base resin from the manufacturer is not a true indicator of grating product corrosion resistance and shall not be accepted.
- F. Depth: 1-1/2-inch with a tolerance of plus or minus 1/16-inch.
- G. Mesh Configuration: 1-1/2-inch x 1-1/2-inch with a tolerance of plus or minus 1/16-inch mesh centerline to centerline.
- H. Design live loads of the FRP gratings for walkway applications shall be 65 psf uniformly distributed load (or as required by the governing building code) with a maximum deflection of 3/8-inch or L/120 at the center of a simple span OR a concentrated load of 250 pounds with a maximum deflection of 1/4-inch at the center of a simple span.
- I. FRP grating shall be Gridwalk High Strength Molded Fiberglass Grating by American Grating, or approved equal.

PART 3 EXECUTION

3.1 GENERAL

- A. Except as otherwise shown, the design, fabrication, and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction".
- B. Install miscellaneous specialties as indicated on the drawings or as recommended by the manufacturer.
- C. Store all materials above ground on platforms, skids or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.
- D. Clean surfaces of metalwork to be in contact with concrete of rust, dirt, grease, and other foreign matter before placing concrete.
- E. Set embedded metalwork accurately in position and support it rigidly before concrete is placed and prevent displacement during and after placement of concrete.
- F. Repair or replace metal items damaged during installation. Follow the manufacturer's procedures for repairing damaged surfaces.
- G. Welding shall be performed by metal-arc method or shielded metal arc method as per the American Welding Society's (AWS) "Welding Handbook". During welding component parts shall be adequately clamped or supported. Avoid irregular surface, non-uniform bead pattern, and high crown. Upon completion of welding, remove weld splatter, flux, slag, and burrs. Accomplish repair, chipping, and grinding of welds in a manner that will not gouge, groove, or reduce the base metal thickness.
- H. Adhesive Anchors. Do not install anchors until the concrete has reached the required 28-day compressive strength. Drill hole in concrete by means of a percussion hammer drill. Hole shall be roughened with a brush on a power drill and then cleaned and dried. Install anchor in accordance with the manufacturer's instructions. Do not load the anchor until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.
- I. Wedge Anchors. Do not install anchors until the concrete has reached the required 28-day compressive strength. Drill hole in concrete by means of a percussion hammer drill. Hole shall be roughened with a brush on a power drill and then cleaned and dried. Install anchor in accordance with the manufacturer's instructions.
- J. Galvanizing Field Repairs:
 - 1. Surface preparation shall consist of removing oil, grease, soil, and soluble material by cleaning with water and detergent (SSPC SP1) followed by brush-off blast cleaning (SSPC SP7) over an area extending at least 4 inches into the undamaged area.
 - 2. The coating shall be applied to at least 3 mils dry film thickness and shall be Zinc-Clad XI by Sherwin-Williams, Galvax by Alvin Products, Galvite by ZRC Worldwide, or approved equal.

- END OF SECTION -

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers the rough carpentry work which includes wood framing, plates, joists, rafters, purlins, wood trusses, blocking, furring, backing, nailers, plywood sheathing, siding, and similar elements, material and accessories, complete and in place according to the contract documents.

1.2 REFERENCES

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN PLYWOOD ASSOCIATION (APA)
1. APA AFG-01 Adhesives for Field-Gluing Plywood to Wood Framing
 2. APA Form E30 Design/Construction Guide, Residential and Commercial
- C. AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)
1. AWPA M4 Standard for the Care of Preservative-Treated Wood Products
- D. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM A 307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 psi Tensile Strength
 2. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 3. ASTM D 3498 Standard Specification for Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems
 4. ASTM F 1667 Standard Specification for Driven Fasteners: Nails, Spikes, and Staples
- E. AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)
1. AWPA U1-13 Use Category System: User Specification for Treated Wood
- F. NATIONAL FOREST PRODUCTS ASSOCIATION (NFOPA)
1. NFOPA-01 National Design Specification for Wood Construction
 2. NFOPA-02 Manual for Wood Frame Construction
- G. TRUSS PLATE INSTITUTE (TPI)
1. TPI TPI-85 Design Specification for Metal Plate Connected Wood Trusses
 2. TPI QST 88 Quality Standard for Metal Plate Connected Wood Trusses Addendum to TPI-85

H. WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

1. WWPA-01 Western Lumber Grading Rules

1.3 RELATED WORK

- A. Related work in other sections includes but is not limited to:

1. Section 01 33 00 Submittal Procedures

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Manufacturer's catalogs showing rough hardware conforming to or equivalent to hardware indicated on the Drawings.
- C. Structural and Miscellaneous Wood Members: Design analysis and calculations of fabricated wood trusses shall show design criteria used to accomplish the applicable analysis. Calculations and drawings shall be stamped by a Professional Engineer licensed in the State of Utah.
- D. Shop Drawings: Drawings of fabricated wood trusses shall indicate materials and shop and field erection details including methods of fastening.
- E. Manufacturer's Certificates: Manufacturer's certificates attesting that lumber and material not normally grade marked or exempt from being grade marked meets the specified requirements.

1.5 DELIVERY AND STORAGE

- A. Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well ventilated areas, and protected from extreme changes in temperature and humidity.

1.6 QUALITY ASSURANCE

- A. Materials and assembly shall be inspected to determine compliance with the Building Code.
- B. At completion of fabrication of the trusses, the fabricator shall submit a certificate of compliance to Engineer stating that the work was performed in accordance with the contract documents.

PART 2 PRODUCTS

2.1 LUMBER AND SHEATHING

- A. Grading and Marking: Materials shall bear the grademark, stamp or other identifying marks indicating grades of material and rules or standards under which produced. Such identifying marks on material shall be in accordance with the rule or standard under

which the material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification. The inspection agency for lumber shall be certified by the Board of Review, American Lumber Standards Committee, to grade species used. Except for plywood and lumber; bundle marking will be permitted in lieu of marking each individual piece. Surfaces that are to be architecturally exposed to view shall not bear grademarks, stamps, or other types of identifying marks.

- B. Sizes: Lumber and material sizes shall conform to requirements of the rules or standards under which produced. Unless otherwise specified, lumber shall be surfaced on four sides. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.
- C. Trussed Rafters: Rafters shall be a prefabricated design. Connections shall be made with light-metal plate-connectors. Light-metal-plate-connected wood trusses shall be designed in conformance with TPI TPI-85 and fabricated in conformance with TPI QST-88.
- D. Plywood: Plywood shall be APA performance rated, Grade C-D with exterior glue. Sheathing for roof without corner bracing of framing shall have a span rating of 16/0 or greater for supports 16 inches on center and a span rating of 24/0 or greater for supports 24 inches on center.
- E. Wood: Provide dressed lumber, S4S, unless otherwise indicated. Provide seasoned lumber with 19 percent maximum moisture. For structural framing use No. 2 grade Douglas-fir or Larch or any species or grade meeting the following requirements:

- 1. Fb: 900 psi
- 2. E: 1,600,000 psi

2.2 TRUSSES

- A. Marking: Each truss shall be marked or have permanently affixed thereto the following information near the center of the span on the bottom chord: truss manufacturer's name and address, design load, and spacing of the trusses.
- B. Connector plates shall be designed by the truss manufacturer in accordance with TPI Standards. Structural plates shall be structural quality steel and hot-dip galvanized according to ASTM A 653. Connector plates shall be provided on both sides of the truss, i.e. 2 plates per joint.

2.3 PRESERVATIVE TREATMENT

- A. The treatment of lumber, timber, and plywood shall meet the requirements of AWWA UC3B for above ground use only. All products shall bear the appropriate AWPB Quality Mark. The wood shall then be dried to the moisture content specified and marked with the word "Dry." Surfaces of lumber that will be exposed shall not be incised. Exposed areas of treated wood that are cut or drilled after treatment shall receive a field treatment in accordance with AWWA M4. Wood preservative shall be **Wolman AG by Arch Treatment Technologies, Preserve CA by Viance**, or approved equal. Unless otherwise specified the following items will always be treated:

1. All wood members used in built-up roofing systems.
2. All wood members set into concrete regardless of location, including flush-with-deck wood nailers for roofs.
3. All wood members used for rough framing of openings in exterior concrete or masonry walls.
4. Nailing strips or nailers used in conjunction with roof systems.

2.4 ACCESSORIES AND NAILS

- A. Anchor Bolts shall conform to ASTM A 307, size as indicated, complete with nuts and washers.
- B. Expansion Shields shall be the Type and size best suited for intended use.
- C. Joist Hangers and Truss Clips shall be steel or iron, zinc-coated, sized to fit members where used, sufficient strength to develop the full strength of supported member, complete with any special nails or bolts required. Framing devices shall be manufacturer by **Simpson Strong-Tie Company, Inc., USP Structural Connectors**, or approved equal. Hangers used with treated lumber and sheathing to be Zmax or hot dip galvanized.
- D. Nails and Staples shall be of the size and type best suited for purpose and shall conform to the requirements of ASTM F 1667. For sheathing, the length of nails shall be sufficient to extend 1 inch into supports. In general, 8-penny or larger nails shall be used for nailing through 1-inch-thick lumber and for toe nailing 2-inch-thick lumber; 16-penny or larger nails shall be used for nailing through 2-inch thick lumber. Nails used with treated lumber and sheathing shall be galvanized.

PART 3 EXECUTION

3.1 INSTALLATION OF FRAMING AND MISCELLANEOUS WOOD MEMBERS

- A. General: Members shall be closely fitted, accurately set to required lines and levels, and rigidly secured in place. Nailing shall be in accordance with the recommended Nailing Schedule as contained in NFOPA-02. Where detailed nailing requirements are not specified, nail size and nail spacing shall be sufficient to develop an adequate strength for the connection without splitting the members. Installation of timber connections shall conform to applicable requirements of NFOPA-01. Members shall be framed for passage of ducts and pipes shall be cut, notched, or bored in accordance with applicable requirements of NFOPA-02. Rafters, purlins, and joists shall be set with crown edge up. Leveling of joists, beams, and girders on masonry or concrete shall be with slate or steel; on wood or metal leveling shall be without shims.
- B. Cutting and Notching: Wood members shall not be cut or notched. If bored more than 1/4 of their depth, then adequate and approved reinforcing is required.
- C. Sill Plates: Sill plates shall be set level and square and anchor bolted at not more than 2 feet 8 inches on centers and not more than 12 inches from end of each piece. A minimum of two anchors shall be used for each piece. Sill plates and other wood resting on or embedded in concrete or masonry shall be pressure treated.

- D. Wall Framing: Wall studs shall be installed at a spacing of 16-inches on center unless otherwise indicated on the Drawings. A single plate shall be provided at the bottom and a double plate at the top of wall framing unless noted otherwise. Joints in the top plates shall be staggered not less than 4 feet.
- E. Roof Framing or Rafters: Tops of supports or rafters shall form a true plane. Valley, ridge, and hip members shall be of depth equal to cut on rafters where practicable, but in no case less than depth of rafters. Valleys, hips, and ridges shall be straight and true intersections of roof planes. Necessary crickets and watersheds shall be formed. Rafters shall be braced to prevent movement until permanent bracing, decking or sheathing is installed. Hip and valley rafters shall be secured to wall plates by clip angles. Openings in roof shall be framed with headers and trimmers. Unless otherwise indicated, headers carrying more than two rafters and trimmers supporting headers carrying more than one rafter shall be double. Hip rafters longer than the available lumber shall be butt jointed and scabbed. Valley rafters longer than the available lumber shall be double, with pieces lapped not less than 4 feet and well spiked together. Trussed rafters shall be installed in accordance with TPI TPI-85.
- F. Blocking and Backing: Blocking and backing shall be nominal 2-inch-thick material and shall be provided as necessary to meet the latest codes for lateral bracing and for application of siding, sheathing, subflooring, wallboard, and other materials or building items, and to provide fire stopping. Blocking and backing shall be cut to fit between framing members and rigidly nailed thereto.
- G. All nailing, except where noted on the drawings, to be per Table 2304.9.1 of the 2012 IBC.

3.2 INSTALLATION OF SHEATHING

- A. Plywood: Sheathing shall be applied in accordance with APA standards and with edges 1/8 inch apart at side and end joints, and nailed at supported edges at 6 inches on center and at intermediate supports 12 inches on center. Nailing of edges shall be 3/8 inch from the edges. Wall sheathing shall extend over top and bottom plates, and if applied horizontally the vertical joints shall be made over supports and staggered. Roof sheathing shall be applied with long dimension at right angles to supports, end joints made over supports, and end joints staggered.

3.3 INSTALLATION OF ROOF TRUSSES

- A. Contractor shall be responsible for field erection of the trusses, including proper handling, safety precautions, temporary bracing to prevent toppling, and other safeguards which are consistent with good workmanship and building erection practices.
- B. Contractor shall comply with all applicable requirements and recommendations of TPI.
- C. Contractor shall not field repair, cut or otherwise alter trusses without consulting the truss manufacturer.

- END OF SECTION -

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SECTION 06 20 23
INTERIOR FINISH CARPENTRY

PART 1 GENERAL

1.1 DESCRIPTION

- A. Work of this Section, as shown or specified, shall be provided by the Interior Contractor and shall be in accordance with the requirements of the Contract Documents.
- B. This Section covers the finish carpentry work which includes coordination, fabrication, and installation of all interior exposed wood members shown on Contract Drawings and specified herein, including but not limited to the following:
 - 1. Lumber
 - 2. Standing and Running Trim
 - 3. Moldings
 - 4. Paneling
 - 5. Plywood
 - 6. Miscellaneous Items

1.2 REFERENCES

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN HARDWOOD ASSOCIATION (AHA)
 - 1. AHA A 135 Hardboard Plywood
- C. AMERICAN WOODWORK INSTITUTE (AWI)
 - 1. AWI 0620 Finish Carpentry/Installation
- D. AMERICAN PLYWOOD ASSOCIATION (APA)
 - 1. APA AFG-01 Adhesives for Field-Gluing Plywood to Wood Framing
- E. AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)
 - 1. AWPA M4 Standard for the Care of Preservative-Treated Wood Products
 - 2. AWPA U1-13 Use Category System: User Specification for Treated Wood
- F. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
- G. HARDWOOD PLYWOOD AND VENEER ASSOCIATION (HPVA)
 - 1. HPVA HP-1 American National Standard for Hardwood and Decorative Plywood

H. NATIONAL FOREST PRODUCTS ASSOCIATION (NFOPA)

1. NFOPA-01 National Design Specification for Wood Construction
2. NFOPA-02 Manual for Wood Frame Construction

I. NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

1. NHLA Rules Rules for the Measurement and Inspection of Hardwood and Cypress

J. WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

1. WWPA-01 Western Lumber Grading Rules

1.3 RELATED WORK

A. Related Work in other sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 09 91 00 Painting and Finishes

1.4 SUBMITTALS

A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Submit the following items of finish carpentry:

1. Shop Drawings, indicating fabrication and installation methods, to include plans and elevations and details. Indicate required anchorage and blocking, accessory items, field dimensions, materials and finishes. Indicate compliance with specification requirements. Indicate weight of any materials or systems to be suspended or which require support from structure.
2. Manufacturer's Product Data for all specialty items not manufactured by the Finish Carpentry Fabricator.
3. Two samples of each species and finish of wood specified. Samples shall be minimum 12-inch by 12-inch finished as specified on one face, one edge, and one end. Samples shall be fire retardant treated wood where such has been specified or required by codes. Review will be for color and texture only; compliance with other requirements is the responsibility of Interior Contractor. Samples of finishes shall be applied on the appropriate wood or base material as will occur in the final Finish Carpentry item when installed.
4. Product data for each type of process, factory and non-factory fabricated product. Indicate component materials, dimensions, profiles, textures, colors and include construction and application details.
5. Where variations in wood and finish may occur, a minimum of three variations showing the extremes which may be expected of any and all wood and finishes as specified shall be submitted to ENGINEER for approval. Minimum size: 12-inch by 20-inch.

6. Where required by OWNER or ENGINEER, the Interior Contractor shall provide full size mockup of panel or woodwork assembly.
7. Interior Contractor shall submit to ENGINEER three samples 20-inch minimum length of all moldings or molding assemblies to be used for the Project. These shall be full size and finished as specified in the Contract Documents.

1.5 DELIVERY AND STORAGE

- A. Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well ventilated areas, and protected from extreme changes in temperature and humidity.
- B. Protect materials against weather and contact with damp or wet surfaces. Stack lumber, plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation within and around stacks and under temporary coverings.
- C. Deliver interior finish carpentry materials only when environmental conditions meet requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.
- D. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.6 QUALITY ASSURANCE

- A. Comply with applicable provisions for Premium Grade as defined in the latest edition of the AWI Quality Standards for all materials, fabrication and workmanship for all work of this Section.
- B. All Work of this Section shall be performed by skilled mechanics of the trade and shall be of the highest quality. Comply with applicable Industry Standards for all Work and materials as specified.
- C. The Interior Contractor shall be responsible for obtaining and complying with all code and regulatory agency requirements for materials and methods.
- D. The Interior Contractor shall be responsible for accurately obtaining all field dimensions related to his/her work prior to fabrication. Where discrepancies are found, he/she shall notify ENGINEER immediately in writing.
- E. Protect sanded and finished surfaces from soiling and damage during handling and installation.
- F. Provide temporary protection of all Finish Carpentry as required to protect Work from damage.

PART 2 PRODUCTS

2.1 MATERIALS

- A. All woodwork materials shall be new and shall conform to the Premium Grade requirements of the AWI Quality Standards, latest edition.
- B. All lumber shall be kiln-dried to the average moisture content as recommended by the AWI Quality Standards latest edition appropriate for the climatic conditions of the Site.
- C. All solid wood elements shall be clear, straight-grain lumber of the best grade of specified species as listed by the NHLA. Lumber shall be free of any defects which might impair serviceability, aesthetics, and/or finish. Solid wood elements shall also be according to the following, unless indicated otherwise on Contract Drawings and/or Specifications:
 - 1. Specie of Face Woods receiving transparent finishes shall be as specified on the Contract Drawings and shall be selected for specified grain with uniform color and grain suitable for use with the finished plywood with which it is used.
 - 2. Face Woods receiving opaque finishes shall be Birch, Poplar or custom grade but otherwise shall have same specification as solid stock for Face Woods above.
 - 3. Unexposed woods shall be Custom grade Poplar, kiln dried.
- D. All veneer core elements shall be clear straight-grain lumber of the best grade of the specified species as listed by the NHLA Lumber shall be free of any defects which might impair serviceability, aesthetics, and/or finish. Where veneer differs on two sides, veneers shall be of similar thickness, density, and characteristics to prevent any warpage. Veneer core elements shall also be according to the following, unless indicated on Contract Drawings or Specifications:
 - 1. Adhesives shall be water-resistant resin or approved equal; process shall be hot plate method using the following number of plies to achieve specified thickness:
 - a. 1/4-inch overall thickness shall be of 3- ply veneer core construction.
 - b. 3/8-inch overall thickness shall be of 5- ply veneer core construction.
 - c. 1/2-inch overall thickness shall be of 5- ply veneer core construction.
 - d. 3/4-inch overall thickness shall be of 7- ply veneer core construction.
 - e. 1-inch overall thickness shall be of 9-ply veneer core construction.
 - 2. Where burl paneling is specified, core must be cross banded with poplar prior to applying burl veneer.
 - 3. For Face Woods receiving transparent finishes, Species shall be as specified on drawings; faces shall be selected and matched by the Interior Contractor with respect to cutting lengths, uniformity of color, figure, and grain character. Face veneers shall not contain open joints, face depressions, glue stain or other manufacturing irregularities.
 - 4. Face Woods receiving opaque finishes shall have custom grade (face veneer) Birch or Poplar select, but otherwise shall have same specification as Plywood for Face Woods (Paragraph 2.1.D.1).
 - 5. Unexposed woods shall be Birch, Poplar or Douglas Fir, rotary cut, Unselect, good one side, interior type plywood, one side Grade A and one side Grade B; Grade A faces shall not contain plugs, knots, pitch pockets, splits, rough grain or other open defects.
 - 6. Wood for plastic lamination shall be minimum 3/4-inch Mahogany face core plywood, good one side.
- E. All particle board shall be resin impregnated wood flakes of high-density construction as manufactured by **Boise Cascade Corporation, Roseburg**, or approved equal and shall be 3/4-inch minimum thickness, unless otherwise specified.

1. For Enameled Face Woods: High density particle board may be substituted for plywood panels, unless specified otherwise on Contract Drawings.
2. For Unexposed Woods: High density particle board may be substituted for plywood panels, unless specified otherwise on Contract Drawings.

F. All masonite shall be 1/8-inch thick tempered, as manufactured by **Masonite Corporation**, or an approved equal.

G. All Finish Carpentry shall be finished as indicated on Contract Drawings and Specifications. Transparent and Opaque Finishes shall match approved samples submitted according to Section 01 33 00 and Paragraph 1.4 above.

2.2 SOFTWOOD PLYWOOD

A. Each sheet of plywood must bear the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood.

B. The mark must identify the plywood by species group or identification index, and show glue type, grade, and compliance with PS1.

2.3 HARDWOOD PLYWOOD

A. Comply with AHA A 135.

B. Each sheet of hardwood plywood must bear the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood. The mark must identify the plywood by species group or identification index, and show glue type, grade, and compliance with HP-1.

C. Hardwood plywood type to meet minimum standards and must comply with specifications.

2.4 PANELING

A. Hardwood Veneer Plywood Paneling: Manufacturer's stock hardwood plywood panels complying with HPVA HP-1, made without urea-formaldehyde adhesive. Manufacturers Subject to compliance with requirements,

B. For Face Woods receiving transparent finishes, Species shall be as specified on Contract Drawings; faces shall be selected and matched by the Interior Contractor with respect to cutting lengths, uniformity of color, figure, and grain character. Face veneers shall not contain open joints, face depressions, glue stain or other manufacturing irregularities.

C. Where burl paneling is specified core must be cross banded with poplar prior to applying burl veneer.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

B. All required hardware and accessories shall be furnished and installed by Interior Contractor and shall be as indicated on Contract Drawings and Specifications. Where

specific products are not specified in the Contract Documents, the Interior Contractor shall recommend hardware to provide the function or condition indicated in the Contract Documents. Hinges, screws, clips and other mounting, attachments or fasteners to be concealed unless otherwise noted on Contract Drawings.

- C. Interior Contractor shall submit samples of each hardware item/type and accessory item/type to ENGINEER for approval according to Paragraph 1.4 above and Section 01 33 00.
- D. Paneling Adhesive: Comply with paneling manufacturer's written recommendations for adhesives. VOC levels shall not exceed what is approved for Project.
- E. All Finish Carpentry hardware and accessories shall be installed in accordance with manufacturer's recommendations.

2.6 OTHER MATERIALS

- A. Interior Contractor shall be responsible for providing and installing all items and materials as indicated on Contract Drawings and Specifications comprising all or part of the Finish Carpentry shown. Such items and materials shall be fabricated and/or installed according to manufacturer's recommendations and comply with applicable AWI Quality Standards and Industry Standards.
- B. All paint and other finish material shall be pure, unadulterated and best quality from specified manufacturer as indicated on the Contract Drawings and Specifications. (See Section 09 91 00 – Painting and Finishes).
- C. All finish materials shall be flame retardant or treated with flame-retardant process where required by local code. Should flame-retardant process cause change in color and effect on finish material, Interior Contractor shall notify ENGINEER.
- D. All finishes and processes shall be in compliance with code requirements for the location of installation.
- E. All transparent finishes shall be alcohol, water and burn resistant.

PART 3 EXECUTION

3.1 EXAMINATION OF CONDITIONS

- A. The Interior Contractor shall be responsible for examination of the substrate and the conditions under which the Work under this section is to be performed, and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work under this section until unsatisfactory conditions have been corrected.
- B. Verify surfaces and substrates are prepared to receive products of this section.
- C. If substrate preparation is the responsibility of another installer, notify ENGINEER of unsatisfactory preparation before proceeding. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative metal.

- D. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the Project conditions.
- B. Clean surfaces thoroughly prior to installation.
- C. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours.

3.3 FABRICATION

- A. All Work shall be performed in such manner as to fulfill the intent of the Contract Drawings and Specifications.
- B. All items to be mill fabricated per AWI Premium Grade specifications and according to the sizes and designs indicated on the Contract Drawings and Specifications, and assembled in single and complete units insofar as the dimensions thereof will permit shipment to and installation at the building. Large pieces requiring sectional construction shall have their several parts accurately fitted and aligned with each other and be provided with ample screws, glue and bolt blocks, tongues, grooves and splines, dowels, mortises and tenons, screws, bolts, or suitable means of concealed fastening, as required to render the Work substantial, rigid and permanently secured in proper position to each related section.
- C. Where necessary to fit at site provide ample allowance for cutting and fitting. Sufficient additional material shall be allowed to permit accurate scribing to walls, floors and related work; and due allowance made wherever possible for such shrinkage as may develop after installation. All single and sectional units shall be provided with adequate cleating, blocking, crating and other forms of protection as required to preclude damages thereto during shipping and handling and installation.
- D. Framing and blocking members shall be assembled with bolted and screwed connections, and shall be secured to the structural backings with expansion screws, or toggle bolts, as required, spaced and installed so as to insure ample strength and rigidity. Rails and stiles shall be mortised and tenoned, work neatly mitered and membered, all butt joints made flush and smooth, and all permanent joints made up with water-resistant glue. All fixtures shall be assembled without face screws or nails, except where it may be necessary to attach trim items. All face screws or nails which are necessary to attach trim items shall be countersunk and plastic wood or wood plugs used to cover heads, and the plug neatly touched up to match finish. The heads of all screws used in any assembly shall be countersunk below the surface.
- E. All items where paint is required shall be shop spray finished, except where impractical or otherwise specified.
- F. Backsides of all Finish Carpentry concealed by the building shall be given a prime coat of paint, color to closely approximate the value and hue of the face finish.

3.4

3.5 INSTALLATION

- A. Installation at the Project shall be by skilled mechanics supervised by the Interior Contractor in accordance with accepted standards.
- B. Install in accordance with the manufacturer's recommendations and the approved shop drawings and in proper relationship with adjacent construction.
- C. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.
- D. Install all Finish Carpentry straight, plumb, level and in true alignment except where otherwise indicated. Fit all joints closely and fasten all pieces rigidly in place. Nails shall be finish or casing nails. Countersink nail heads and leave ready for putty. Joints shall be neatly matched and mitered. Fill exposed joints prior to jointing.
 - 1. Finished size shall be as indicated on the Contract Drawings.
 - 2. Surfaces shall be left free from hammer marks, free from warp, twist, open joints or other defects and shall be cleaned, scraped and sanded ready for finishing.
 - 3. Lengths of all running trim shall be as long as practical.
 - 4. Shim as required using concealed shims.
- E. Cut Finish Carpentry to fit unless specified to be shop fabricated or shop-cut to exact size. Where Finish Carpentry abuts other finished work, scribe and cut for accurate fit. Before making cutouts, drill pilot holes at corners.
- F. Distribute defects allowed in the quality grade specified to the best overall advantage, when installing job assembled items.
- G. Attach Finish Carpentry securely in place with uniform joints providing for thermal and building movements. Attach to substrates by anchoring and fastening as shown, as required by recognized standards, and as follows:
 - 1. Nailing: Blind nail where possible. Use fine finishing nails where exposed. Set exposed nail heads for filling except for exterior wood which is to receive a natural finish (if any).
 - 2. Anchoring: Secure Finish Carpentry to anchors or blocking built-in or directly attached to substrates.
- H. For standing and running trim, install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary. Stagger joints in adjacent and related standing and running trim. Cope at returns and miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.

1. Install trim after gypsum board joint finishing operations are completed.
 2. Drill pilot holes in hardwood before fastening to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.
 3. Cope moldings at returns, miter interior angles and corners.
- I. Where finishes are applied at job site, clean items and fill nail holes in preparation for finishes application. Where work is to receive a transparent finish, use matching wood filler.
 - J. For Fire-Retardant Finish Carpentry, handle, store and install in accordance with manufacturer's direction and as required to meet the required classification or rating. Provide special fasteners, adhesives and other accessories as tested and listed for the type of fire-retardant work indicated. Re-coat any and all cut surfaces with a heavy brush coating of the same compound used for wood treatment.
 - K. Fit Finish Carpentry to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow proper support.
 - L. Paneling: Select and arrange panels on each wall to minimize noticeable variations in grain character and color between adjacent panels. Leave 1/4-inch gap to be covered with trim at top, bottom, and openings. Install with uniform tight joints between panels.
 1. Attach panels to supports with manufacturer's recommended panel adhesive and fasteners. Space fasteners as recommended by panel manufacturer.
 2. Conceal fasteners to greatest practical extent.
 - M. Adjust all hardware for smooth operation.
 - N. Coordinate with plumbing and electrical work for installation of fixtures and service connections in millwork items.

3.6 CLEANING AND PROTECTION

- A. Clean shop finished work, touch-up finish as required and remove and refinish damaged or soiled areas of finish.
- B. Protect installed Finish Carpentry from damage by Work of other trades until OWNER's acceptance of the Work. Subcontractor to advise Interior Contractor of procedures and precautions for protection of materials and installed work from damage and of the required temperature/humidity conditions which must be maintained during the remainder of the construction period in areas of Finish Carpentry installations.
- C. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.
- D. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

- END OF SECTION -

SECTION 07 21 00
INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. This section covers the work required to provide and install insulation in buildings and structures, complete and in place.

1.2 RELATED WORK

- A. Related Work in other Sections includes, but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 04 22 00 Reinforced Unit Masonry

1.3 REFERENCES

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. C 518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
 - 2. C 547 Standard Specification for Mineral Fiber Pipe Insulation
 - 3. C 553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
 - 4. C 578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
 - 5. C 592 Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
 - 6. C 612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation
 - 7. C 665 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
 - 8. D1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics
 - 9. D1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics
 - 10. D2842 Standard Test Method for Water Absorption of Rigid Cellular Plastics
 - 11. E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
 - 12. E 96 Standard Test Methods for Water Vapor Transmission of Materials
- C. UNDERWRITERS LABORATORIES (UL)
 - 1. UL1256 Fire Test of Rook Deck Constructions
- D. FACTORY MUTUAL (FM)
 - 1. Approval Standard for Class 1 Fire Rating of Insulated Wall or Wall and Roof/Ceiling Panels, Interior Finish Materials or Coatings and Exterior Wall Systems.

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit manufacturer's literature, installation instructions, product test reports and technical data.
- C. Submit manufacturer's certification that the proposed materials comply with this Section.
- D. For foam-in-place insulation, submit a copy of the foam insulation contractor's certification and ICC-ES report and manufacturer's documentation confirming material conforms to ASTM C 1029.

1.5 DELIVERY AND STORAGE

- A. Materials shall not be allowed to become wet, soiled, or covered with ice and snow. Manufacturer's recommendations for handling storage and protection shall be strictly followed. If required, during cold weather, store in heated storage areas following the manufacturer's guidelines for minimum and maximum temperatures. Material shall not be exposed to sunlight and shall be protected against ignition. Materials shall be concealed as quickly as possible after completion of work.

PART 2 PRODUCTS

2.1 INSULATION

- A. Thermal resistance of insulation shall be not less than the R-values shown on the Contract Drawings. R-values shall be determined at 75 degrees F in accordance with ASTM C 518. Insulation shall be the standard product of a manufacturer and factory marked or identified with manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages.
- B. The materials and application of building insulation shall conform to the applicable requirement of the Underwriters Laboratories "Fire Resistance Index", Factory Mutual requirements, and the manufacturer's recommendations.
- C. Minimum R-Value in all roof insulation shall be R-30.

2.2 FOAMED-IN-PLACE THERMAL INSULATION

- A. Foamed-in-place or sprayed polyurethane foam plastic insulation conforming to the requirements of ASTM C 1029 shall be placed in cavities of masonry walls. Foamed-in-place thermal insulation in walls shall be 2-component spray polyurethane mix for producing rigid, closed-cell insulation by frothing/pouring in place. It shall have the following characteristics:

Property	Requirement	Standard
Core Density	1.5 to 2.5 pcf	ASTM D 1622
Thermal Resistance at 140°F/90 day Aged R Value, at 75°F mean Temp, min	R6.0/inch	ASTM C 518
Vapor Transmission, max	3.0 perm-inch	ASTM E 96

Water Absorption, max	3.0 %	ASTM D 2842

- B. Foamed-in-place insulation shall be **Bayseal CCX by Covsetro, STYROFOAM (MX Series) by Dow Chemical, CertaSpray by CertainTeed, Corbond MCS by Johns-Manville, ICYNENE MD-C-200 by Icynene, Inc.**, or approved equal.

2.3 BLANKET INSULATION

- A. Blanket insulation shall be glass or other inorganic fibers and resinous binders formed into flexible blankets complying with ASTM C 665, Type III, with foiled back vapor barrier laminated to one face, with 1-inch flanges on long edges, and vapor transmission not more than 0.50 perms. Manufacturers shall be **Owens-Corning, CertainTeed, Johns-Manville**, or approved equal.

2.4 EXTRUDED POLYSTYRENE BOARD (RIGID) INSULATION

- A. Rigid insulation shall be polystyrene conforming to ASTM C 578, Type IV with surface burning characteristics per ASTM E84 maximum of 5 for flame-spread and 175 for smoke developed. Minimum thermal resistance per inch of R-5.0 per ASTM C 518 at 75°F mean temperature. Minimum compressive strength of 25 psi per ASTM D 1621.
- B. Insulation, where required on drawings, for roof decks shall be listed per UL 1256 and shall be in compliance with FM Class I roof decks.
- C. Insulation thickness in interior walls, where required on drawings, shall be 4 inches.
- D. Manufacturers shall be **Dow Chemical, Owens Corning**, or approved equal.
- E. Sill Sealer: Mineral wool, 1 inch thick and compressible to 1/32 inch, width of sill, designed to perform as an air, dirt, and insect seal.

2.5 RIGID INSULATION WITH ALUMINUM JACKETING

- A. Vaults with electric power shall be insulated with a combination of rigid insulation (see 2.4) and 24-mil thick (min) aluminum jacketing with stucco embossed finish.
- B. Accessories:
1. Adhesive: As recommended by manufacturer. Adhesive shall be formulated specifically to bond insulation to aluminum jacket, steel (hatches and panels) and to concrete surfaces.
 2. Tape: Aluminum foil tape with facing to match rigid insulation as recommended by the manufacturer.
 3. J-Channel: PVC Closure strip as recommended by manufacturer for terminations.
 4. Clip Strip: PVC closure strip for vertical and horizontal seams.
 5. Fasteners: Hilti Insulation Fasteners (IZ-type), or approved equal.
- C. Aluminum Jacket Manufacturer: **Insul-Mate Aluminum Jacketing by RPR Products, Inc.**, or approved equal.

2.6 EXTRUDED POLYSTYRENE BOARD (RIGID) INSULATION (BURIED LOCATIONS)

- A. Rigid insulation for buried locations shall be polystyrene conforming to ASTM C 578, Type IV with surface burning characteristics per ASTM E84 maximum of 75 for flame-spread and maximum of 450 for smoke-developed. Minimum thermal resistance per inch of R-5.0 per ASTM C 518 at 75°F mean temperature. Minimum compressive strength of 25 psi per ASTM D 1621.
- B. Insulation thickness for exterior foundation walls shall be 1.5 inches minimum.
- C. Manufacturers shall be Dow Chemical, Owens Corning, or approved equal.
- D. Sill Sealer: Mineral wool, 1 inch thick and compressible to 1/32 inch, width of sill, designed to perform as an air, dirt, and insect seal.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify substrate and adjacent materials and insulation board are dry and ready to receive adhesive.
- B. Verify mechanical and electrical services within walls have been installed and tested.

3.2 INSTALLATION OF INSULATION

- A. Insulation shall be installed after construction has advanced to a point that the installed insulation will not be damaged by remaining work. For thermal insulation the actual installed thickness shall provide the R-values shown. For acoustical insulation the installed thickness shall be as shown. Insulation shall be installed on the weather side of such items as electrical boxes and water lines. Unless otherwise specified, installation shall be in accordance with the manufacturer's recommendation.

3.3 INSTALLATION OF FOAMED-IN-PLACE THERMAL INSULATION

- A. Installer will blend resin and foaming catalyst according to the manufacturer's instructions prior to arriving at the jobsite and/or at the jobsite, at the installer's discretion.
- B. Verify that the wall assembly is essentially dry with no standing water in the CMU core cells and no visible wetness on exterior surfaces. Verify that mortar is adequately cured.
- C. All empty core cells and voids within each insulated wall shall be filled with foam insulation as shown on the drawings.
- D. Walls can be filled using top-fill injection techniques.
 - 1. Installer shall use an extension tube to begin installing foam from the bottom of the cavity, withdrawing the extension tube as foam fills the cavity.
 - 2. Foamed-in-place thermal insulation shall be injected until it completely fills each vertical cell column. This procedure shall be completed for each vertical column beneath each bond beam, prior to placing the bond beam.

- E. After foam insulation sets, remove excess foam from outside of cavity, sweeping the wall and floor as needed. Cured foam is an inert material and, therefore, can be disposed of with other construction waste in accordance with local regulations.
- F. Materials must be maintained at a minimum temperature of 75° F.

3.4 INSTALLATION - RIGID INSULATION

A. Foundation Perimeter:

1. Adhere a 6 inches wide strip of polyethylene sheet over joints with double beads of adhesive on each side of the joint. Tape seal joints between sheets. Extend sheet full height of joint.
2. Install boards on foundation wall perimeter, horizontally. Place boards in a method to maximize contact bedding. Stagger end joints. Butt edges and ends tight to adjacent board and to protrusions.
3. Extend boards over expansion joints, unbonded to foundation 12 inches either side of joint.

B. Exterior Walls and Interior Vault Walls:

1. Apply adhesive in 3 continuous beads per board length. Daub adhesive tight to protrusions.
2. Install boards on wall surface perimeter, vertically. Place membrane surface of insulation against adhesive.
3. Place boards in a method to maximize contact bedding. Stagger side joints. Butt edges and ends tight to adjacent board and to protrusions.
4. Place 24" side polyethylene sheet at perimeter of wall openings from adhesive vapor and air retarder bed to window and door frames. Tape seal in place to ensure continuity of vapor and air retarder.
5. Install aluminum jacketing on board surface per manufacturer's requirements.

C. Cavity Walls:

1. Secure impale fasteners to substrate at a frequency of 6 per insulated board.
2. Apply adhesive in 3 continuous beads per board length. Daub adhesive tight to protrusions to ensure continuity of vapor and air retarder.
3. Install boards horizontally between wall reinforcement.

D. Under Concrete Slabs:

1. Place insulation under slabs on grade after base for slab has been compacted.
2. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.5 INSTALLATION - BATT INSULATION

- A. Install batt insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install batt insulation without gaps or voids.
- C. Trim insulation neatly to fit spaces. Use batts free of damage.

- D. Fit insulation tight in spaces airtight to exterior side of mechanical and electrical services within the plane of insulation.
- E. Protect all insulation materials during storage and insulation from moisture, tears or other damage. All damaged material shall be replaced at no additional cost to OWNER.

- END OF SECTION -

SECTION 07 32 00
METAL ROOFING SYSTEMS

PART 1 GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall furnish and install metal roofing and soffit panels, system support framing, and appurtenant work, complete and in place. Provide standing seam system with concealed fasteners.
- B. The principal items of sheet metal work included in the metal roofing system shall include sheet metal flashing, covers, trim, enclosure batts, collars and sleeves at all roof penetrations, metal soffit panels, and all other sheet metal items necessary for a complete and watertight metal roofing system.
- C. The metal roofing applicator shall coordinate his work with sheet metal gutter work and shall report to CONTRACTOR and ENGINEER if any sheet metal work provided by others affects his work negatively.

1.2 RELATED WORK

- A. Related Work in other Sections includes, but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 07 62 00 Sheet Metal Flashing and Trim

1.3 REFERENCES

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - 2. ASTM A 924 Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
 - 3. ASTM D 226 Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
 - 4. ASTM D 1938 Standard Test Method for Tear-Propagation Resistance (Trouser Tear) of Plastic Film and Thin Sheeting by a Single-Tear Method
 - 5. ASTM E 96 Standard Test Methods for Water Vapor Transmission of Materials
 - 6. ASTM E 330 Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
 - 7. ASTM E 1646 Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference
 - 8. ASTM E 1680 Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems

C. UNDERWRITERS LABORATORY (UL)

1. UL 580 Test for Uplift Resistance of Prepared Roof Assemblies

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit detailed shop drawings showing materials, gages, finishes, layout, corners, trim, flashing, enclosures, edge conditions, jointing, profiles, supports, fasteners, fabrication of special shapes, and method of attachment to adjacent construction to Engineer prior to fabrication. Submit drawings indicating roof size, location and type of penetrations, perimeter and penetration details, roof insulation make-up and sheet layout that have been accepted by an authorized manufacturer's representative.
- C. Submit manufacturer's literature indicating materials, finish, construction, and method of installation of prefabricated items and sealant.
- D. Provide color samples for color selection by OWNER.
- E. Submit the following test reports, certified by an Independent Testing Laboratory or a professional engineer registered in the State of Utah to verify the proposed roofing will meet performance requirements of this Specification:
 1. Thermal Cycle Test
 2. ASTM E-330 Adapted to Test Formed Metal Panels
 3. Clip Fastener Pull-Out Tests and Calculations
 4. UL 580 Class 90
 5. Concentrated Load Test Data
 6. Air Infiltration (E-283) and Water Penetration (E-331) Test Results
 7. Coating Performance Testing
- F. Submit certification by the manufacturer that the roofing assembly is listed in the UL Building Materials Directory with a Class 1-90 wind uplift rating, including relevant construction number.

1.5 WARRANTIES

- A. Manufacturer shall provide to OWNER written warranty that the roof panels will not rupture, fail structurally, or perforate due to corrosion for a period of 20 years from the date of installation.
- B. Roofing manufacturer shall provide written 10-year material and labor warranty beginning at the date of final acceptance.
- C. CONTRACTOR shall provide to OWNER written warranty that the roof system is installed in accordance with the manufacturer's recommendations and will be free from defective workmanship and remain watertight and weatherproof with normal usage for two (2) years following Project Substantial Completion date.

1.6 QUALITY ASSURANCE

- A. A single installer shall perform the work of this Section and shall have completed projects

of similar scope and complexity.

PART 2 PRODUCTS

2.1 GENERAL

- A. Subject to compliance with the requirements, manufacturers who may offer metal roofing systems and products, which may be incorporated into the work, include **AEP Span, Fabral, Holcim Elevate**, or approved equal.

2.2 ROOF PANELS

A. Minimum Performance Ratings and Properties:

1. Air infiltration: Panel shall have less than 0.01 cfm/sf air infiltration at ± 6.24 psf pressure differential when tested in accordance with ASTM E 1680.
2. Water penetration: Panel shall have no leakage through panel joints when tested in accordance with ASTM E 1646 at static pressure differential of 12.0 psf.
3. Provide UL90 rated roofing system that has been tested in accordance with UL 580 test procedure.

B. Profile:

1. Roof panels shall be factory formed ribbed seam pattern with minimum 1-inch-high seams and a nominal panel width of 16 inches.
2. Soffit panels shall be 12-inches wide, 1-1/2-inch deep, 22- gauge, G90 galvanized finish steel, with concealed fastener, lock-joint design and shall be continuous-vented.

C. Length:

1. Provide panels of sufficient length to minimize end laps.

D. Profile Composition:

1. Base metal shall be a minimum 24-gage structural steel (minimum yield strength 50,000 psi) with G90 hot dipped galvanized coating conforming to ASTM A 653.
2. Sheet metal trim, flashing, and accessories shall be the same material, gauge, finish, and color as the metal roofing.
3. Paint Finish:
 - a. All panels shall receive a factory applied Kynar 500/Hylar 5000 finish applied to both sides of the panel over the base protective coating or approved equal. The exposed side coating shall have a minimum total dry film thickness of 1.0 mil and the underside coating shall have a minimum total dry film thickness of 0.5 mil. Color to be as determined by OWNER.

E. Concealed-Clips:

1. Material: 18-gauge steel with class G60 galvanized coating.
2. Configuration: clips shall be designed so as to attach with two concealed fasteners, and fully attach two ribs of every panel.
3. Spacing: In accordance with the manufacturer's recommendations.

F. Fasteners:

1. Self-drilling or self-tapping galvanized steel screws and/or stainless-steel pop rivets painted to match the panels where visible, per the panel manufacturer's recommendations.

G. Sealants:

1. Sealants shall not contain oil, asbestos, or asphalt. Factory applied sealant shall be applied in the seam and designed for metal-to-metal concealed joints. Field applied panel end sealant shall be mastic tape sealant. Exposed sealant shall be one-part polyurethane joint sealant. All sealants used shall be as recommended by the metal roofing manufacturer for the job conditions and warranty requirements.

- H. Leak Barrier (Water and Ice Shield) shall be a cold applied, self-adhering membrane composed of high strength polyethylene film coated with a layer of rubberized asphalt adhesive and interwound with a disposable release sheet designed for use with metal roofing systems. An embossed lip resistant surface shall be provided on the polyethylene. Underlayment shall be UL 790 (ASTM E 108) listed Class A fire classification and meet the requirements of Table 07 32 00-1. Leak Barrier shall be **Ice and Water Shield HT by Grace Construction Products**, or approved equal.

Property	Value	Test Method
Color	Gray-Black	
Thickness	40 mil	ASTM D 3767 method A
Tensile Strength	MD 25 lbf/in CD 25 lbf/in	ASTM D 412 (Die C modified)
Elongation	250%	ASTM D 412 (Die C modified)
Low Temperature Flexibility	Unaffected @ -20°F	ASTM D 1970
Adhesion to Plywood	3.0 lbs/in width	ASTM D 903
Permeance (maximum)	0.05 Perms	ASTM E 96

I. Weather resistive barrier:

1. Membrane underlayment shall be composed of a high-strength, spun-bonded polypropylene base sheet, co-extruded on both sides with UV stabilized polyolefin, weight 30-pound. Membrane underlayment shall conform to ASTM D 226, Type II. Permeability shall be 0.54 perms maximum in accordance with ASTM E 96, Procedure A, and tear strength shall be minimum 20 pounds in accordance with ASTM D 1938. Membrane underlayment shall be **Grace Tri-Flex 30 by Grace Construction Products**, or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify proper placement of all roof openings, pipes, curbs, sleeves, ducts, vents and drains.

3.2 SUBSTRATE PREPARATION

- A. Comply with manufacturer's instructions for preparation of substrate to receive roofing. Clean substrate of dust, debris and other substances detrimental to the roofing work.

3.3 NAILERS

- A. Install treated wood nailers at roof perimeters, at base of roof projections, and around specified roof penetrations.
 - 1. Total nailer height shall match total thickness of insulation being used. Install with 1/8" gap between each length and at changes in direction.
 - 2. Firmly fasten nailer to the deck, wall, or existing structurally sound and secured nailer at (16") o.c. maximum, so as to resist a force of 200 pounds per lineal foot in any direction.
 - 3. Taper nailer where applicable to be flush at point of contact with membrane in either the vertical or horizontal applications.

3.4 GENERAL

- A. The metal roofing shall be installed by an applicator and fabricator approved by the roofing system manufacturer who has working experience with the roofing system. Contractor shall provide a letter signed by the roofing manufacturer that the installer is an approved applicator and fabricator of the roofing system.
- B. The metal roofing systems shall be installed in accordance with the manufacturer's instructions and recommendations applicable to the job conditions and supporting substrates.
- C. The panels and other components of the system shall be securely anchored and placed with concealed fasteners and shall be provided with provisions for thermal/structural movement.
- D. Shim and align panel units within installed tolerances of 1/4-inch in 20 feet on level/plumb/slope and location/line as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- E. Joint sealers shall be furnished and installed where necessary or where required for weatherproofing of the system.

3.5 INSTALLATION OF UNDERLAYMENT

- A. General: Install underlayment using methods recommended by the manufacturer and in accordance with local building codes. When local codes and application instructions are in conflict, the more stringent shall take precedence.
- B. Eaves: Install eaves with metal flashing tight with fascia boards. Lap joints 2 inches and seal with plastic cement or high-quality urethane sealant. Nail at the top of the flange. Install leak barrier up slope from eaves edge a full 36 inches or to at least 24 inches beyond the interior "warm wall". Lap ends of leak barrier at least 6 inches.
- C. Valleys: Install leak barrier at least 36 inches wide and centered on the valley. Lap ends at least 6 inches.

- D. Hips and Ridges: Install leak barrier along entire lengths. If ridge vents are to be installed, position leak barrier so that the ridge slots will not be covered.
- E. Roof Deck: Install a layer of roof underlayment over the entire area not protected by leak barrier. Install sheets horizontally so water sheds and nail in place. On roofs sloped more than 4:12 lap horizontal edges at least 2 inches and at least 2 inches over leak barrier. For roofs sloped between 2:12 and 4:12, lap horizontal edges at least 19 inches and at least 19 inches over leak barrier. Lap ends at least 4 inches and stagger ends laps at least 36 inches. Lap roof underlayment at least 6 inches over leak barrier in valley.
- F. Penetrations:
 - 1. Vent Pipes: Install a 24-inch square piece of leak barrier lapping over roof underlayment and seal tightly to pipe.
 - 2. Skylights or Access Hatches: Install leak barrier membrane extending at least 6 inches up the wall and 12 inches on to the roof surface. Lap the membrane over the roof deck underlayment.

3.6 INSTALLATION

- A. Metal panels shall be installed in accordance with the approved shop drawings and the manufacturer's recommendations.
- B. Remove any strippable protective coating on the panels and flashings prior to installation and in any case do not allow the strippable coating to remain on the panels in extreme heat, cold, or in direct sunlight or other UV source.
- C. Loosely lay roof insulation with end joints staggered. (Stagger joints between layers.) Joints shall be 1/4" or less in width. Neatly cut and fit insulation around roof penetrations and projections. Install only dry insulation and only as much insulation as can be covered the same day with membrane and completed.

3.7 CLEANING AND PROTECTION

- A. Panels and other components of the work which have been damaged or have deteriorated beyond successful repair by means of finish touch-ups or similar minor repair procedures, shall be removed and replaced at no cost to OWNER.
- B. Temporary protective coverings and strippable films shall be removed from the materials during installation. Upon completion of the work, the roofing systems shall be cleaned as recommended by the roofing manufacturer and shall be maintained in a clean condition until acceptance of the work by OWNER.

- END OF SECTION -

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 DESCRIPTION

- A. The CONTRACTOR shall provide and install sheet metal flashing and trim, and appurtenant work, complete in place, in accordance with the Contract Documents.

1.2 RELATED DOCUMENTS

- A. Related Work in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
 2. Section 07 32 00 Metal Roofing Systems
 3. Section 07 92 00 Joint Sealants

1.3 REFERENCES

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 2. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 3. ASTM A792 Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
 4. ASTM C920 Standard Specification for Elastomeric Joint Sealants.
 5. ASTM C1311 Standard Specification for Solvent Release Sealants.
 6. ASTM D1187 Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
 7. ASTM D4586 Standard Specification for Asphalt Roof Cement, Asbestos-Free.
- C. Sheet Metal and Air Conditioning Contractors Association, SMACNA – Architectural Sheet Metal Manual

1.4 PERFORMANCE REQUIREMENTS

- A. Materials, anchorage, fastenings, and workmanship shall qualify for U.L. Class 115 MPH (3 second gust) wind uplift rating.
- B. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- C. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other

detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 degrees F, ambient; 180 degrees F, material surfaces.

D. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.5 SUBMITTALS

A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:

1. Identify material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.
4. Details of expansion-joint covers, including showing direction of expansion and contraction.

C. Submit manufacturer's specifications, literature, and published installation and maintenance instructions for all sheet metal products.

D. Provide samples of color where required.

1.6 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.8 COORDINATION

A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leak-proof, secure, and noncorrosive installation.

PART 2 MATERIALS

2.1 SHEET METAL

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.
 - 1. Thickness 0.0239-inch (24 U.S. Standard gauge), unless shown otherwise.
 - 2. Finish-factory applied to match color of metal frames, or trim.
- B. Manufacturers shall be **Cheney Flashing Company, Fry Reglet Corporation, Heckmann Building Products, Inc.**, or approved equal.

2.2 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.
- B. Fasteners: Self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
 - 1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating. Steel, galvanized per ASTM A153/A153M or stainless steel.
 - 2. Fasteners for Flashing and Trim: Steel, galvanized per ASTM A153/A153M or stainless steel. Blind fasteners or self-drilling screws, gasketed, with hex washer head.
 - 3. Blind Fasteners: High-strength stainless-steel rivets.
- C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanent elastic, non-sag, nontoxic, non-staining tape.
- D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.
- F. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

- B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
- C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 - 1. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flatlock seams. Tin edges to be seamed, form seams, and solder.
- D. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.
- F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
 - 1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual for application but not less than thickness of metal being secured.
- H. Reinforcement and Supports: Provide same material as flashing, unless other material is shown. Steel, where shown or required, shall be galvanized or stainless.
- I. Rigid Joints and Seams: make mechanically strong. Solder galvanized and stainless-steel metal joints. Do not use solder to transmit stress.
- J. Provide watertight closures at exposed ends of counterflashing.

2.4 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Counterflashing: Fabricate from the following material:
 - 1. Galvanized Steel: 0.0217 inch thick.
- B. Roof-Penetration Flashing: Fabricate from the following material:
 - 1. Galvanized Steel: 0.0239 inch thick.

2.5 FASCIA AND RAKE TRIM

- A. Fascia and rake trim shall be same metal and thickness as roof panels.
- B. Color shall match roof panels.

2.6 DOWNSPOUTS AND GUTTERS FABRICATION

- A. Downspouts, gutters, and trim shall be same metal and thickness as roof panels. Fabricate gutters in minimum 96-inch-long sections. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from the same material as gutters. Fabricate expansion joints, expansion joints covers, gutter bead reinforcing bars, and gutter accessories from same material as gutters. Shop fabricate interior and exterior corners.
- B. Color shall match roof panels.
- C. Form downspouts and gutters in maximum lengths as practicable to sizes and shapes indicated on the Contract Drawings.
 - 1. Lock longitudinal joints of downspouts.
 - 2. Telescope end joints 1-1/2 inches.
 - 3. Provide elbows at bottom where downspouts discharge onto splash blocks.
 - 4. Anchor downspouts with straps of same material as downspouts.
 - 5. Install gutters at locations indicated on drawings.

2.7 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following material:
 - 1. Galvanized Steel: 0.0239 inch thick.

2.8 FLEXIBLE BASE PIPE SEALS

- A. Flexible base pipe seals shall be prefabricated on-piece aluminum flanged base with stepped, graduated EPDM profile which creates a compression seal between the piping and the flashing. Aluminum base shall be flexible to conform to profile of roof panels.
- B. Manufacturers and Products:
 - 1. Pate Co.; Dektite.
 - 2. Portals Plus, Inc.; Deck-Mate.
- C. Coat aluminum surfaces in contact with dissimilar metals in accordance with 3.2.B of this Section.
- D. Isolation tape shall be butyl or polyisobutylene, internally reinforced.
- E. Fasteners shall be stainless steel of type required.

2.9 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.
 1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 1. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
 1. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.
 2. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.
 3. Use only stainless-steel fasteners to connect isolated dissimilar metals.
- C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
- D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric or butyl sealant.
- E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 30 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing

hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

- G. Seal joints with elastomeric sealant as required for watertight construction.
 - 1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40- and 70-degrees F, set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 degrees F.
 - 2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 - "Joint Sealants."
- H. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches except where pretinned surface would show in finished Work.
 - 1. Pretinning is not required for lead-coated copper.
 - 2. Where surfaces to be soldered are lead coated, do not tin edges, but wire brush lead coating before soldering.
 - 3. Lead-Coated Copper Soldering: Wire brush edges of sheets before soldering.
 - 4. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.

3.3 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal roof flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.
- B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
- C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric sealant.
 - 1. Secure in a waterproof manner by means of anchor and washer at 36-inch centers, or other method approved by ENGINEER.
- D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:
 - 1. Use appropriate flexible base pipe seal where pipe, conduit or cable, etc. penetrate roofing system.

2. Make work watertight and free of expansion and contraction noise. Seal and clamp flashing to pipes penetrating roof.

3.4 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION -

SECTION 07 92 00
JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Polyurethane Sealants
- B. Tape Mastic Sealants
- C. Non-skinning Sealants
- D. Silicone Sealants
- E. Acrylic Sealants

1.2 REFERENCES

- A. American Architectural Manufacturer's Association (AAMA)
 - 1. AAMA 800-10 - Voluntary Specifications and Test Methods for Sealants
- B. ASTM International (ASTM)
 - 1. ASTM A 653 Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM A 792 Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy Coated by the Hot-Dip Process.
 - 3. ASTM C 639 Standard Test Method for Rheological (Flow) Properties of Elastomeric Sealants
 - 4. ASTM C 661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer
 - 5. ASTM C 681 Standard Test Method for Volatility of Oil- and Resin-Based, Knife Grade, Channel Glazing Compounds
 - 6. ASTM C 711 Standard Test Method for Low-Temperature Flexibility and Tenacity of One-Part, Elastomeric, Solvent-Release Type Sealants
 - 7. ASTM C 794 Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants
 - 8. ASTM C 908 Standard Test Method for Yield Strength of Preformed Tape Sealants
 - 9. ASTM C 920 Standard Specification for Elastomeric Joint Sealants
 - 10. ASTM D 56 Standard Test Method for Flash Point by Tag Closed Cup Tester
 - 11. ASTM D 217 Standard Test Methods for Cone Penetration of Lubricating Grease
 - 12. ASTM D 412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
 - 13. ASTM D 792 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
 - 14. ASTM D 925 Standard Test Methods for Rubber Property—Staining of Surfaces (Contact, Migration, and Diffusion)

- 15. ASTM D 2452 Standard Test Method for Extrudability of Oil- and Resin-Base Caulking Compounds
- 16. ASTM D 2453 Standard Test Method for Shrinkage and Tenacity of Oil- and Resin Base Caulking Compounds
- 17. ASTM D 1475 Standard Test Method For Density of Liquid Coatings, Inks, and Related Products
- 18. ASTM D 2202 Standard Test Method for Slump of Sealants
- 19. ASTM D 2203 Standard Test Method for Staining from Sealants
- 20. ASTM G 154 Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

C. Interim Federal Specifications (FS)

- 1. FS TT-S-00230C - Sealing Compound: Elastomeric Type, Single Component
- 2. FS TT-C-1796A – Caulking Compounds, Metal Seam and Wood Seam
- 3. FS TT-S-001543A – Sealing Compounds: Silicone Rubber Base (For Caulking, Sealing, and Glazing in Buildings and Other Structures)

D. South Coast Air Quality Management District (SCAQMD)

- 1. Rule 1168 – Adhesive and Sealant Applications

E. Underwriter’s Laboratories

- 1. UL 580 - Tests for Uplift Resistance of Roof Assemblies

1.3 SUBMITTALS

- A. Material Safety Data Sheets (MSDS): Provide in accordance with 29 CFR 1910.1200,
- B. Hazard Communication
- C. Product Test Reports: Reports of tests required by this section performed by a qualified testing agency, indicating that the sealants comply with the requirements.
- D. VOC Content: Provide documentation of the Volatile Organic Content (VOC) in accordance with SCAQMD Rule 1168
- E. USDA Approval: Provide documentation that the product is approved for use in meat and poultry processing areas by the USDA for the following types of sealants:
 - 1. Polyurethane
 - 2. Tape Mastic
 - 3. Non-skinning Sealant

1.4 WARRANTY

- A. A. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within 5 years of installation.

PART 2 PRODUCTS

2.1 GENERAL MATERIAL REQUIREMENTS

- A. Substrate Requirements: When testing is required on a substrate, the material used shall be either ASTM A653 G-90 or ASTM A792 AZ50 and tests shall be conducted with each of the following coatings:
1. Bare (No coating)
 2. Acrylic (Galvalume Plus)
 3. Polyester
 4. Siliconized Polyester
 5. Polyvinylidene Fluoride Resin (PVDF)

2.2 POLYURETHANE SEALANT

- A. General: Provide Sealants that meet the following specifications:
1. ASTM C 920, Type S, Grade NS, Class 25, Use: NT, A, M, G and O paintable sealant
 2. AAMA 808.3
 3. FS TT-S-00230C, Type II, Class A
- B. Color: The sealant shall be selected by OWNER. :
- C. Physical Properties: The sealant shall have the following additional physical properties:
1. Peel Adhesion: All panels shall have at least a 90% cohesive failure of at least 15 lb/in when tested in accordance with ASTM C 794.
 2. Tensile Strength: Sealant shall have a tensile maximum of 300 psi and an elongation of 500-600% when tested in accordance with ASTM D 412.
 3. Sag: There shall be no sag when tested in accordance with ASTM C 639.
 4. Hardness: Shore "A" hardness on all three samples shall not exceed 40 when tested in accordance with ASTM C 661
 5. Service Temperature Range: -40 degrees Fahrenheit to 200 degrees Fahrenheit.
 6. Water Resistance: There shall be no presence of voids, cracks, separation or breakdown of the compound when tested in accordance with AAMA 800-10, Section 2.11.1.
 7. Flash Point: No less than 145 degrees Fahrenheit when tested in accordance with ASTM D 56.
 8. Shelf Life: The compound shall have a shelf life of 9 months or more when stored at or below 80 degrees.
 9. Skin Time: The compound shall have a skin time of 2-4 hours
 10. Cure Time: The compound shall have a cure time of 24-48 hours
 11. VOC Content: The Volatile Organic Compound (VOC) content shall be less than 250 g/L when calculated SCAQMD Rule 1168.

2.3 TAPE MASTIC SEALANT

- A. General: Provide Sealants that meet the following specifications:
1. AAMA 804.3

2. AAMA 807.3
3. FS TT-C-1796A, Type II, Class B
4. Approved by Underwriters Laboratories for use in roof deck constructions classified under UL-518 Class 90

B. Color: The sealant shall be selected by OWNER.

C. Physical Properties: The sealant shall have the following additional physical properties:

1. Specific Gravity: 1.4 or higher when tested in accordance with ASTM D 792
2. Tensile Adhesive Strength: 20 psi or higher when tested in accordance with ASTM C 908
3. Elongation: 1000% or higher when tested in accordance with ASTM C 908
4. Cone Penetration: The sealant shall meet the following conditions when tested in accordance with ASTM D 217 with a 300g cone in 5 seconds:
 - a. 8.5 – 100 mm at 77 degrees Fahrenheit
 - b. 125-135 mm at 120 degrees Fahrenheit
 - c. 45-55 mm at Zero degrees Fahrenheit
5. VOC Content: The Volatile Organic Compound (VOC) content shall be less than 250 g/L when calculated SCAQMD Rule 1168.

2.4 NON-SKINNING SEALANT

A. General: Provide sealants that meet the following specifications:

1. AAMA 809.2
2. FS TT-C-1796A, Type 1, Class A

B. Color: The sealant shall be selected by OWNER.

C. Physical Properties: The sealant shall have the following additional physical properties:

1. Extrudability: The sealant shall deposit in 30 to 50 seconds through a 0.104" orifice at 50 psi pressure in accordance with ASTM D 2452.
2. Total Solids: At least 85% by weight when determined in accordance with ASTM C 681.
3. Volume Shrinkage: Less than 15% when determined in accordance with ASTM D 2453.
4. Weight per U.S. Gallon: 10.75 lbs. +/- 0.25 lbs. when determined in accordance with ASTM D 1475.
5. Vehicle Bleed out: There shall be no visible exudation of vehicle from sealant after 21 days at 158 degrees Fahrenheit on the test panel.
6. Flexibility: There shall be no loss of adhesion at -60 degrees Fahrenheit when tested in accordance with ASTM C 711.
7. Sag: 0.20 in max, full button when tested in accordance with ASTM D 2202.
8. Staining: Sealant will not stain a painted test panel when tested in accordance with ASTM D 925, Method A.
9. UV Resistance: There shall be no cracking, bleeding, or loss of elasticity after 1,000 hours of QUV exposure in accordance with ASTM G 154.
10. Wet Flammability: No less than 110 degree Fahrenheit flash point when determined in accordance with ASTM D 56.
11. Coverage: Each gallon of sealant shall provide the following minimum coverage:

- a. 500 lineal feet with 1/8 in bead
 - b. 690 lineal feet with 3/16 in bead
 - c. 390 lineal feet with 1/4 in bead.
12. Shelf Life: 18 months minimum in unopened container when stored at or below 90 degrees Fahrenheit.
 13. Drying time: Non-skinning, remains permanently soft and tacky.
 14. Engageability: Sealant will easily engage and transfer to male joint at 10 degrees Fahrenheit.
 15. Service Temperature Range: -60 degrees Fahrenheit to 200 degrees Fahrenheit.
 16. Application Temperature Range: 10 degrees Fahrenheit to 120 degrees Fahrenheit.
 17. Non-Reactive: Will not darken, etch, or leave salt deposits on the test panel after two years.
 18. VOC Content: The Volatile Organic Compound (VOC) content shall be less than 250 g/L when calculated SCAQMD Rule 1168.

2.5 SILICONE SEALANT

A. General: Provide sealants that meet the following specifications:

1. ASTM C 920, Type S, Grade NS, Class 25
2. AAMA 802.3, Type I and II
3. AAMA 805.2 Group C
4. AAMA 808.3
5. FS TT-S-001543A, Class A
6. FS TT-S-00230C, Class A

B. Color: Clear

C. Physical Properties: The sealant shall have the following additional physical properties:

1. Mechanical Properties: The sealant shall have the following mechanical properties as determined by ASTM D 412:
 - a. Tensile Strength: 150 psi minimum (Method A)
 - b. Modulus at 100% Elongation: 35 psi minimum
 - c. Elongation: 400% minimum
 - d. Recovery: 100%
2. Hardness: Maximum Shore A hardness of 15 when determined in accordance with ASTM C 661.
3. Tack-free Time: 1/4 in dia. bead at 77 degrees Fahrenheit, 50% relative humidity, 10-15 minutes.
4. Cure Time: 1/4 in dia. bead at 77 degrees Fahrenheit, 50% relative humidity, 10-12 hours.
5. Service Temperature: -60 degrees Fahrenheit to 300 degrees Fahrenheit.
6. Shelf Life: 9 months when stored in unopened original containers at 80 degrees Fahrenheit or less.
7. VOC Content: The Volatile Organic Compound (VOC) content shall be less than 250 g/L when calculated SCAQMD Rule 1168.

2.6 ACRYLIC SEALANT

A. Color:

1. Clear
2. White
3. Gray

B. Physical Properties:

1. Percent Solids:
 - a. Colors: 75% minimum determined in accordance with ASTM D 1475
 - b. Clear: 70% minimum determined in accordance with ASTM D 1475
2. Peel Adhesion: All panels shall have at least a 90% cohesive failure of at least 5 lb./in when tested in accordance with ASTM C 794.
3. Weight per U.S. Gallon: 8.7 lbs. +/- 0.25 lbs. when determined in accordance with ASTM D 1475.
4. Viscosity: The sealant shall meet the following conditions when tested in accordance with ASTM D 2452 with a 20g cone with a 0.104 in orifice at 60 psi at 77 degrees Fahrenheit in the indicated time:
 - a. Colors: 40-60 seconds
 - b. Clear: 35-45 seconds
5. Elongation: 200% minimum when tested in accordance with ASTM D 412.
6. Hardness: Maximum Shore A hardness of 55 when determined in accordance with ASTM C 661.
7. Flash Point: No less than the following when tested in accordance with ASTM D 56
 - a. Colors: 52 degrees Fahrenheit
 - b. Clear: 40 degrees Fahrenheit
8. Slump: 0.10" maximum when tested in accordance with ASTM D 2202.
9. Vehicle Migration: No vehicle migration from the sealant edge when tested in accordance with ASTM D 2203 as modified by Section 2.8.1 of AAMA 800-10.
10. Paintability: Compatible with Alkyds, enamels and lacquers post-solvent release.
11. Service Temperature Range: Zero degrees Fahrenheit to 180 degrees Fahrenheit.
12. Shelf Life: 18 months when stored in original, unopened containers at or below 80 degrees Fahrenheit.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install joint sealants in accordance with manufacturer's specifications and requirements.

- END OF SECTION -

SECTION 08 10 00
DOORS AND FRAMES

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers all the work necessary to furnish and install the new doors, frames, and hardware, complete and operable.
- B. All doors and their pressed steel frames shall be steel, insulated, exterior, 1 3/4-inch doors of the dimensions in the drawings and along with the required windows and transoms.

1.2 RELATED WORK

- A. Related work in other sections includes but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 04 21 13 Hollow Load Bearing Brick Masonry
 - 3. Section 09 91 00 Painting and Finishes

1.3 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publications are referred to in the text by basic designation only.
- B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
 - 1. ANSI A 115.IG Installation Guide for Doors and Hardware
 - 2. ANSI A 156.6 Standard for Architectural Door Trim
 - 3. ANSI A 156.16 Standard for Auxiliary Hardware
 - 4. ANSI A 250.8 SDI-100 Recommended Specifications for Standard Steel Doors and Frames
 - 5. ANSI A 250.10 Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames
 - 6. ANSI A 250.11 Recommended Erection Instructions for Steel Frames
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM A 123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - 2. ASTM A 229 Standard Specification for Steel Wire, Quenched and Tempered for Mechanical Springs
 - 3. ASTM A 653 Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process
 - 4. ASTM A 1008 Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
 - 5. ASTM C 177 Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus

6. ASTM D 256 Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
7. ASTM D 635 Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
8. ASTM D 790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
9. ASTM D 792 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
10. ASTM D 882 Standard Test Method for Tensile Properties of Thin Plastic Sheeting
11. ASTM D 1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics
12. ASTM D 2583 Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
13. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
14. ASTM E 330 Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference

D. AMERICAN WELDING SOCIETY (AWS)

1. AWS D1.1 Structural Welding - Steel
2. AWS D1.3 Structural Welding Code – Sheet Steel

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Manufacturer's catalog data and preprinted installation instructions of doors.
- C. A schedule showing the location of each door shall be included with the drawings. Submittal drawings shall include elevations of each door type, details and method of anchorage, details of construction, method of assembling sections, location and installation of hardware, shape and thickness of materials, details of joints and connections.
- D. Manufacturer's certificates that certify products meet or exceed the specified requirements.
- E. Warranty: Provide documentation of the manufacturer's standard written one (1) year warranty.

1.5 DELIVERY AND STORAGE

- A. Doors shall be delivered to the job site wrapped in a protective covering with the brands and names clearly marked thereon. Doors shall be stored in a dry location that is adequately ventilated and free from dust or water, and in a manner that permits easy access for inspection and handling. Doors shall be handled carefully to prevent damage to the faces, edges, and ends. Damaged items that cannot be restored to like-new condition shall be replaced.

1.6 MEASUREMENT AND PAYMENT

- A. There shall be no separate measurement and payment for doors. Full compensation for all doors shall be considered as included in the contract unit or lump sum bid prices for the various items of the contract to which doors relate.

PART 2 PRODUCTS

2.1 STEEL DOORS

- A. Steel doors and frames shall be of hollow metal construction and shall be full flush design with no visible seams. Interior and Exterior door face sheets shall be hot-dip galvanized according to the requirements of ASTM A 653. Manufacturer's shall be **Republic Doors and Frames, Steelcraft, Ceco Door Products**, or approved equal. Doors shall conform to ANSI A 250.8 and to the following requirements:
 - 1. Hollow metal door, 1-3/4 inches thick flush type, constructed of two sheets of not less than stretcher leveled, 16-gauge steel sheets formed and welded for flush pan assembly, with internal 20-gauge vertical reinforcing channels spaced not over 8 inches on centers the full height of the door. There shall be no visible joints on the face of the doors. Reinforcing channels shall be uniformly spot welded to face plates at top and bottom of all doors. Filler channels shall be provided at the top and bottom of doors to provide a flush closure. The top of exterior doors shall be provided with flush, water- and weather-tight top enclosures.
 - 2. All interior void spaces shall be completely filled with EPS foam or polyurethane.
 - 3. Concealed sheet or bar steel reinforcement shall be provided for mortise type hardware. Reinforcing shall not be less than the following: 9-gauge for butts, 12-gauge for locksets and 14-gauge for surface applied hardware. Reinforcing shall be drilled and tapped to template requirements. Concealed reinforcing shall be provided for closures. Door bottom weather stripping shall be included to match thresholds.
 - 4. Door frames shall be pressed steel constructed of not less than 16-gauge steel and shall be of the shape indicated on the plans and as required to fit the various wall constructions. Frames shall be of welded unit construction assembled and welded in the shop. Welding shall be to a hairline joint with all exposed beads ground smooth.
 - 5. Concealed reinforcing of the frames for the mortise hardware shall be not less than the following: 3/16 inch for butts, 12-gauge for lock strike, 14-gauge for surface applied items and 18-gauge for plaster guards over mortised hardware reinforcement. Frames shall be mortised drilled and tapped to template requirements. Lock reinforcing units shall be supplied by finishing hardware supplier. Frames shall be anchored as shown in the Contract Drawings.
 - 6. Hinges shall be heavy duty ball bearing hinges with non-removable pins.
 - 7. Pull plates shall be chrome plated or stainless steel and mounted on interior and exterior sides of all doors.
 - 8. All double doors are to be supplied with a "Z" astragal of 14-gauge steel for 1-3/4-inch doors and 16-gauge for 1-3/8-inch doors.
 - 9. Hardware including locksets and hinges shall be stainless steel.
- B. Door Hardware (or approved equal):
 - 1. Trim material shall be stainless steel, unless noted otherwise.
 - 2. Pull Plates: 8" CTC pull, 4" x 16" plate, stainless steel, No. 110 x 70C by Rockwood Mfg. Co., or approved equal, conforming to ANSI A 156.6.

3. Hinges: satin stainless steel, 5 knuckles minimum, non-rising pin for interior doors and non-removable pin for exterior doors, number of hinges per door manufacturer's recommendation (minimum of 3 hinges per door). Where necessary to keep door leaf clear of walls, casings, jambs or reveals in door opening, wide throw hinges of an approved type shall be furnished. Finish shall be stainless steel satin (32D or 630). Manufacturer shall be Mckinney T4A3386, Hager, Stanley Works FBB199 (32D), or approved equal.
4. Cylinder Lock Set: Best Access Systems, Cylinder 1C-7E1 626. Pin cylinders to customer Code 2-1. Locks must be compatible with Owners existing keys Contractor shall verify that lock sets and keys will match Owner's requirements.
5. Lever Extension Flush Bolt, Upper, Rockwood No. 555, or approved equal, cadmium plated finish (inactive leaf only), conforming to ANSI A 156.16.
6. Lever Extension Flush Bolt, Lower, Rockwood No. 555, or approved equal, cadmium plated finish (inactive leaf only), conforming to ANSI A 156.16.
7. Threshold: #277AS by Pemko Corporation, or approved equal, raised interior, extruded aluminum threshold with neoprene seal.
8. Drip Cap: Provide drip cap on all exterior doors. Drip cap shall be clear anodized aluminum, Pemko 346C, or approved equal.
9. Door Closers: Door closers shall be full rack and pinion, cast iron, with adjustable regulators for closing and latching speed, back check and spring power. Closers shall be mounted for 180 degrees of swing whenever possible. All closers shall be LCN Model 4040XP with 4041-3071 DEL cylinder with extra duty hold open arm. Mounting plates shall be supplied as necessary. All door closers attached to mineral core or particle filled doors shall be installed with hex bolts. Cover shall be metal 4040XP-72MC with 689 Aluminum finish.
10. Lock Strikes: Strikes shall have extended curved lips where required to protect trim from being marred by latch bolt. Strike lips shall not protrude more than 1/8-inch beyond door frame trim. Wrought box strikes shall be furnished on all locks, latches and deadlocks.
11. Door Stop: Solid cast brass, DuraFlex bumper, Rockwood #445, or approved equal (Inactive leaf only)
12. Non-Mortise Door Edge with Astragal: 0.06" thick stainless steel, Rockwood HD306B-AST, or approved equal (double doors only)
13. Kick Plates: Unless otherwise indicated, kick plates shall be provided and shall be satin stainless 18-8, 18 gage, Rockwood No. K1050F, or approved equal.
14. Weatherstripping and Seals: silicone gasketing, Pemko S88D, or approved equal.
15. Frames and Transom Panels shall be manufactured similar to the insulated door panels. Rear Maintenance Entry frames shall be 7070 CD DBL A60 SU 16 KD 734/634 WMA RHRA. The frame between transom and door shall be removable to allow for a higher opening. They shall be 7'4"X10'4" CD SPCL with A60/SC SU 16 KD 734/634 WMA RHRA.
16. Windows where shown shall be 3/8-inch thick clear polycarbonate and shall be removable and replaceable.

2.2 ACCESS DOORS AND FRAMES MISCELLANEOUS

- A. Fabricate doors and frames as shown on the drawings and in accordance with best shop practices. Frames shall be rigid, neat in appearance and free from defects. Field measurements shall be taken as required for coordination with adjoining work.
- B. Form exposed surfaces free from warp, wave and buckle, with all corners square, unless

otherwise shown. Set each member in proper alignment and relationship to other members with all surfaces straight and in a true plane.

- C. Reinforce members and joints with plates, tubes or angles for rigidity and strength.
- D. Doors and frames shall be mortised and reinforced for hardware in accordance with the hardware manufacturer's instructions and templates. The reinforcement shall be designed to receive hinges, locks, strikes, closures, etc.
- E. Mortar guard boxes shall be provided for hardware cutouts in frames.
- F. Furnish at least three (3) metal anchors or polymer spacers in each jamb of frames up to 84" high and one (1) additional anchor for each 24" in height above 84", in shapes, sizes and spacing shown or required for anchorage into adjoining wall construction. Fabricate joint anchor of stainless steel.
- G. Terminate bottom of frames at the indicated finished floor level.
- H. Where glazing is required, flush integral stops on one side and screw-on stops on the opposite side shall be provided.

2.3 FINISH

- A. Surfaces shall be provided with a shop-primed galvanized finish. Prior to receiving primer, all surfaces shall be cleaned thoroughly and phosphate-treated to assure maximum paint adherence. Primer shall be a metallic oxide or synthetic resin primer of the manufacturer's standard type and shall be applied by dipping or spraying in accordance with ANSI A 250.10.
- B. Painting of doors and frames shall be in accordance with Section 09 91 00 – Painting and Finishes. Finish coat shall be compatible with the shop applied primer coating.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Doors shall be installed in accordance with approved detail drawings and manufacturer's instructions and in accordance with ANSI A 115IG. Anchors and inserts for guides, brackets, hardware, and other accessories shall be accurately located. Upon completion, doors shall be weather tight and shall be free from warp, twist, or distortion. Doors shall be lubricated, properly adjusted, and demonstrated to operate freely. Contractor shall provide temporary construction keying and replace it to match Owner keying at the end of the job.
- B. Access Door Frame Installation
 - 1. Place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged. Frame must not be drilled for brace supports as finish may be damaged. Install frames in accordance with ANSI A 250.11.
 - 2. Locate three (3) wall anchors per jamb at hinge and strike levels. Frames may be grouted full of mortar at jambs and anchors shall be built into the joints as walls are

laid up. A continuous bead of silicone sealant is to be applied between the head and jamb at the miter joint.

- C. Adjust doors for free swing without binding. Adjust hinge sets, locksets, and other hardware. Lubricate using a suitable lubricant compatible with the door and frame coatings.
- D. Install work of this Section in strict accordance with approved shop drawings and manufacturer's recommended installation instructions. Where installations require field welding, all work must be performed by certified welders in accordance with AWS D1.1/D1.3.
- E. Upon installation, secure the services of a qualified representative of the manufacturer to visit the jobsite and inspect the complete installation of the door and frame assemblies, test all components thru a minimum of ten (10) cycles of operation and direct installer in correcting any non-conforming items found.
- F. Remove temporary coverings. Repair or replace damaged installed products. Clean all installed products in accordance with the manufacturer's instructions before acceptance by Owner.
- G. Clearances at edge of doors:
 - 1. Between door and frame at head and jambs: 1/8 inch.
 - 2. At meeting edges pairs of doors and at mullions: 1/8 inch.
 - 3. At transom panels, without transom bars: 1/8 inch.
 - 4. At sills without thresholds: 5/8-inch maximum above finish floor.
 - 5. At sills with thresholds: 1/8-inch above threshold

- END OF SECTION -

SECTION 08 31 00
HATCHES

PART 1 GENERAL

1.1 SUMMARY

- A. This section covers all the work necessary to furnish and install hatches.

1.2

1.3 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract:
 - B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. A 36-93a Standard Specification for Structural Steel
 - 2. A 123 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - 3. A 229 Steel Wire, Oil-Tempered for Mechanical Springs
 - 4. A 366 Cold Rolled Steel
 - 5. A 525 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

1.4 PERFORMANCE REQUIREMENTS

- A. Hatches shall be reinforced to support a minimum live load of 40 psf with a maximum deflection of 1/150th of the span or 20 psf wind uplift.
- B. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
- C. Operation of the cover shall not be affected by temperature.
- D. Entire hatch shall be weather tight with fully welded corner joints on cover and curb.

1.5 SUBMITTALS

- A. Manufacturer's catalog data and preprinted installation instructions of hatches.
- B. A schedule showing the location of each hatch shall be included with the drawings. Submittal drawings shall include details and method of anchorage, details of construction, method of assembling sections, location and installation of hardware, shape and thickness of materials, details of joints and connections.

1.6 DELIVERY AND STORAGE

- A. Hatches shall be delivered to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon.

1.7 WARRANTY

- A. Manufacturer shall provide to the Owner written guarantee against defects in material or workmanship for a period of five (5) years.

PART 2 PRODUCTS

2.1 ROOF HATCHES

- A. Hatches shall be provided in sizes and locations as noted on the drawings as follows:
 - 1. Surge Tank Vault: Insulated single leaf Bilco Type E SS Roof Hatch Curb Option – Fully Enclosed with Apron or equal.
- B. Roof hatches shall be preassembled from the manufacturer. Submit manufacturer's product data and shop drawings including profiles, accessories, location, adjacent construction interface, and dimensions.
- C. Covers shall be 14-gauge, type 304 stainless steel, for hatches up to 36"x36" and 11-gauge type 304 stainless steel for larger hatches. Covers shall have a heavy duty extruded EPDM rubber gasket that is bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb. Cover insulation shall be fiberglass 1" thickness, fully covered and protected by a stainless-steel metal liner.
- D. Curbs shall be 12-inch in height and minimum 14-gauge type 304 stainless steel for hatches up to 36"x36" and 11-gauge, type 304 stainless steel, for larger hatches. Curbs shall be supplied without cap flashing and shall be fully welded at the corners with mounting flange (or apron) as specified. Curb insulation shall be fiberboard 1-inch thickness, fully covered and protected by a stainless-steel metal liner.
- E. Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. Covers shall automatically lock in the open position with a rigid hold open arm equipped with a 1-inch diameter red vinyl grip handle to permit easy release for closing. All hardware shall be type 316 stainless steel. Each hatch shall be provided with a permanent label showing the manufacturer's name and address and the model number.
- F. Covers shall be equipped with an exterior concealed padlock hasp with a 3-sided padlock hasp cover and lifting handles. Padlock hasp shall be positioned so as not to interfere with exterior access ladder.
- G. Provide hatch position switch for all hatches, 120v.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Hatches shall be installed in accordance with approved detail drawings and manufacturer's instructions. Anchors and inserts for guides, brackets, hardware, and other accessories shall be accurately located. Upon completion, hatches shall be weather tight and shall be free from warp, twist, or distortion. Hatches shall be lubricated, properly adjusted, and demonstrated to operate freely.

- END OF SECTION -

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SECTION 09 20 00
GYP SUM BOARD

PART 1 GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall provide gypsum board and appurtenances, complete and in place, as shown on the Contract Drawings and in accordance with the specifications.

1.2 RELATED WORK

- A. Related Work in other sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 01 60 00 Product Requirements
3. Section 09 90 00 Painting and Finishes

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

- B. American Society for Testing and Materials (ASTM)

1. ASTM C 473 Standard Test Methods for Physical Testing of Gypsum Panel Products
2. ASTM C 475 Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board
3. ASTM C 754 Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
4. ASTM C 840 Standard Specification for Application and Finishing of Gypsum Board
5. ASTM C 919 Standard Practice for Use of Sealants in Acoustical Applications
6. ASTM C 920 Standard Specification for Elastomeric Joint Sealants
7. ASTM C 1002 Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
8. ASTM C 1177 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
9. ASTM C 1178 Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel
10. ASTM C 1280 Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing
11. ASTM C 1325 Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units
12. ASTM C 1396 Standard Specification for Gypsum Board
13. ASTM C 1629 Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels
14. ASTM C 1658 Standard Specification for Glass Mat Gypsum Panels
15. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

- 16. ASTM E 72 Standard Test Methods of Conducting Strength Tests of Panels for Building Construction
- 17. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
- 18. ASTM E 90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
- 19. ASTM E 96 Standard Test Methods for Water Vapor Transmission of Materials
- 20. ASTM E 119 Standard Test Methods for Fire Tests of Building Construction and Materials
- 21. ASTM E 136 Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C
- 22. ASTM E 814 Standard Test Method for Fire Tests of Penetration Firestop Systems
- 23. ASTM G 21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

C. American National Standards Institute (ANSI)

- 1. ANSI A 108.11 Specifications for Interior Installations of Cementitious Backer Units
- 2. ANSI A 118.9 Test Methods and Specifications for Cementitious Backer Units

D. Gypsum Association (GA)

- 1. GA-214 Recommended Levels of Finish – Gypsum Board, Glass Mat & Fiber-Reinforced Gypsum Panels
- 2. GA-216 Application Finishing Gypsum Panel Products
- 3. GA-234 Control Joints for Fire-Resistance Rated Systems
- 4. GA-253 Application of Gypsum Sheathing
- 5. GA-600 Fire Resistance Design Manual

E. Wall and Ceiling Bureau (WCB)

- 1. TB-52010 Control Joints for Gypsum Board

1.4 SUBMITTALS

- A. CONTRACTOR shall submit documents per the requirements of Section 01 33 00 Submittal Procedures.
- B. Submit manufacturer’s literature, product data sheets, and installation instructions for plaster and gypsum products and appurtenances to be used in the Work.

1.5 DELIVERY AND STORAGE

- A. Delivery, storage, and handling of gypsum products shall be in accordance with Section 01 60 00 – Product Requirements, the manufacturer’s printed instructions, and as indicated below.
- B. Manufactured materials shall be delivered in original unbroken packages, containers, or bundles, bearing the manufacturer’s label.

- C. Verify products undamaged before acceptance at the Project Site. Do not use products with visible signs of mold and damage.
- D. Storage
 - 1. Store the materials in an area that is protected from the elements as recommended by the manufacturer.
 - 2. Storage shall be in a manner that will prevent damage to the material and its finish.
 - 3. Materials shall be stored above ground in a dry and ventilated space,
 - 4. Boards that will be directly applied to masonry walls shall be stored at 70 degrees F for 24 hours prior to installation.

1.6 PROJECT CONDITIONS

- A. Do not install gypsum board when the ambient temperature is below 40 degrees F.

PART 2 PRODUCTS

2.1 MANUFACTURERS OR APPROVED EQUAL:

- A. National Gypsum Company
- B. United States Gypsum Company (USG Corporation)
- C. Georgia Pacific Corporation
- D. Certainteed (a Saint-Gobain Company)

2.2 FIRE-RESISTANCE RATED GYPSUM BOARD WITH ENHANCED MOLD AND MILDEW RESISTANCE

- A. Type C, Panel Physical Characteristics
 - 1. Core: Mold and moisture resistant gypsum core with enhanced fire-resistance (Type C)
 - 2. Surface Paper: 100 percent recycled content moisture/mold/mildew resistant paper on front, back, and long edges
 - 3. Long Edges: Tapered
 - 4. Overall Thickness: 5/8 inch
 - 5. Panel complies with Type X requirements of ASTM C 1396
 - 6. Mold/Mildew Resistance: 10 when tested in accordance with ASTM D 3273

2.3 ACCESSORY PRODUCTS

- A. Acoustical Sealant
 - 1. Conform to ASTM C 919
 - 2. VOC content less than 15 g/L
 - 3. Manufacturer, or approved equal:
 - a. Grabber Acoustical Sealant GSCS
 - b. USG Acoustical Sealant
 - c. STI SpecSeal Smoke N Sound Caulk
 - d. BOSS 824 Acoustical Sound Sealant

B. Firestopping

1. Conform to ASTM E 90
2. Manufacturer, or approved equal:
 - a. STI SpecSeal SSP Putty Pads
 - b. USG Firecode Smoke-Sound Sealant
 - c. 3M Fire Barrier Moldable Putty Pads MPP+
 - d. BOSS 818 Fire Rated Putty Pads

C. Metal trim, corner beads, edge, casing beads, and accessories shall be manufactured from galvanized sheet steel unless noted otherwise.

2.4 FASTENERS

A. General: Fastener screws shall be of the self-drilling, self-tapping, bugle head type for use with power tools, with a length as recommended by the Gypsum Association referenced standards and in accordance with the local Building Code.

1. Types:
 - a. Type "S" for board-to-sheet metal application
 - b. Type "W" for board-to-wood application
 - c. Type "G" for board-to-board application
 - d. Type "S" or "S-12", for tile backing board-to-metal studs application

2.5 TAPE

A. General: Joint reinforcing tape shall conform to ASTM C 475 and ASTM C 840.

B. Tape:

1. Paper Tape: 2- 1/16 inches wide, **ProForm Joint Tape – Heavy, USG Heavy Joint Tape, CertainTeed Marco Spark-Perf 94# Heavy Weight**, or approved equal.
2. Fiberglass Mesh Tape: Nominal 2-inch-wide self-adhering tape, **ProForm Fiberglass Mesh Tape, FibaTape Drywall Joint Tape**, or approved equal.
3. Cement Board Tape: Alkali-resistant fiberglass tape, 2-inch-wide polymer-coated for interior applications and 4-inch wide polymer coated for exterior applications, **PermaBase Cement Board Tape, FibaTape Cement Board Tape, USG Durock Cement Board Tape**, or approved equal.

2.6 JOINT COMPOUND

A. General: Joint compound shall conform to ASTM C 475.

B. Drying Type Compound:

1. Ready Mix vinyl base compound, **ProForm All Purpose Ready Mix Joint Compound, USG All Purpose Joint Compound - Select, CertainTeed All Purpose**, or approved equal.
2. Ready Mix vinyl base compound formulated for enhanced mold and mildew resistance, **ProForm XP Ready Mix Joint Compound, CertainTeed Mold Resistant Lite All-Purpose**, or approved equal, conforms to ASTM D 3273

3. Ready Mix vinyl base topping compound for finish coating, **ProForm Topping Compound, CertainTeed Topping, USG Topping Joint Compound**, or approved equal
4. Ready Mix vinyl base compound for embedding joint tape, cornerbeads or other accessories, **ProForm Taping Joint Compound, CertainTeed Heavy Taping Joint Compound, USG Ready-Mixed Taping Joint Compound**, or approved equal.
5. Field Mix vinyl base compound, **ProForm Triple-T Compound**, or approved equal.

C. Setting Compound:

1. Field mixed hardening compound, **ProForm Quick Set Setting Compound, USG Durabond Setting-Type Compound**, or approved equal.
2. Field mixed hardening compound for fire resistance rated construction and penetrations, **ProForm Fire Shield 90, USG Firecode Compound**, or approved equal, conforms to ASTM E 136 and ASTM E 814.
3. Field mixed hardening compound for mold and moisture resistance, **CertainTeed M2Tech 90 Setting Compound**, or approved equal.

D. Joint Sealant

1. Joint sealants shall conform to ASTM C 920
2. Joint sealants shall have VOC content less than 2 g/L

2.7 ACCESS PANELS

- A. Provide access panels where indicated or where required for access to valves and equipment
- B. Standard access panels: flush installation type, grey powder coated steel, double-acting concealed spring hinges, screw type lock, **Milcor Type DW, KARP Model KDW**, or approved equal.
- C. Acoustical access panel: recessed panel, with screw type lock, **Milcor Type AP**, or approved equal.
- D. Fire rated access panel: UL listed, self-closing, self-latching, **Milcor Type UFR**, or approved equal.

PART 3 EXECUTION

3.1 GENERAL

- A. Provide gypsum board over framing and furring members.
- B. Gypsum board installation and fire-rated gypsum board construction shall conform to applicable codes, reference standards, manufacturer's printed recommendations, the Gypsum Association's recommendations, and the following requirements:
 1. Gypsum board shall be applied first to the ceiling and then to the walls.
 2. Fastening
 - a. Gypsum board shall be screwed to metal framing and furring.
 - b. The fastener spacing shall be in accordance with the referenced standards.
 - c. Do not attach gypsum board to metal roof decking.

3. The gypsum wall board surface finish shall be as indicated below.
4. The installation of the steel framing shall be in accordance with ASTM C 754 and code requirements.

3.2 EXAMINATION

- A. Verify installation conditions are satisfactory to receive work of this Section before beginning.
- B. Verify framing systems, including backing, insulation, vapor barriers, and other systems ready for the work of this Section.
- C. Do not begin work until the building envelope is fully enclosed and temperature, ventilation, and humidity are controlled.
- D. Do not begin work under conditions that gypsum board installation may be exposed to contact with water.

3.3 PREPARATION

- A. Protect surrounding areas and surfaces to preclude damage.
- B. Avoid soiling, spattering, and damage to work of other trades. Use cover cloths, or other means of protection. Remove, clean, and repair soiled or damaged work.

3.4 INSTALLATION

- A. Conform to ASTM C 840, GA-216, and manufacturer's instructions.
- B. Corner Trim: Reinforce external corners with specified corner beads.
- C. Edge Trim: Install square edged metal trim bead at exposed edges and boundaries of areas where abutting dissimilar materials.
- D. Reveal Trim:
 1. Install with screws at 12 inches on center in 10 foot lengths, except where shorter lengths are sufficient for dimension of wall plane.
 2. Make butt joints tight and in alignment.
 3. Miter corners.
 4. Promptly remove excess joint compound.
- E. Control Joints: Conform to WCB TB-52010 and GA-234, except as otherwise indicated. Verify that required double framing is in place before installing control joints.
 1. Door and Other Openings: Install control joints at each side of wall opening and at both sides of wall, except alcoves and similar wall configurations.
 2. Continuous Wall Planes: Install control joints floor to ceiling at each 30 lineal foot of wall.
 3. Ceilings: Install across ceiling at each 50 lineal foot distance and each 2,500 square foot of ceiling area.

4. Joints with Other Materials: Install where gypsum board meets masonry, concrete, and other materials, except where joints are concealed under horizontal chair rails or other trim.
- F. Other Trim: Install as indicated or required for complete and finished installation.
- G. Panel Joints:
1. Layout: Design to reduce joints to minimum.
 2. Install board in maximum lengths to minimize horizontal and vertical joints.
 3. Start installation of panels at exterior wall to position butt joints as far away from exterior wall as possible.
 4. Place edges in contact and fit neatly, without forcing into place.
 5. Stagger joints on opposite sides of partitions and on same side of wall surface at adjacent joints.
 6. Maintain 1/2 inch clearance from bottom of wall panel and top of floor. Seal with acoustical sealant.
 7. To prevent wicking of moisture, do not let gypsum board rest on floor after installation.
- H. Single Layer Systems: Install in accordance with ASTM C840. Where modified, amended, or required by fire resistive or sound isolation system, conform to the requirements of the manufacturer's tests, as approved.
- I. Double Layer Systems: Install in accordance with ASTM C840, including System VIII for double layer gypsum wallboard installations applied with screws. Conform to required fire resistance standards.
- J. Moisture and Mold Resistant Gypsum Board: Install at restrooms, kitchen, janitorial closets, and areas where moisture is present. Do not install as backer board for ceramic tile.
- K. Ceramic Tile Backerboard: Install per manufacturer's recommendations. Moisture resistant (green board) gypsum board not accepted as backer for ceramic tile.
- L. Joint Sealant and Acoustical Sealant: Install to completely fill void between wallboard edges and adjacent surface.
- M. Firestopping and Smoke Sealants: Install in accordance with manufacturer's recommendations.
- N. Plumbing, HVAC, and Electrical: Coordinate work with other Divisions. Provide for installations and penetrations of ductwork, equipment, receptacles, and other work.

3.5 TOLERANCES

- A. Shim panels as necessary to conform to tolerances.
- B. Between Board Faces: 1/16 inch offset.

3.6 ADJUSTING

- A. Remove and replace the following gypsum board installations:

1. Board in contact with water for over 18-hour time period
2. Gypsum core exhibiting dampness or water intrusion
3. Facing paper exhibiting delamination
4. Facing of core exhibiting mold growth or turning black
5. Board sagging or warped
6. Board directly exposed to water determined to be contaminated

3.7 CLEANING

- A. Clean beads, screeds, metal base, metal trim, mechanical and electrical items, and other work.
- B. Wipe clean, leaving work ready for finish specified under other Sections.
- C. As work is completed in each space, clean all rubbish, utensils, and surplus materials from the space. Leave floors broom clean.

3.8 SURFACE FINISH

- A. Gypsum board joints shall be taped, and joints, end trim, corner beads, fasteners, and other depressions shall be treated with joint and finishing compounds, applied in accordance with the manufacturer's printed recommendations for Level 4 Finish (3-coat work) according to ASTM C 840 and the table below.
- B. The gypsum board shall be sanded smooth, dusted, and provided with a smooth finish coat.

3.9 PAINTING

- A. The surface shall be painted in accordance with Section 09 91 00 Painting and Finishes.

LEVEL OF FINISH	
Finish Level	Description
Level 0	No taping, finishing or corner beads are required.
Level 1	All joints and interior angles shall have tape embedded in joint compound. Surface shall be free of excess joint compound. Tool marks and ridges shall be acceptable.
Level 2 (1-coat work)	All joints and interior angles shall have tape embedded in joint compound and shall be immediately wiped with a joint knife or trowel leaving a thin coating of joint compound over all joints and interior angles. Fastener heads and accessories shall be covered with a coat of joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable. Joint compound applied over the body of the tape at the time of tape embedment shall be considered a separate coat of joint compound and shall satisfy the conditions of this level.
Level 3 (2-coat work)	All joints and interior angles shall have tape embedded in joint compound and shall be immediately wiped with a joint knife or trowel leaving a thin coating of joint compound over all joints and interior angles. One additional coat of joint compound shall be applied over all joints and interior angles. Fastener heads and accessories shall be covered with two separate coats of joint compound. All joint

	compounds shall be smooth and free of tool marks and ridges. The prepared surface shall be covered with a drywall primer prior to the application of the final decoration.
Level 4 (3-coat work)	All joints and interior angles shall have tape embedded in joint compound and shall be immediately wiped with a joint knife or trowel leaving a thin coating of joint compound over all joints and interior angles. Two separate coats of joint compound shall be applied over all flat joints. One separate coat of joint compound shall be applied over interior angles. Fastener heads and accessories shall be covered with three separate coats of joint compound. All joint compounds shall be smooth and free of tool marks and ridges. The prepared surface shall be covered with a drywall primer prior to the application of the final decoration.
Level 5 (3-coat work)	All joints and interior angles shall have tape embedded in joint compound and shall be immediately wiped with a joint knife or trowel leaving a thin coating of joint compound over all joints and interior angles. Two separate coats of joint compound shall be applied over all flat joints. One separate coat of joint compound shall be applied over interior angles. Fastener heads and accessories shall be covered with three separate coats of joint compound. A thin skim coat of joint compound shall be trowel-applied to the entire surface. Excess compound is immediately sheared off, leaving a film of skim coating compound completely covering the paper. As an alternate to a skim coat, a material manufactured especially for this purpose shall be applied. The surface shall be smooth and free of toll marks and ridges.

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SECTION 09 25 00
STUCCO – EXTERIOR INSULATION AND FINISH SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. This document is to be used in preparing specifications for projects utilizing the Dryvit Outsulation System. For complete product description and usage refer to:
1. Dryvit Outsulation System Data Sheet, DS447.
 2. Dryvit Outsulation System Application Instructions, DS204.
 3. Dryvit Outsulation System Installation Details, DS107.

1.2 MEASUREMENT AND PAYMENT

- A. Stucco – Exterior Insulation and Finish System shall not be measured or paid as a separate item, but shall be included as part of the various items to which it relates.

1.3 RELATED WORK

- A. Related work in other Sections includes but is not limited to:
1. Section 01 33 00 Submittal Procedures
 2. Section 04 22 00 Reinforced Unit Masonry
 3. Section 03 30 00 Cast-in-Place Concrete

1.4 REFERENCES

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS
1. ASTM B 117 (Federal Test Standard 141A Method 6061) Standard Practice for Operating Salt Spray (Fog) Apparatus
 2. ASTM C 150 Standard Specification for Portland Cement
 3. ASTM C 297 Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions
 4. ASTM C 1177 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
 5. ASTM C 1396 (formerly C 79) Standard Specification for Gypsum Board
 6. ASTM D 968 (Federal Test Standard 141A Method 6191) Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
 7. ASTM D 2247 (Federal Test Standard 141A Method 6201) Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
 8. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
 9. ASTM D 4060 Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
 10. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials

11. ASTM E 96 Standard Test Methods for Water Vapor Transmission of Materials
12. ASTM E 119 Standard Method for Fire Tests of Building Construction and Materials
13. ASTM E 330 Test Method for Structural Performance of Exterior Windows, Doors and Curtain Walls by Uniform Static Air Pressure Difference
14. ASTM E 331 Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference.
15. ASTM E 2098 Test Method for Determining the Tensile Breaking Strength of Glass Fiber Reinforcing Mesh for use in Class PB Exterior Insulation and Finish Systems (EIFS), after Exposure to Sodium Hydroxide Solution
16. ASTM E 2134 Test Method for Evaluating the Tensile-Adhesion Performance of Exterior Insulation and Finish Systems (EIFS)
17. ASTM E 2430 Standard Specification for Expanded Polystyrene (EPS) Thermal Insulation Boards for use in Exterior Insulation and Finish System (EIFS)
18. ASTM E 2485 (formerly EIMA Std. 101.01) Standard Test Method for Freeze-Thaw Resistance of Exterior Insulation and Finish Systems (EIFS) and Water-Resistive Barrier Coatings
19. ASTM E 2486 (formerly EIMA Std. 101.86) Standard Test Method for Impact Resistance of Class PB and PI Exterior Insulation and Finish Systems (EIFS)
20. ASTM G 155 (Federal Test Standard 141A Method 6151) Standard Practice for Operating-Xenon Arc Light Apparatus, for Exposure of Nonmetallic Materials

C. DRYVIT SYSTEM STANDARDS

1. DS107 Dryvit Outsulation System Installation Details
2. DS131 Dryvit Expanded Polystyrene Insulation Board Specification
3. DS135 Specification for Outsulation System with Mechanical Fasteners
4. DS151 Custom Brick™ Polymer System Specifications for Use on Vertical Walls
5. DS152 Dryvit Cleaning and Recoating
6. DS153 Dryvit Expansion Joints and Sealants
7. DS159 Dryvit Water Vapor Transmission
8. DS204 Dryvit Outsulation System Application Instructions
9. DS456 Rapidry DM™ 35-50 or DS457, Rapidry DM™ 50-75 Data Sheets
10. DS494 Dryvit AquaFlash™ System

D. MILITARY STANDARD

1. E 5272 Environmental Testing
2. 810B Environmental Test Methods

E. UNIFORM BUILDING CODE

1. 26-4 (Formerly UBC 17-6) Multi-Story Fire Evaluation of Exterior Non Load-Bearing Foam Plastic Insulated Wall Systems

- F. NFPA 268 Standard Test Method for Determining Ignitibility of Exterior Wall Assemblies Using a Radiant Heat Energy Source.

- G. NFPA 285 Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Non Load-Bearing Wall Assemblies Containing Combustible Components Using the Intermediate-Scale, Multistory Test Apparatus
- H. ULC S101 Standard Methods of Fire Endurance Tests of Building Construction Materials
- I. ANSI FM 4880 Evaluating Insulated Wall or Wall and Roof/Ceiling Assemblies; Plastic Interior Finish Materials; Plastic Exterior Building Panels; Wall/Ceiling Coating Systems; Interior or Exterior Finish Systems

1.5 DEFINITIONS

- A. Base Coat: Material used to encapsulate one or more layers of reinforcing mesh fully embedded that is applied to the outside surface of the EPS.
- B. Building Expansion Joint: A joint through the entire building structure designed to accommodate structural movement.
- C. Contractor: The contractor that installs the Outsulation System to the substrate.
- D. Dryvit: Dryvit Systems, Inc., the manufacturer of the Outsulation System, a Rhode Island corporation.
- E. Expansion Joint: A structural discontinuity in the Outsulation System.
- F. Finish: An acrylic-based coating, available in a variety of textures and colors that is applied over the base coat.
- G. Insulation Board: Expanded polystyrene (EPS) insulation board, which is affixed to the substrate.
- H. Panel Erector: The contractor who installs the panelized Outsulation System.
- I. Panel Fabricator: The contractor who fabricates the panelized Outsulation System.
- J. Reinforcing Mesh: Glass fiber mesh(es) used to reinforce the base coat and to provide impact resistance.
- K. Sheathing: A substrate in sheet form.
- L. Substrate: The material to which the Outsulation System is affixed.
- M. Substrate System: The total wall assembly including the attached substrate to which the Outsulation System is affixed.

1.6 SYSTEM DESCRIPTIONS

- A. General: The Dryvit Outsulation System is an Exterior Insulation and Finish System, Class PB, consisting of an adhesive, expanded polystyrene insulation board, base coat, reinforcing mesh(es) and finish. Mechanically attached systems shall conform to Dryvit specification DS135.
- B. Methods of Installation
- C. Field Applied: The Outsulation System is applied to the substrate system in place.
- D. Panelized: The Outsulation System is shop-applied to the prefabricated wall panels.
- E. Design Requirements

- F. Acceptable substrates for the Outsulation System shall be:
1. Exterior grade gypsum sheathing meeting ASTM C 1396 (formerly C 79) requirements for water-resistant core or Type X core at the time of application of the Outsulation System.
 2. Exterior sheathing having a water-resistant core with fiberglass mat facers meeting ASTM C 1177.
 3. Exterior fiber reinforced cement or calcium silicate boards.
 4. APA Exterior or Exposure 1 Rated Plywood, Grade C-D or better, nominal 12.7 mm (1/2 in), minimum 4-ply.
 5. Unglazed brick, cement plaster, concrete, or masonry.
 6. APA Exposure 1 rated Oriented Strand Board (OSB), nominal 12.7 mm (1/2 in).
 7. Galvanized expanded metal lath 1.4 or 1.8 kg/m² (2.5 or 3.4 lbs/yd²) installed over a solid substrate.
- G. Deflection of substrate systems shall not exceed 1/240 times the span.
- H. The substrate shall be flat within 6.4 mm (1/4 in) in a 1.2 m (4 ft) radius.
- I. The slope of inclined surfaces shall not be less than 6:12, and the length shall not exceed 305 mm (12 in).
- J. All areas requiring an impact resistance classification higher than "standard", as defined by ASTM E 2486 (formerly EIMA Std. 101.86), shall be as detailed in the drawings and described in the contract documents. Refer to Section 1.04.D.1.c of this specification.
- K. Expansion Joints
1. Design and location of expansion joints in the Outsulation System is the responsibility of the project designer and shall be noted on the project drawings. As a minimum, expansion joints shall be placed at the following locations:
 - a. Where expansion joints occur in the substrate system.
 - b. Where building expansion joints occur.
 - c. At floor lines in wood frame construction.
 - d. At floor lines of non-wood framed buildings where significant movement is expected.
 - e. Where the Outsulation System abuts dissimilar materials.
 - f. Where the substrate type changes
 - g. Where prefabricated panels abut one another
 - h. In continuous elevations at intervals not exceeding 23 m (75 ft).
 - i. Where significant structural movement occurs such as changes in roofline, building shape or structural system.
- L. Terminations
1. Prior to applying the Dryvit Outsulation System, wall openings shall be treated with Dryvit AquaFlash System or Flashing Tape. Refer to Dryvit Outsulation System Installation Details, DS107.
 2. The Outsulation System shall be held back from adjoining materials around openings and penetrations such as windows, doors and mechanical equipment a minimum of 19 mm (3/4 in) for sealant application. See Dryvit's Outsulation System Installation Details, DS107.
 3. The system shall be terminated at a minimum of 203 mm (8 in) above finished grade.
 4. Sealants
 - a. Shall be manufactured and supplied by others.

- 1) Shall be compatible with Outsulation System materials. Refer to current Dryvit Publication DS153 for listing of sealants tested by sealant manufacturer for compatibility.
 - 2) The sealant backer rod shall be of closed cell.
- M. Vapor Retarders – The use and location of vapor retarders within a wall assembly shall comply with local building code requirements. Vapor retarders may be inappropriate in certain climates and can result in condensation within the wall assembly. Refer to Dryvit Publication DS159 for additional information.
- N. Dark Colors - The use of dark colors must be considered in relation to wall surface temperature as a function of local climatic conditions. Use of dark colors in high temperature climates can affect the performance of the system.
- O. Flashing: Shall be provided at all roof-wall intersections, windows, doors, chimneys, decks, balconies and other areas as necessary to prevent water from entering behind the Outsulation System.
- P. Performance Requirements
1. The Outsulation System shall have been tested as follows:
 - a. Durability

TEST	TEST METHOD	CRITERIA	RESULTS
Abrasion Resistance	ASTM D 968	No deleterious effects after 500 liters (528 quarts)	No deleterious effects after 1000 liters (1056 quarts)
Accelerated Weathering	ASTM G 155 Cycle 1	No deleterious effects after 2000 hours	No deleterious effects after 5000 hours
	ASTM G 154 Cycle 1 (QUV)		No deleterious effects after 5000 hours
Freeze-Thaw	ASTM E 2485 (formerly EIMA 101.01)	No deleterious effects after 60 cycles	Passed - No deleterious effects after 90 cycles
	ASTM C 67 modified	No deleterious effects after 60 cycles	Passed - No deleterious effects after 60 cycles
	ASTM E 2485/ICC-ES Proc.; ICC ES (AC219)***	No deleterious effects after 10 cycles	Passed - No deleterious effects after 10 cycles
Mildew Resistance	ASTM D 3273	No growth during 28 day exposure period	No growth during 60 day exposure period
Water Resistance	ASTM D 2247	No deleterious effects after 14 days exposure	No deleterious effects after 42 days exposure
Taber Abrasion	ASTM D 4060	N/A	Passed 1000 cycles
Salt Spray Resistance	ASTM B 117	No deleterious effects after 300 hours exposure	No deleterious effects after 1000 hours exposure
Water Penetration	ASTM E 331 ICC ES (AC 219)***	No water penetration beyond the inner-most plane of the wall after	Passed 2 hours at 299 Pa (6.24 psf)

		2 hours at 299 Pa (6.24 psf)	
Water Vapor Transmission	ASTM E 96 Procedure B	Vapor permeable	EPS 5 perm-inch Base Coat* 40 Perms Finish** 40 Perms
<p>* Base Coat perm value based on Dryvit Genesis® ** Finish perm value based on Dryvit Quarzputz *** AC 219 – Acceptance Criteria for EIFS</p>			
TEST	TEST METHOD	CRITERIA	RESULTS
Tensile Bond	ASTM C 297/E 2134	Minimum 104 kPa (15 psi) – substrate or insulation failure	Minimum 132 kPa (19.1 psi)
Transverse Wind Load	ASTM E 330	Withstand positive and negative wind loads as specified by the building code	Minimum 4.3 kPa (90 psf)* 16 inch o.c. framing, ½ in sheathing screw attached at 203 mm (8 inch) o.c.
* All Dryvit components remain intact – for higher wind loads contact Dryvit Systems, Inc.			

b. Impact Resistance: In accordance with ASTM E 2486 (formerly EIMA Standard 101.86).

Reinforcing Mesh/Weight g/m ² (oz/yd ²)	Minimum Tensile Strengths	EIMA Impact Classification	EIMA Impact Range Joules (in-lbs)		Impact Results Joules (in-lbs)		Test
Standard - 146 (4.3)	27 g/cm (150 lbs/in)	Standard	3-6	(25-49)	4	(36)	
Standard Plus™ - 203 (6)	36 g/cm (200 lbs/in)	Medium	6-10	(50-89)	6	(56)	
Intermediate® - 407 (12)	54 g/cm (300 lbs/in)	High	10-17	(90-150)	12	(108)	
Panzer® 15 * - 509 (15)	71 g/cm (400 lbs/in)	Ultra High	>17	(>150)	18	(162)	
Panzer 20 * - 695 (20.5)	98 g/cm (550 lbs/in)	Ultra High	>17	(>150)	40	(352)	
Detail® Short Rolls - 146 (4.3)	27 g/cm (150 lbs/in)	n/a	n/a	n/a	n/a	n/a	n/a
Corner Mesh™ - 244 (7.2)	49 g/cm (274 lbs/in)	n/a	n/a	n/a	n/a	n/a	n/a

*Shall be used in conjunction with Standard Mesh (recommended for areas exposed to high traffic)

c. Fire performance

TEST	TEST METHOD	CRITERIA	RESULTS
Fire Resistance	ASTM E 119	No effect on the fire resistance of a rated wall assembly	Passed 1 hour Passed 2 hour
Ignitability	NFPA 268	No ignition at 12.5 kw/m ² at 20 minutes	Passed
Full Scale Multi-	UBC Std. 26-4 (formerly	1. Resist vertical spread of	Passed

TEST	TEST METHOD	CRITERIA	RESULTS
Story Fire Test	17-6)	flame within the core of the panel from one story to the next 2. Resist flame propagation over the exterior surface 3. Resist spread of vertical flame over the interior surface from one story to the next 4. Resist significant lateral spread of flame from the compartment of fire origin to adjacent spaces	
Intermediate Multi-Story Fire Test	NFPA 285 (UBC 26-9)	1. Resist flame propagation over the exterior surface 2. Resist vertical spread of flame within combustible core/ component of panel from one story to the next 3. Resist vertical spread of flame over the interior surface from one story to the next 4. Resist lateral spread of flame from the compartment of fire origin to adjacent spaces	Passed
Full Scale Multi-Story* (corner test)	ANSI FM 4880	Resist flame propagation over the exterior surface.	Passed; No height restrictions*
* Dryvit FM products must be specified			

2. The Outsulation components shall be tested for:

a. Fire

TEST	TEST METHOD	CRITERIA	RESULTS
Surface Burning Characteristics	ASTM E 84	All components shall have a: Flame Spread \leq 25 Smoke Developed \leq 450	Passed

b. Durability

TEST	TEST METHOD	CRITERIA	RESULTS
Reinforcing Mesh Alkali Resistance of Reinforcing Mesh	ASTM E 2098 (formerly EIMA 105.01)	$>$ 21dN/cm (120 pli) retained tensile strength after exposure	Passed
EPS (Physical			

Properties)	ASTM C 303, D 1622	15.2-20.0 kg/m ³ (0.95-1.25 lb/ft ³)	Pass
Density	ASTM C 177, C 518		Pass
Thermal Resistance		4.0 @ 4.4 °C (40 °F)	Pass
	ASTM C 272	3.6 @ 23.9 °C (75 °F)	Pass
Water Absorption	ASTM D 2863	2.5 % max. by volume	Pass
Oxygen Index	ASTM D 1621 Proc. A	24% min. by volume	Pass
Compressive Strength	ASTM C 203	69 kPa (10 psi) min.	Pass
Flexural Strength	ASTM E 84	172 kPa (25 psi) min.	Pass
Flame Spread		25 max.	Pass
Smoke Developed		450 max.	

1.7 SUBMITTALS

- A. The following Product Data shall be submitted:
 1. Manufacturer's literature or cut sheet for each component of system.
- B. Product Data – The contractor shall submit to the owner/architect the manufacturer's product data sheets describing products, which will be used on this project.
- C. Shop Drawing for Panelized Construction: The panel fabricator shall prepare and submit to the owner/architect complete drawings, showing wall layout, connections, details, expansion joints and installation sequence.
- D. Samples: The contractor shall submit to the owner/architect two (2) samples of the Outsulation System for each finish, texture and color to be used on the project. The same tools and techniques proposed for the actual installation shall be used. Samples shall be of sufficient size to accurately represent each color and texture being utilized on the project.
- E. Test Reports – When requested, the contractor shall submit to the owner/architect copies of selected test reports verifying the performance of the Outsulation System.

1.8 QUALITY ASSURANCE

- A. Qualifications
 1. System Manufacturer: Shall be Dryvit Systems, Inc.
 2. Contractor: Shall be knowledgeable in the proper installation of the Dryvit Outsulation System and shall be experienced and competent in the installation of Exterior Insulation and Finish Systems.
- B. Regulatory Requirements
 1. The EPS shall be separated from the interior of the building by a minimum 15-minute thermal barrier.
 2. The use and maximum thickness of EPS shall be in accordance with the applicable building codes.
- C. Certification
 1. The Outsulation System shall be recognized for the intended use by the applicable building code(s).

D. Mock-Up

1. The contractor shall, before the project commences, provide the owner with a mock-up for approval.
2. The mock-up shall be of suitable size as required to accurately represent the products being installed, as well as each color and texture to be utilized on the project.
3. The mock-up shall be prepared with the same products, tools, equipment and techniques required for the actual application. The finish used shall be from the same batch that is being used on the project.
4. The approved mock-up shall be available and maintained at the job site.
5. For panelized construction, the mock-up shall be available and maintained at the panel fabrication location.

1.9 DELIVERY, STORAGE AND HANDLING

- A. All Dryvit materials shall be delivered to the job site in the original, unopened packages with labels intact.
- B. Upon arrival, materials shall be inspected for physical damage, freezing, or overheating. Questionable materials shall not be used.
 1. Materials shall be stored at the jobsite in a cool, dry location, out of direct sunlight, protected from weather and other sources of damage. Minimum storage temperature shall be as follows:
 - a. Demandit®, Revyvit®: 7 °C (45 °F)
 - b. Ameristone™, TerraNeo® and Limestone™: 10 °C (50 °F)
 - c. DPR, PMR™ and E™ Finishes, Color Prime™, Primus®, Genesis and NCB™: 4 °C (40 °F)
 - d. Custom Brick™ finish: Refer to Custom Brick Polymer Specification, DS151.
 - e. For other products, refer to specific product data sheets.
 2. Maximum storage temperature shall not exceed 38° C (100 °F).
NOTE: Minimize exposure of materials to temperatures over 32 °C (90 °F). Finishes exposed to temperatures over 43 °C (110 °F) for even short periods may exhibit skinning, increased viscosity and should be inspected prior to use.
- C. Protect all products from inclement weather and direct sunlight.

1.10 PROJECT CONDITIONS

- A. Environmental Requirements
 1. Application of wet materials shall not take place during inclement weather unless appropriate protection is provided. Protect materials from inclement weather until they are completely dry.
 2. At the time of application, the minimum air and wall surface temperatures shall be as follows:
 - a. Demandit, Revyvit: 7 °C (45 °F)
 - b. Ameristone, TerraNeo and Limestone: 10 °C (50 °F)
 - c. DPR, PMR and E Finishes, Color Prime, Primus, Genesis and NCB: 4 °C (40 °F)
 - d. Custom Brick Finish: refer to Custom Brick Polymer Specification, DS151.
 - e. For other products, refer to specific product data sheets.

3. These temperatures shall be maintained with adequate air ventilation and circulation for a minimum of 24 hours (48 hours for Ameristone, TerraNeo and Limestone) thereafter, or until the products are completely dry. Refer to published product data sheets for more specific information.
- B. Existing Conditions - The contractor shall have access to electric power, clean water, and a clean work area at the location where the Dryvit materials are to be applied.

1.11 SEQUENCING AND SCHEDULING

- A. Installation of the Outsulation System shall be coordinated with other construction trades.
- B. Sufficient manpower and equipment shall be employed to ensure a continuous operation, free of cold joints, scaffold lines, texture variations, etc.

1.12 LIMITED MATERIALS WARRANTY

- A. Dryvit Systems, Inc. shall provide a limited warranty against defective material upon written request. Dryvit shall make no other warranties, expressed or implied. Dryvit does not warrant workmanship. Full details are available from Dryvit Systems, Inc.
- B. The applicator shall warrant workmanship separately. Dryvit shall not be responsible for workmanship associated with installation of the Outsulation System.

1.13 MAINTENANCE

- A. Maintenance and repair shall follow the procedures noted in Dryvit Outsulation Application Instructions, DS204.
- B. Some cleaning may be required. See Dryvit publication DS152 on Cleaning & Recoating.
- C. Sealants and Flashings should be inspected on a regular basis and repairs made as necessary.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. All components of the Outsulation System shall be supplied or obtained from Dryvit or its authorized distributors.

2.2 MATERIALS

- A. Portland Cement: Shall be Type II, meeting ASTM C 150, white or gray in color, fresh and free of lumps.
- B. Water: Shall be clean and free of foreign matter.
- C. Mechanical Fasteners (required when installing in accordance with DS135): Shall be Wind-lock's Wind Devil™ plates, or equivalent, used in conjunction with corrosion resistant fasteners appropriate for the substrate system.

2.3 COMPONENTS

- A. Flashing Materials: Used to protect substrate edges at terminations.
 - 1. Liquid Applied: An extremely flexible water-based polymer material, ready for use.
 - a. Shall be AquaFlash and AquaFlash Mesh
 - 2. Sheet Type:
 - a. Shall be Flashing Tape and Surface Conditioner
 - 1) Dryvit Flashing Tape™: A high density polyethylene film backed with a rubberized asphalt adhesive available in rolls 102 mm (4 in), 152 mm (6 in) and 229 mm (9 in) wide by 23 m (75 ft) long.
 - 2) Dryvit Flashing Tape Surface Conditioner™: A water-based surface conditioner and adhesion promoter for the Dryvit Flashing Tape.
- B. Adhesives: Used to adhere the EPS to the substrate, shall be compatible with the substrate and the EPS.
 - 1. Cementitious: A liquid polymer-based material, which is field mixed with Portland cement for use over non-wood-based substrates.
 - a. Shall be Primus®, Genesis® or Genesis FM
 - 2. Ready mixed: A dry blend cementitious, copolymer-based product, field mixed with water for use over non-wood-based substrates.
 - a. Shall be Primus® DM, Genesis® DM, Genesis® DMS, Rapidry DM 35-50 or Rapidry DM 50-75.
 - 3. Noncementitious: A factory-mixed, fully formulated water-based adhesive for use over wood-based substrates.
 - a. Shall be ADEPS®.
- C. Insulation Board: Expanded polystyrene meeting Dryvit Specification for Insulation Board, DS131.
 - 1. Thickness of insulation board shall be minimum 1 in and shall be maintained at all locations
 - 2. The insulation board shall be manufactured by a board supplier listed by Dryvit Systems, Inc.
- D. Base Coat: Shall be compatible with the EPS insulation board and reinforcing mesh(es).
 - 1. Cementitious: A liquid polymer-based material, which is field mixed with Portland cement.
 - a. Shall be Primus, Genesis or Genesis FM.
 - 2. Noncementitious: A factory-mixed, fully formulated, water-based product.
 - a. Shall be NCB™.
 - 3. Ready mixed: A dry blend cementitious, copolymer-based product, field mixed with water.
 - a. Shall be Primus DM, Genesis DM, Genesis DMS, Rapidry DM 35-50 or Rapidry DM 50-75.
- E. Reinforcing Mesh: A balanced open weave, glass fiber fabric treated for compatibility with other system materials. Note: Reinforcing meshes are classified by impact resistance and specified by weight and tensile strength as Section 1.04.D.1.c.
 - 1. Shall be Standard, Standard Plus, Intermediate, Panzer 15, Panzer 20, Detail and Corner Mesh.

- F. Finish: Shall be the type, color and texture as selected by the owner and shall be one or more of the following:
1. Standard DPR (Dirt Pickup Resistance): Water-based, acrylic coating with integral color and texture and formulated with DPR chemistry:
 - a. Quarzputz® DPR: Open-texture.
 - b. Sandblast® DPR: Medium texture.
 - c. Freestyle® DPR: Fine texture.
 - d. Sandpebble® DPR: Pebble texture.
 - e. Sandpebble® Fine DPR: Fine pebble texture.
 2. E: Water-based, lightweight acrylic coating with integral color and texture and formulated with DPR chemistry:
 - a. Quarzputz® E
 - b. Sandpebble® E
 - c. Sandpebble® Fine E
 3. FM: Water-based, acrylic coating with integral color and texture, formulated with PMR chemistry:
 - a. Quarzputz® FM
 - b. Sandblast® FM
 - c. Sandpebble® FM
 - d. Sandpebble® Fine FM
 4. Specialty: Factory mixed, water-based acrylic:
 - a. Ameristone: Multi-colored quartz aggregate with a flamed granite appearance.
 - b. Stone Mist®: Ceramically colored quartz aggregate.
 - c. Custom Brick: Acrylic polymer-based finish used in conjunction with a proprietary template system to create the look of stone, brick, slate or tile.
 - d. TerraNeo: 100% acrylic-based finish with large mica chips and multi-colored quartz aggregates.
 - e. Limestone: A premixed, 100% acrylic-based finish designed to replicate the appearance of limestone blocks.
 5. Elastomeric DPR (Dirt Pickup Resistance): Water-based elastomeric acrylic coating with integral color and texture and formulated with DPR chemistry:
 - a. Weatherlastic® Quarzputz
 - b. Weatherlastic® Sandpebble
 - c. Weatherlastic® Sandpebble Fine
 - d. Weatherlastic® Adobe
 6. Medallion Series PMR™ (Proven Mildew Resistance): Water-based acrylic coating with integral color and texture and formulated with PMR chemistry:
 - a. Quarzputz® PMR
 - b. Sandblast® PMR
 - c. Freestyle® PMR
 - d. Sandpebble® PMR
 - e. Sandpebble® Fine PMR
 7. Coatings, Primers and Sealers:
 - a. Demandit
 - b. Weatherlastic® Smooth
 - c. Tuscan Glaze™
 - d. Revyvit
 - e. Color Prime
 - f. Prymit®
 - g. SealClear™

PART 3 EXECUTION

3.1 EXAMINATION

- A. Prior to installation of the Outsulation System, the contractor shall verify that the substrate:
 - 1. Is of a type listed in Section 1.04.C.1.
 - 2. Is flat within 6.4 mm (1/4 in) in a 1.2 m (4 ft) radius.
 - 3. Is sound, dry, connections are tight, has no surface voids, projections or other conditions that may interfere with the Outsulation System installation or performance.
- B. Prior to the installation of the Outsulation System, the contractor shall insure that all needed flashings and other waterproofing details have been completed, if such completion is required prior to the Outsulation application. Additionally, the Contractor shall ensure that:
 - 1. Metal roof flashing has been installed in accordance with Asphalt Roofing Manufacturers Association (ARMA) Standards.
 - 2. Openings are flashed in accordance with the Outsulation System Installation Details, DS107, or as otherwise necessary to prevent water penetration.
 - 3. Chimneys, Balconies, and Decks have been properly flashed.
 - 4. Windows, Doors, etc. are installed and flashed per manufacturer's requirements and the Outsulation System Installation Details, DS107.
- C. Prior to the installation of the Outsulation System, the contractor shall notify the owner of all discrepancies.

3.2 PREPARATION

- A. The Outsulation materials shall be protected by permanent or temporary means from inclement weather and other sources of damage prior to, during, and following application until completely dry.
- B. Protect adjoining work and property during Outsulation installation.
- C. The substrate shall be prepared to be free of foreign materials, such as, oil, dust, dirt, form release agents, efflorescence, paint, wax, water repellants, moisture, frost and any other condition that inhibit adhesion.

3.3 INSTALLATION

- A. The system shall be installed in accordance with the current Dryvit Outsulation System Application Instructions, DS204.
- B. The overall minimum base coat thickness shall be sufficient to fully embed the mesh. The recommended method is to apply the base coat in two (2) passes.
- C. Sealant shall not be applied directly to textured finishes or base coat surfaces. Dryvit Outsulation System base coat surfaces in contact with sealant shall be coated with Demandit or Color Prime.
- D. When installing the Outsulation System, the notched trowel method of adhesive application shall be used over gypsum sheathing substrates.
- E. High impact meshes shall be installed as specified at ground level, high traffic areas and other areas exposed to or susceptible to impact damage.

3.4 FIELD QUALITY CONTROL

- A. The contractor shall be responsible for the proper application of the Outsulation materials.
- B. If required, the contractor shall certify in writing the quality of work performed relative to the substrate system, details, installation procedures, workmanship and as to the specific products used.
- C. If required, the EPS supplier shall certify in writing that the EPS meets Dryvit's specifications.
- D. If required, the sealant contractor shall certify in writing that the sealant application is in accordance with the sealant manufacturer's and Dryvit's recommendations.

3.5 CLEANING

- A. All excess Outsulation System materials shall be removed from the job site by the contractor in accordance with contract provisions and as required by applicable law.
- B. All surrounding areas where the Outsulation System has been installed, shall be left free of debris and foreign substances resulting from the contractor's work.

3.6 PROTECTION

- A. The Outsulation System shall be protected from inclement weather and other sources of damage until dry and permanent protection in the form of flashings, sealants, etc. are installed.

- END OF SECTION -

SECTION 09 91 00
PAINTING AND FINISHES

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers furnishing, surface preparation, and applying paints and coatings, complete and in place, to all specified surfaces including exposed valves, piping or fittings.
- B. Definitions
 - 1. The term "paint", "coatings", or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.
 - 2. The term "DFT" means minimum dry film thickness, without any negative tolerance.
 - 3. The term "mil" means thousandths of an inch.
 - 4. The term "SSPC" means The Society for Protective Coatings.
- C. The following surfaces shall not be coated:
 - 1. Concrete, unless otherwise required herein or on the Drawings.
 - 2. Stainless steel
 - 3. Machined surfaces
 - 4. Grease fittings
 - 5. Glass
 - 6. Equipment nameplates
 - 7. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.
- D. The protective coatings applicator (Applicator) shall possess a valid state license as required for the performance of the painting and coating work called for in this specification and shall provide 5 references which show the Applicator has previous successful experience with the indicated of comparable coating systems. Include the name, address, and the telephone number for the owner of each installation for which the Applicator provided the protective coating.

1.2 RELATED WORK

- A. Related Work in other Sections includes, but is not limit to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 04 21 13 Hollow Load Bearing Brick Masonry
 - 3. Section 08 10 00 Doors and Frames
 - 4. Section 09 98 10 Pipeline Coatings and Linings
 - 5. Section 33 05 05 Ductile Iron Pipe
 - 6. Section 33 12 10 Mechanical Appurtenances
 - 7. Section 33 92 10 Steel Pipe, Specials, and Fittings

1.3 REFERENCES AND STANDARDS

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract:
1. OSHA Occupation Safety and Health Act: State of Utah and Federal
 2. ICRI International Concrete Repair Institute Guideline No. 310.2 –
Selecting and Specifying Concrete Surface Preparation for Sealers,
Coatings, and Polymer Overlays
- B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
1. ANSI A 13.1 Standard for Scheme for the Identification of Piping Systems
 2. ANSI Z 535 Standard for Safety Colors
- C. AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM)
1. ASTM A 123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on
Iron and Steel Products.
 2. ASTM C 309 Standard Specification for Liquid Membrane-Forming Compounds
for Curing Concrete
 3. ASTM D 6943 Standard Practice for Immersion Testing of Industrial Protective
Coatings Linings
 4. ASTM D 1653 Standard Test Methods for Water Vapor Transmission of Organic
Coating Films
 5. ASTM D 2370 Standard Test Method for Tensile Properties of Organic Coatings
 6. ASTM D 2794 Standard Test Method for Resistance of Organic Coatings to the
Effects of Rapid Deformation (Impact)
 7. ASTM D 4263 Standard Test Method for Indicating Moisture in Concrete by the
Plastic Sheet Method
 8. ASTM D 4414 Standard Practice for Measurement of Wet Film Thickness by
Notch Gages
 9. ASTM D 4417 Standard Test Methods for Field Measurement of Surface Profile of
Blast Cleaned Steel
 10. ASTM D 7234 Standard Test Method for Pull-Off Adhesion Strength of Coatings
on Concrete Using Portable Pull-Off Adhesion Testers
 11. ASTM D 7682 Standard Test Method for Replication and Measurement of
Concrete Surface Profiles Using Replica Putty
 12. ASTM E 96 Standard Test Methods for Water Vapor Transmission of Materials
 13. ASTM F 1869 Standard Test Method for Measuring Moisture Vapor Emission
Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
 14. ASTM F 2170 Standard Test Method for Determining Relative Humidity in
Concrete Floor Slabs Using in situ Probes
- D. AMERICAN WATER WORKS ASSOCIATION (AWWA)
1. AWWA C 210 Liquid Epoxy Coating Systems for the Interior and Exterior of Steel
Water Pipelines
 2. AWWA C 222 Polyurethane Coatings for the Interior and Exterior of Steel Water
Pipe and Fittings

E. AMERICAN CONCRETE INSTITUTE (ACI)

1. ACI 301 Specifications for Structural Concrete

F. NACE International (NACE)

1. NACE RP0287 Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surfaces Using a Replica Tape
2. NACE SP0188 Standard Practice for Discontinuity (Holiday) Testing of Protective Linings
3. NACE SP0892 Standard Practice for Coatings and Linings over Concrete for Chemical Immersion and Containment Service
4. NACE No. 1/SSPC-SP 5 White Metal Blast Cleaning
5. NACE No. 6/SSPC-SP13 Surface Preparation of Concrete

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. CONTRACTOR shall supply shop drawings for approval on all paint materials at least 30 days prior to installation. Submittals shall include the following data sheets:
 1. For each paint system used herein, furnish a Paint System Data Sheet (PSDS), Technical Data Sheets, and paint colors available (where applicable) for each product used in the paint system, except for products applied by equipment manufacturers.
- C. Where ANSI/NSF 61 approval is required, submit ANSI/NSF 61 certification letter for each coating in the system indicating the product application limits on size of tank or piping, dry film thickness, number of coats, specific product tests, colors certified, and approved additives.
- D. Quality Control Submittals:
 1. Furnish a list of references for the Applicator substantiating the requirements as specified.
 2. Manufacturer's certification stating factory applied coating systems meets or exceeds requirements specified herein.
 3. If the manufacturer of finish coating differs from that of shop primer, provide both manufacturers' written confirmation that materials are compatible.

1.5 PAINT DELIVERY, STORAGE, AND HANDLING

- A. Deliver paint to the project site in unopened containers that plainly show, at the time of use, the designated name, date of manufacture, color, and name of manufacturer.
- B. Store paints in a suitable protected area that is heated or cooled as required to maintain temperatures within the range recommended by the manufacturer.

1.6 QUALITY ASSURANCE

- A. All inspection for quality assurance shall ultimately be the responsibility of CONTRACTOR. OWNER retains the right to observe, accept, or reject the work based

on the results of CONTRACTOR's inspection or observations by ENGINEER, at OWNER's discretion, in accordance with the specifications.

- B. Repair and recoat all runs, overspray, roughness, or any other signs of improper application in accordance with paint manufacturer's instructions and as reviewed by ENGINEER.
- C. Observations by OWNER or ENGINEER, or the waiver of inspection of any particular portion of the work, shall not be construed to relieve CONTRACTOR of his responsibility to perform the work in accordance with these specifications.

1.7 MANUFACTURER'S SERVICES

- A. Furnish paint manufacturer's representative to visit jobsite at intervals during surface preparation and painting as may be required for product application quality assurance, and to determine compliance with manufacturer's instructions and these specifications, and as may be necessary to resolve field problems attributable to, or associated with, manufacturer's products furnished under this Contract.

1.8 SPECIAL CORRECTION OF DEFECTS REQUIREMENTS

- A. An inspection may be conducted during the eleventh month following completion of coating work. CONTRACTOR and a representative of the coating material manufacturer shall attend this inspection. Defective work shall be repaired in accordance with these specifications and to the satisfaction of OWNER. OWNER may, by written notice to CONTRACTOR, reschedule the inspection to another date within the one-year correction period or may cancel the inspection altogether. CONTRACTOR is not relieved of its responsibilities to correct defects whether or not the inspection is conducted.

PART 2 PRODUCTS

2.1 GENERAL

- A. CONTRACTOR shall use suitable coating materials as recommended by the manufacturer. Materials shall comply with Volatile Organic Compound (VOC) limits applicable at the Site.
- B. Where manufacturers and product numbers are listed, it is to show the type and quality of coatings that are required. If a named product does not comply with VOC limits in effect at the time of Bid opening, that product will not be accepted, and CONTRACTOR shall propose a substitution product of equal quality that does comply. Proposed substitute materials will be considered as indicated below. Coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater treatment plants.
- C. In any coating system, only compatible materials from a single manufacturer shall be used in the work. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.
- D. Colors and shades of colors of coatings shall be as indicated or selected by OWNER. Each coat shall be of a slightly different shade to facilitate observation of surface coverage

of each coat. Finish colors shall be as selected from the manufacturer's standard color samples by OWNER.

E. Substitute or "Or-Equal" Products

1. Basis of Design: The Coating Systems listed below in paragraph 2.3 are based on products from Tnemec, Sherwin Williams, Devoe, and Wasser.
2. Product Substitution: To establish equality under Section 01 60 00 – Product Requirements, the specified coating systems are the minimum standard of quality for this project. Equivalent materials of other manufacturers may be substituted only by approval of ENGINEER. Requests for material substitutions shall be in accordance with requirements of the project specification.
3. Product Requirements: CONTRACTOR shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or equal" product that the material meets the indicated requirements and is equivalent or better in the following properties: Quality, Durability, Resistance to abrasion and physical damage, Life expectancy, Ability to recoat in the future, Solids content by volume, Dry film thickness per coat, Compatibility with other coatings, Suitability to chemical attack, Temperature limitations during application and in service, Type and quality of recommended undercoats or topcoats, Ease of repairing damaged areas, and stability of colors.
4. Manufacturers of "or equal" products shall provide direct performance comparison with the materials specified, in addition to complying with all other requirements of these Specifications. "Or equal" products shall employ the same generic type materials and system components as the specified coating systems.
5. CONTRACTOR shall bear any additional costs, if a proposed substitution requires changes or additional work.

2.2 COLORS

- A. Provide colors as selected by OWNER or ENGINEER unless otherwise specified herein.
- B. Colors shall be formulated with colorants free of lead, lead compounds, or other materials which might be affected by the presence of hydrogen sulfide or other gas likely to be present at the project.
- C. Proprietary identification of colors is for identification only. Any authorized manufacturer may supply color matches.
- D. Equipment colors;
 1. Equipment shall mean the machinery or vessel itself plus the structural supports and fasteners.
 2. Paint non-submerged portions of equipment in the same color as the process piping it serves, except as indicated below:
 - a. Dangerous parts of equipment and machinery: OSHA Orange
 - b. Fire protection equipment and apparatus: OSHA Red
 - c. Radiation hazards: OSHA Purple
 - d. Physical hazards in normal operating area: OSHA Yellow
 3. Fiberglass reinforced plastic (FRP) equipment with an integral-colored gel coat does not require painting, provided the color is as specified.

- E. Piping color coding shall be in accordance with ANSI A13.1, Division of Drinking Water R-309-525, and International Plumbing Code.
1. Color code non-submerged metal piping except electrical conduit. Paint fittings and valves the same color as the pipe unless otherwise specified.
 2. Pipe supports: If pipe supports are not galvanized or stainless steel, supports shall be painted ANSI No. 70 light gray as specified in ANSI Z535.
 3. Fiberglass reinforced plastic (FRP) pipe and polyvinyl chloride (PVC) pipe located outside of buildings and enclosed structures will not require painting, unless noted otherwise on the Drawings.

2.3 COATING SYSTEMS

A. System No. 1A Steel Pipe Lining – Potable Water NSF 61 Certification

1. Materials

Type	Epoxy conforming to AWWA C 210 and D 102 (for steel tanks).
VOC content, max, g/L	311
Volume Solids, min, %	67
Demonstrated Suitable for	Long term immersion in water, resistant to corrosion, good color retention
Certification	NSF 61 if in contact with potable water

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
SSPC-SP10 Near-White Blast Cleaning with minimum angular profile of 1.5 mils	<u>6" -16" Pipes</u> Primer: Tnemec Series 1220 (White) Intermediate: N/A Finish: Tnemec Series 1220 (White) Max thinner: 15%, Recoat cure time 6 hrs @ 75-deg F, Final cure time 7 days @ 75-deg F, Mix ratio 2:1 (A:B by volume), Series 44-700 Accelerator may be added up to 1 fl. oz./gal	<u>6" – 16" Pipes (Tnemec Only)</u> Primer: 6-8 DFT Finish: 6-8 DFT
	<u>18" and Greater</u> Primer: Tnemec N140 Pota-Pox Plus (00WH White or 15BL Tank White) Intermediate: Tnemec N140 Pota-Pox Plus (00WH White or 15BL Tank White) Finish: Tnemec N140 Pota-Pox Plus (00WH White or 15BL Tank White) Max thinner: 5% No. 60 by volume, Recoat cure time 9 hrs @ 75-deg F (5 hrs @ 75-deg F with accelerator), Final cure time 30 days @ 75-deg F; Mix ratio 1:1 (A:B by	<u>18" and Greater</u> Primer: 3-5 DFT Intermediate: 4-6 DFT Finish: 4-6 DFT

	volume), Series 44-700 Accelerator may be added to Part A in the field and may be added at up to 4 fluid ounces per two mixed gallons of parts A and B.	
	Primer: Sherwin Williams Tank Clad HS Intermediate: Sherwin Williams Tank Clad HS Finish: Sherwin Williams Tank Clad HS	
	Primer: Carboline Carboguard 891 VOC Intermediate: Carboline Carboguard 891 VOC Finish: Carboline Carboguard 891 VOC (For AWWA C210 only)	

3. Application

- a. For use on lining of pipes, valves, pumps, equipment in potable water service including items under submerged conditions, such as wall pipes, pipes, pipe sleeves, and the following specific surfaces unless noted otherwise:
 - 1) Interior of pump discharge head.

B. System No. 2 Steel – Immersion Non-Potable Water

1. Materials

Type	High Solids Epoxy
VOC content, max, g/L	250
Volume Solids, min, %	82
Demonstrated Suitable for	Ferrous surfaces, superior color and gloss retention, exceptional resistance to weathering, chemical fumes, and salt spray

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
SSPC-SP10 Near-White Blast Cleaning with a minimum angular anchor profile of 2.0 mils	Primer: Tnemec Series 104 HS Finish: Tnemec Series 104 HS	Primer: 8-10 DFT Finish: 8-10 DFT
	Primer: Sherwin Williams Dura-Plate UHS Finish: Sherwin Williams Dura-Plate UHS	

3. Application

- a. For use on the interior and exterior of steel or concrete not in potable water service, including concrete embedded surfaces of metallic items under submerged conditions, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles, and structural steel, except reinforcing steel.
- b. Field apply primer and topcoat to bolts (head & tail), nuts, fittings, and valves to match the vault piping color.

4. Special Requirements

- a. The surface preparation and primer shall be shop applied to all surfaces prior to installation.

C. System No. 3 Steel – Interior Exposed

1. Materials

Type	Polyamidoamine Epoxy
VOC content, max, g/L	250
Volume Solids, min, %	67
Demonstrated Suitable for	Ferrous, galvanized, surfaces in industrial exposure, resistant to mild corrosion and chemical fumes, has good color and gloss retention
Certification	None

1. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
Ferrous Metal: SSPC-SP6 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils Galvanized and Non-Ferrous: SSPC-SP16 with a minimum angular anchor profile of 1.5 mils	Primer: Tnemec Series 69 Hi-Build Epoxoline II Finish: Tnemec Series 69 Hi-Build Epoxoline II	Primer: 3-5 DFT Finish: 4-6 DFT
	Primer: Sherwin Williams Macropoxy 646 Fast Cure Epoxy Finish: Sherwin Williams Macropoxy 646 Fast Cure Epoxy	
	Primer: Carboline Carboguard 60 Finish: Carboline Carboguard 60	

2. Application

- a. All exposed metal surfaces located inside of structures, excluding pre-painted electrical cabinets or equipment. For pipelines, use on exterior pipe surfaces only. Interior pipe surfaces shall be coated with System No. 1 Steel – Immersion Potable Water NSF 61 Certification.

3. Special Requirements

- a. The surface preparation and primer shall be shop applied to all surfaces prior to installation. Finish coats need only be applied to the surfaces exposed after completion of construction.
- b. Field apply primer and topcoat to bolts (head & tail), nuts, fittings, and valves to match the piping color.

- 4. Color: Blue for water piping, color to be approved by owner.

D. System No. 4 Steel – Exterior Exposed

1. Exterior exposed steel pipe shall be zinc coated in accordance with ASTM A 123. All other steel exposed steel surfaces shall be in accordance with the following:
2. Materials

Type	Zinc-Rich primer with Polyamide Epoxy (intermediate coat), and Aliphatic Acrylic Polyurethane (topcoat)
VOC content, max, g/L	340 Zinc Primer 300 Intermediate and Finish Coats
Demonstrated Suitable for	Ferrous, galvanized, surfaces in industrial exposure, highly resistant to abrasion, wet conditions, corrosive fumes, and exterior weathering
Certification	Primer shall be SSPC Paint 20, Type II and meet requirements for ASTM 520 Type III or ASTM 521

3. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
SSPC-SP6 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils	Primer: Tnemec Series 90-97 Tneme-Zinc Intermediate: Tnemec Series 69 Hi-Build Epoxoline II Finish: Tnemec Series 1095 Endura-Shield	Primer: 2.5-3.5 DFT Intermediate: 4-6 DFT Finish: 3-5 DFT
	Primer: Sherwin Williams Zinc Clad III HS Intermediate: Sherwin Williams Macropoxy 646 Fast Cure Epoxy Finish: Sherwin Williams HS Polyurethane 250	
	Primer: Carboline Carbozinc 859 Intermediate: Carboline Carboguard 60 Finish: Carboline Carbothane 134VOC(Gloss) or 133LV(Satin)	

4. Application
 - a. All exposed steel surfaces located outside of structures.
5. Special Requirements
 - a. The surface preparation and primer shall be shop applied to all surfaces prior to installation. Finish coats need only be applied to the surfaces exposed after completion of construction.

E. System No. 5 Buried Steel Pipe

1. Coatings and finishes shall be in accordance with Section 09 98 10 Pipeline Coatings and Linings.

F. System No. 6 Steel – Doors and Frames

1. Materials

Type	Modified Polyamidoamine Epoxy with Aliphatic Acrylic Polyurethane (topcoat)
VOC content, max, g/L	250
Demonstrated Suitable for	Interior and Exterior Industrial, Architectural, and Commercial applications

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
SSPC-SP2/SP3 Hand and Power Tool Cleaning; feather rough edges; remove loose rust, dirt, and other contaminants with sandpaper	Primer: Tnemec Series 135 Chem-Build Finish: Tnemec Series 1075 Endura-Shield II	Primer: 3-5 DFT Finish: 3-5 DFT
	Primer: Sherwin Williams Macropoxy 646 Fast Cure Epoxy Finish: Sherwin Williams HS Polyurethane 250	
	Primer: Devoe Devran 224 HS Finish: Devoe Devthane 379H	

3. Application

- a. Factory primed steel doors and frames
- b. Exterior and Interior steel in non-corrosive and non-immersion environments.
- c. Maintenance of existing marginally prepared rusty steel and tightly adhering old coatings.

G. System No. 7 Galvanized Steel and Cast/Ductile Iron – Exterior Exposed

1. Materials

Type	Polyamide Epoxy with Aliphatic Acrylic Polyurethane (topcoat)
VOC content, max, g/L	250
Demonstrated Suitable for	Ferrous, galvanized, nonferrous, cast/ductile iron surfaces in industrial exposure, highly resistant to abrasion, wet conditions, corrosive fumes, and exterior weathering

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
Galvanized Steel and Non-Ferrous: SSPC-SP16 brush-off blast cleaning of coated and uncoated galvanized steel and non-ferrous metals to achieve a uniform anchor profile of 1.0-2.0 mils. Ductile and Cast Iron: Prepare all surfaces as per NAPF 500-03 - Uniformly abrasive blast the entire exterior surface using abrasive to an NAPF 500-03-04 with a minimum angular anchor profile of 1.5 mils.	Primer: Tnemec Series 69 Hi-Build Epoxoline II Finish: Tnemec Series 1095 Endura-Shield	Primer: 3-5 DFT Finish: 2.5-4 DFT
	Primer: Sherwin Williams Macropoxy 646 Fast Cure Epoxy Finish: Sherwin Williams HS Polyurethane 250	
	Primer: Carboline Carboguard 890 Finish: Carboline Carbothane 133LV(Satin) or 134VOC(Gloss)	

3. Application

- a. Exposed galvanized and cast/ductile iron surfaces located outside of structures requiring painting and the following specific surfaces unless noted otherwise:
 - 1) All exposed galvanized pipe
 - 2) All exposed cast/ductile iron pipe
- 4. Color: Wisconsin Blue for interior pipelines, by OWNER for all other surfaces.

H. System No. 8 Galvanized Steel and Cast/Ductile Iron – Interior Exposed

1. Materials

Type	Polyamide Epoxy
VOC content, max, g/L	250
Demonstrated Suitable for	Ferrous, galvanized, nonferrous, cast/ductile iron surfaces in industrial exposure, resistant to mild corrosion and chemical fumes, has good color and gloss retention

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
Galvanized Steel and Non-Ferrous: SSPC-SP16 brush-off blast cleaning of coated and uncoated galvanized steel and non-ferrous metals to achieve a uniform anchor profile of 1.0-2.0 mils. Ductile and Cast Iron: Prepare all surfaces as per NAPF 500-03 - Uniformly abrasive blast the entire exterior surface using abrasive to an NAPF 500-03-04 with a minimum angular anchor profile of 1.5 mils.	Primer: Tnemec Series 69 Hi-Build Epoxoline II Finish: Tnemec Series 69 Hi-Build Epoxoline II	Primer: 3-5 DFT Finish: 3 – 5 DFT
	Primer: Sherwin Williams Macropoxy 646 Fast Cure Epoxy Finish: Sherwin Williams Macropoxy 646 Fast Cure Epoxy	
	Primer: Carboline Carboguard 60 Finish: Carboline Carboguard 60	

3. Application

- a. Exposed galvanized and cast/ductile iron surfaces located inside of structures requiring painting and the following specific surfaces unless noted otherwise:
 - 1) All exposed galvanized pipe
 - 2) All exposed cast/ductile iron pipe
- b. Do not paint galvanized steel mechanical pipe and equipment supports unless noted otherwise.

I. System No. 9 Concrete Floors and Inside Foundation Wall – Light Traffic, Low Impact

1. Materials

Type	Modified Polyamine Epoxy
VOC content, max, g/L	75
Demonstrated Suitable for	Concrete floors providing protection against various acids and alkalis and frequent cleaning

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
	Primer: Tnemec Series 201 Epoxoprime	Primer: 6-8 DFT Intermediate: 6-8 DFT

SSPC-SP13 Concrete Surface Preparation, ICRI CSP 2-4	Intermediate: Tnemec Series 281 Tneme-Glaze Finish: Tnemec Series 281 Tneme-Glaze	Finish: 6-8 DFT
	Primer: Sherwin Williams Armorseal 33 Intermediate: Sherwin Williams 650 SL/RC Finish: Sherwin Williams 650 SL/RC	

3. Application
 - a. Concrete floors not exposed to wastewater or chemicals unless noted otherwise.
4. Color: Gray

J. System No. 10 Concrete Floors and Inside Foundation Wall – Chemical Exposure

1. Materials

Type	Modified Polyamine Epoxy (primer) with Polyamine Novolac Epoxy (topcoats)
VOC content, max, g/L	75
Demonstrated Suitable for	Highly chemical- and solvent-resistant on concrete floors and walls providing protection against abrasion, impact, most acids, alkalis, and solvents

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
SSPC-SP13 Concrete Surface Preparation, ICRI CSP 2-4	Primer: Tnemec Series 201 Epoxoprime Intermediate: Tnemec Series 282 Tneme-Glaze Finish: Tnemec Series 282 Tneme-Glaze	Primer: 6-8 DFT Intermediate: 6-8 DFT Finish: 6-8 DFT

3. Application
 - a. Concrete floors exposed to wastewater or chemicals unless noted otherwise.
4. Color: Gray

K. System No. 11 – Gypsum Wallboard and Plaster

1. Materials

Type	Waterborne Epoxy/Acrylic Polymer
VOC content, max, g/L	175/94
Demonstrated Suitable for	long term protection in both interior/exterior exposures

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
Sand joint compound smooth and feather edge. Clean and dry.	Primer: Tnemec Elasto-Grip FC Series 151-1051 Intermediate: Tnemec Enduratone Series 1028 Finish: Tnemec Enduratone Series 1028	Primer: 0.7-1.5 DFT Intermediate: 2-3 DFT Finish: 2-3 DFT
	Primer: Carboline Sanitile 120 Intermediate: Carboline Carbocrylic 3359 Finish: Carboline Carbocrylic 3359	

3. Application

- a. Interior gypsum wallboard and plaster on walls and ceilings.

L. System No. 12 – Concrete Walls and Concrete Masonry Units, Interior – Not Exposed to Chemicals

1. Materials

Type	Latex Filler/Water Based Acrylic Epoxy
VOC content, max, g/L	<60/244
Demonstrated Suitable for	long term protection for interior exposures

2. Coating System

Products	Total System (mils)
Filler: Tnemec Series 54 Intermediate: Tnemec H.B. Tnem-Tufcoat Series 113 Finish: Tnemec H.B. Tnem-Tufcoat Series 113	Surfacer/Filler Intermediate: 4-6 DFT Finish: 4-6 DFT
Filler: Sherwin-Williams PrepRite B25W25 Finish: Sherwin-Williams Water Based Catalyzed Epoxy B70 Series	
Filler: Carboline Sanitile 100 Finish: Carboline Sanitile 555VOC	

3. Surface preparation

- a. Surface cracks, holes, or other imperfections in concrete surfaces only that exceed 1/64 of an inch shall be filled with pointing mortar. Masonry joints found

to be unsound, hollow, or otherwise defective shall be raked out to a depth of 1/2 inch and pointed with mortar.

- b. Remove loose particles and foreign matter. Remove oil or foreign substance with a cleaning agent which will not affect the coating.
- c. Scrub and rinse surfaces with water, and let dry.
- d. Protect adjacent surfaces not scheduled to receive coating and landscaping, property and vehicles from over spray and drift.
- e. Concrete shall cure a minimum of 28 days before application.
- f. Apply coating per manufacturer's recommendations and instructions.

4. Application

- a. Interior concrete and concrete masonry unit walls not subject to splashing from wastewater and/or chemicals.

M.System No. 13 – Concrete Walls and Concrete Masonry Units, Interior – Exposed to Chemicals

1. Materials

Type	Epoxy
VOC content, max, g/L	<50/244
Demonstrated Suitable for	long term protection for interior exposures

2. Coating System

Products	Total System (mils)
Filler: Tnemec Series 130 Environfill Intermediate: Tnemec Series 69 Hi-Build Epoxoline II Finish: Tnemec Hi-Build Series 69 Epoxoline II	Surfacers/Filler: 60 to 115 sq ft per gallon Intermediate: 4-6 DFT Finish: 4-6 DFT

3. Surface preparation

- a. Masonry joints found to be unsound, hollow, or otherwise defective shall be raked out to a depth of 1/2 inch and pointed with mortar.
- b. Remove loose particles and foreign matter. Remove oil or foreign substance with a cleaning agent which will not affect the coating.
- c. Scrub and rinse surfaces with water, and let dry.
- d. Protect adjacent surfaces not scheduled to receive coating and landscaping, property and vehicles from over spray and drift.
- e. Concrete shall cure a minimum of 28 days before application.
- f. Apply coating per manufacturer's recommendations and instructions.

4. Application

- a. **Interior concrete and concrete masonry unit walls subject to splashing from wastewater and/or chemicals.**

5. Color: White

N.System No. 15 Wood, Interior Exposed

1. Materials

Type	Acrylic
VOC content, max, g/L	50
Demonstrated Suitable for	Wood trim and plywood sheathing in pump stations and similar municipal water and wastewater facilities.

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
Surface Preparation: Sand rough areas, Clean and Dry	Primer: Sherwin Williams Multi-purpose Interior-Exterior Latex Primer-Sealer Intermediate: Sherwin Williams Pro-Industrial Acrylic Coating Finish: Sherwin Williams Pro-Industrial Acrylic Coating	Primer: 0.7-1.5 DFT Intermediate: 2-3 DFT Finish: 2-3 DFT
	Primer: Tnemec Series 51-1051 Elasto-Grip Intermediate: Tnemec Series 1026 EnduraTone Finish: Tnemec Series 1026 EnduraTone	
	Primer: Carboline Sanitile 120 Intermediate: Carboline Carbocrylic 3359 Finish: Carboline Carboguard 3359	

3. Application

- a. Trim and plywood sheathing

4. Color: White

2.4 SPECIAL COATING SYSTEMS

A.System 200 - PVC Tape: Prior to wrapping the pipe with PVC tape, the pipe and fittings first shall be primed using a primer recommended by the PVC tape manufacturer. After being primed, the pipe shall be wrapped with a 20-mil adhesive PVC tape, half-lapped, to a total thickness of 40 mils. PVC Tape wrap buried pipe where indicated on the Drawings.

B.System 201 – Water Retardant, Concrete and Masonry

1. Materials and Coating System

Type	Silane-modified siloxane
Demonstrated suitable for	Repelling water from vertical concrete

	and masonry surfaces
VOC Content, g/L, max	250
Products, or approved equal	TAMMS Barracade M.E./9 Rainguard Blok-Lok Tnemec Dur A Pell 20 Series 636

2. Preparation
 - a. Surface cracks, holes, or other imperfections in concrete surfaces only that exceed 1/64 of an inch shall be filled with pointing mortar. Masonry joints found to be unsound, hollow, or otherwise defective shall be raked out to a depth of 1/2 inch and pointed with mortar.
 - b. Remove loose particles and foreign matter. Remove oil or foreign substances with a cleaning agent which will not affect the coating.
 - c. Scrub and rinse surfaces with water and let dry.
 - d. Protect adjacent surfaces not scheduled to receive coating and landscaping, property and vehicles from over spray and drift.
 - e. Concrete shall cure a minimum of 28 days before application.
 - f. Apply coating per manufacturer’s recommendations and instructions.

3. Application
 - a. Exterior concrete walls of pump station

C.System 202 – Polyethylene Encasement: Application of polyethylene encasement shall be in accordance with ANSI/AWWA C105 using Method C. Provide polyethylene encasement where indicated on the Contract Drawings or per Section 30 05 05 – Ductile Iron Pipe.

2.5 CONCRETE FINISHES

- A. Exterior Above Grade Concrete: Concrete surfaces exposed to view outside the building and including 6 inches below finished grade on the building or structure should be finished with a “Class A” finish. Products for the “Class A” finish are identified or specified in Section 03 30 00 - Cast-In-Place Concrete.
- B. Interior Exposed Concrete Above Floor: Interior above grade concrete shall be finished with a “Class B” finish. Products for the “Class B” finish are identified or specified in Section 03 30 00 - Cast-In-Place Concrete.
- C. Interior Concrete Floors: Interior concrete floors shall be finished with a “Trowel” finish. Products for the “Trowel” finish are identified or specified in Section 03 30 00 - Cast-In-Place Concrete.
- D. Exterior Concrete Flat Surfaces: Exterior concrete flat surfaces shall be finished with a “Broom” finish. Products for the “Broom” finish are identified or specified in Section 03 30 00 - Cast-In-Place Concrete.

PART 3 EXECUTION

3.1 GENERAL

- A. The intention of this specification is for all new surfaces, interior and exterior, wood, dry wall, masonry, concrete, and metal, whether atmospheric or submerged exposure, to be

painted whether specifically mentioned or not, except as modified herein. Concealed structural steel surfaces shall receive a prime coat only unless modified herein.

- B. Surface preparation and coating application shall be in accordance with these specifications and the coating manufacturer's written product data sheets and written recommendations of the manufacturer's technical representative. Where conflict occurs between the manufacturer's recommendations and these specifications, the more stringent of the two shall apply unless approved by ENGINEER.
- C. For immersion coatings, obtain full cure for completed system before immersing or allowing exposure to water of condensation for more than 12 hours.

3.2 REGULATORY REQUIREMENTS

- A. Meet federal, state, and local requirements limiting the emission of volatile organic compounds and worker exposures.
- B. Protect workers and comply with applicable federal, state, and local air pollution and environmental regulations for surface preparation, blast cleaning, disposition of spent aggregate and debris, coating application, and dust prevention including but not limited to the following Acts, Regulations, Standards, and Guidelines:
 - 1. Clean Air Act
 - 2. National Ambient Air Quality Standard
 - 3. Resource Conservation and Recovery Act (RCRA)
 - 4. SSPC Guide 6
- C. Comply with applicable federal, state, and local regulations for confined space entry.
- D. Provide and operate equipment that meets explosion-proof requirements.

3.3 ENVIRONMENTAL CONDITIONS

- A. Do not apply paint in extreme heat, temperatures below 40 degrees F, nor in dust, smoke-laden atmosphere, damp or humid weather. The Applicator shall adhere to the manufacturer's recommendations regarding environmental conditions. The Applicator shall monitor humidity, air temperature, and surface temperature with properly calibrated instruments.
- B. Do not perform abrasive blast cleaning whenever relative humidity exceeds 85 percent, nor whenever surface temperature is less than 5 degrees F above dew point of ambient air. Strictly adhere to manufacturer's recommendations.
- C. Surface preparation power tools and blast equipment shall contain dust collection devices that will prevent discharge of dust particles into the atmosphere around electrical or mechanical equipment unless otherwise permitted by ENGINEER.
- D. Where weather conditions or project requirement dictate, the Applicator shall provide and operate dehumidification equipment to maintain environmental conditions suitable for abrasive blasting and coating application as specified.

3.4 WORKMANSHIP

- A. Skilled craftsmen and experienced supervision shall be used on coating work.
- B. Coating shall be done in a workmanlike manner to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to ensure thorough surface preparation. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given so that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other precautionary measures.
- C. Damage to other surfaces resulting from the work shall be cleaned, repaired, and refinished to their original condition.

3.5 STORAGE, MIXING, AND THINNING OF MATERIALS

- A. Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for other procedures relative to coating shall be strictly observed.
- B. Coating materials shall be used within the manufacturer's recommended shelf life.
- C. Coating materials shall be stored under the conditions recommended by the Product Data Sheets, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings from different manufacturers shall not be mixed together.

3.6 SURFACE PREPARATION

- A. All surfaces which receive paint or other coatings shall be prepared in accordance with the recommendations of the manufacturer of the material being used. The Applicator shall examine surfaces to be coated and shall correct surface defects before application of any coating material. Marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any field coating application.
- B. Perform sandblasting for piping and any other items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed. Materials, equipment, and procedures shall meet the requirements of the Society for Protective Coatings (formerly the Steel Structures Painting Council).

3.7 PROTECTION OF MATERIALS NOT TO BE PAINTED

- A. Surfaces that are not to receive coatings shall be protected during surface preparation, cleaning, and coating operations.
- B. Remove, mask or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted.
- C. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.

- D. Protect working parts or mechanical and electrical equipment and motors from damage.
- E. Care shall be exercised not to damage adjacent work during blasting operations. Spraying shall be conducted under carefully controlled conditions. CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent work or adjoining property occurring from blasting or coating operations.

3.8 SURFACE PREPARATION STANDARDS

- A. The following referenced surface preparation specifications of the Society for Protective Coatings shall form a part of this specification:
 - 1. Solvent Cleaning (SSPC SP1): Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.
 - 2. Hand Tool Cleaning (SSPC SP2): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.
 - 3. Power Tool Cleaning (SSPC SP3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.
 - 4. White Metal Blast Cleaning (SSPC SP5): Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.
 - 5. Commercial Blast Cleaning (SSPC SP6): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.
 - 6. Brush-Off Blast Cleaning (SSPC SP7): Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.
 - 7. Near-White Blast Cleaning (SSPC SP10): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.
 - 8. Surface Preparation of Concrete (SSPC-SP13): Removal of protrusions, laitance and efflorescence, existing coatings, form-release agents, and surface contamination by detergent or steam cleaning, abrasive blasting, water jetting, or impact or power tool methods as appropriate for the condition of the surface and the requirements of the coating system.

3.9 FERROUS METAL SURFACE PREPARATION (UNGALVANIZED)

- A. The minimum abrasive blasting surface preparation shall be as indicated in the coating system schedules included in this Section. Where there is a conflict between these requirements and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.
- B. Oil, grease, welding fluxes, and other surface contaminants shall be removed by solvent cleaning per SSPC SP1 - Solvent Cleaning prior to blast cleaning.
- C. Round or chamfer all sharp edges and grind smooth burrs and surface defects and weld splatter prior to blast cleaning.
- D. Surfaces shall be cleaned of dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming, or another approved method prior to painting.

- E. Enclosed areas and other areas where dust settling is a problem shall be vacuum cleaned and wiped with a tack cloth.
- F. Damaged or defective coating shall be removed by the blast cleaning to meet the clean surface requirements before recoating.
- G. If the required abrasive blast cleaning will damage adjacent work, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC SP2 or SSPC SP3 may be used.
- H. Shop-applied coatings of unknown composition shall be completely removed before the indicated coatings are applied. Valves, castings, ductile or cast-iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings. Temporary coatings shall be completely removed by solvent cleaning per SSPC SP1 before the abrasive blast cleaning has been started.
- I. Shop primed equipment shall be solvent-cleaned in the field before finish coats are applied.
- J. Exposed ductile iron pipe shall be given a shop coat of rust-inhibitive primer conforming to these specifications. Abrasive blasting of the asphaltic coating on ductile iron pipe will not be allowed.

3.10 FERROUS METAL SURFACE PREPARATION (GALVANIZED)

- A. Galvanized ferrous metal shall be alkaline cleaned per SSPC SP1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system, followed by brush off blast cleaning per SSPC SP16.
- B. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer.

3.11 CONCRETE BLOCK MASONRY SURFACE PREPARATION

- A. Surface preparation shall not begin until at least 30 Days after the masonry has been placed.
- B. Oil, grease, and form release and curing compounds shall be removed by detergent cleaning per SSPC SP1 before abrasive blast cleaning.
- C. Concrete block masonry surfaces to be coated shall be abrasive blast cleaned to remove existing coatings, laitance, deteriorated concrete, and to roughen the surface equivalent to the surface of the No. 80 grit flint sandpaper.
- D. If acid etching is required by the coating application instructions, the treatment shall be made after abrasive blasting. After etching, rinse surfaces with water and test the pH. The pH shall be between neutral and 8.
- E. Surfaces shall be clean and as recommended by the coating manufacturer before coating is started.

- F. Unless required for proper adhesion, surfaces shall be dry prior to coating. The presence of moisture shall be determined with a moisture detection device such as Delmhorst Model BD-2100, or equal.

3.12 CAST-IN-PLACE CONCRETE SURFACE PREPARATION

- A. Concrete surfaces to receive protective coating shall be cast with a Smooth Form Finish in accordance with ACI 301. Surfaces shall not be rubbed, sacked, troweled or otherwise finished in any manner that will obscure or cover the parent concrete surface with materials other than materials as specified in this Section.
- B. All surfaces must be clean, dry and free of oil, grease and other contaminants, prior to preparation in accordance with NACE No. 6/SSPC-SP13. Concrete surfaces must be sound and capable of supporting the corrosion protection lining system.
- C. Prepare concrete surfaces in accordance with NACE No. 6/SSPC-SP13 Joint Surface Preparation Standards and ICRI Technical Guidelines. Abrasive blast, shot-blast, water jet or mechanically abrade concrete surfaces to remove laitance, curing compounds, hardeners, sealers, existing coatings, and other contaminants and to provide the recommended ICRI-CSP Profile.
- D. Level or grind concrete substrates to produce a uniform and smooth surface, including removal of sharp edges, ridges, form fins, and other concrete protrusions.
- E. Unless required for proper adhesion, surfaces shall be dry prior to coating. The presence of moisture shall be determined with a moisture detection device such as Delmhorst Model BD-2100, or equal.

3.13 SHOP COATING REQUIREMENTS

- A. Unless otherwise indicated, items of equipment or parts of equipment which are not submerged in service shall be shop-primed and then finish-coated in the field after installation with the indicated or selected color. The methods, materials, application equipment, and other details of shop painting shall comply with this Section. If the shop primer requires top coating within a specific period of time, the equipment shall be finish coated in the shop and then be touched up after installation.
- B. Items of equipment or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have surface preparation and coating performed in the field.
- C. For certain pieces of equipment, it may be undesirable or impractical to apply finish coatings in the field. Such equipment shall be primed and finish coated in the shop and touched up in the field with the identical material after installation. CONTRACTOR shall require the manufacturer of each such piece of equipment to certify as part of its Shop Drawings that the surface preparation is in accordance with these specifications. The coating material data sheet shall be submitted with the Shop Drawings for the equipment.
- D. For certain small pieces of equipment, the manufacturer may have a standard coating system that is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the Shop Drawing submittals.

Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.

- E. Shop-painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 2 months before being top coated, or less time if recommended by the coating manufacturer.
- F. CONTRACTOR shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Copies of applicable coating manufacturer's data sheets shall be submitted with equipment Shop Drawings.
- G. Damage to shop-applied coatings shall be repaired in accordance with this Section and the coating manufacturer's printed instructions.

3.14 APPLICATION

A. General

1. Schedule inspection with ENGINEER in advance for cleaned surfaces and all coats prior to each succeeding coat.
2. Apply coatings in accordance with the paint manufacturer's recommendations and these specifications, whichever is more stringent. Allow sufficient time between coats to assure thorough drying of previously applied paint.
3. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same day.
4. Special attention shall be given to materials that will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.
5. Finish coats, including touch-up and damage repair coats shall be applied in a manner that will present a uniform texture and color matched appearance.
6. Non-buried steel piping shall be abrasive blast cleaned and primed before installation.
7. Finish coats shall be applied after concrete, masonry, and equipment installation is complete, and the working areas are clean and dust free.

3.15 CURING OF COATINGS

- A. CONTRACTOR shall maintain curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the most stringent, prior to placing the completed coating system into service.
- B. In the case of enclosed areas, forced air ventilation, using heated air if necessary, may be required until the coatings have fully cured.

3.16 SHOP AND FIELD OBSERVATION AND TESTING

- A. CONTRACTOR shall give ENGINEER a minimum of 3 Days advance notice of the start of any field surface preparation or coating application, and a minimum of 7 Days advance notice of the start of any surface preparation activity in the shop.

- B. Observation by ENGINEER, or the waiver of inspection of any particular portion of the work, shall not relieve CONTRACTOR of its responsibility to perform the work in accordance with these Specifications.
- C. CONTRACTOR shall furnish inspection devices in good working condition for the detection of holidays and measurement of dry film thicknesses of coatings. Dry-film thickness gauges shall be made available for ENGINEER's use while coating is being done, until final acceptance of such coatings. CONTRACTOR shall furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of ENGINEER.
- D. CONTRACTOR shall test for continuity all coated ferrous surfaces inside a steel reservoir, other surfaces that will be submerged in water or other liquids, surfaces that are enclosed in a vapor space in such structures, and surfaces coated with any of the submerged and severe service coating systems. Areas that contain discontinuities shall be marked and repaired or recoated in accordance with the coating manufacturers' printed instructions and then be retested.
 - 1. Coatings with thickness exceeding 20-mils total DFT: Pulse-type holiday detector such as Tinker & Razor Model AP-W, D.E. Stearns Co. Model 14/20, or equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the required coating thickness.
 - 2. Coatings with thickness of 20-mils or less total DFT: Tinker & Razor Model M1 nondestructive type holiday detector, K-D Bird Dog, or equal shall be used. The unit shall operate at less than 75 volts. For thicknesses between 10- and 20-mils, a nonsudsing type wetting agent, such as Kodak Photo-Flo or equal, shall be added to the water prior to wetting the detector sponge.
- E. On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC Paint Application Specification No. 2 using a magnetic type dry film thickness gauge such as Mikrotest Model FM, Elcometer Model 111/1EZ, or equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.
- F. Evaluation of blast cleaned surface preparation will be based upon comparison of the blasted surfaces with the standard samples available from NACE, using NACE standards TM-01-70 and TM-01-75.
- G. Visually inspect concrete, nonferrous metal, plastic, drywall, and wood surfaces to ensure proper and complete coverage has been attained.

3.17 CLEANUP

- A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at the end of each day.
- B. Upon completion of the work, remove staging, scaffolding, and containers from the site or destroy in a legal manner.
- C. Completely remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

- D. Damages due to overspray on buildings, vehicles, trees, or other surfaces not specified to be painted would be the responsibility of CONTRACTOR.

3.18 MANUFACTURER' SERVICES

- A. Furnish paint manufacturer's representative to visit jobsite at intervals during surface preparation and painting as may be required for product application quality assurance, and to determine compliance with manufacturer's instructions and these specifications, and as may be necessary to resolve field problems attributable to, or associated with, manufacturer's products furnished under this Contract.

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SECTION 09 98 10
PIPELINE COATINGS AND LININGS

PART 1 GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall apply external coating and internal lining on steel pipe, field coating of joints, and field repair of coating damage, complete and in place, in accordance with the specifications.
- B. Existing buried steel pipe shall be repaired with the cement mortar lined and coated system matching the existing system. New buried steel pipe shall be cement lined and coated and encased with CLSM.
- C. Exposed steel pipe shall be epoxy lined and coated in accordance with Section 09 91 00 – Painting and Finishes, unless noted otherwise.

1.2 RELATED WORK

- A. It is CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
- B. Related Work in other Sections includes, but is not limit to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 09 91 00 Painting and Finishes
 - 3. Section 33 12 00 Mechanical Appurtenances
 - 4. Section 33 92 10 Steel Pipe, Specials, and Fittings (AWWA C200, modified)

1.3 REFERENCES AND STANDARDS

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract.
- B. Occupation Safety and Health Act: State of Utah and Federal
- C. AMERICAN STANDARD FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM D 4541 Standard Test for Pull-Off Strength of Coatings Using Portable Adhesion Testers
- D. AMERICAN WATER WORKS ASSOCIATION (AWWA)
 - 1. AWWA C205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe-4-inch and Larger- Shop Applied.
 - 2. AWWA C210 Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
 - 3. AWWA C216 Heat-shrinkable Cross-linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines

4. AWWA C217 Cold-Applied Petrolatum Tape and Petroleum Wax Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines

E. FEDERAL INTERNATIONAL ORGANIZATION (ISO)

1. ISO 8502-3 Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 3: Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method)

F. NATIONAL ASSOCIATION OF CORROSION ENGINEERS INTERNATIONAL (NACE)

1. NACE RP 274 High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation
2. NACE RP 287 Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surface Using Replica Tape

G. SOCIETY FOR PROTECTIVE COATINGS (SSPC)

1. SSPC-SP-1 Solvent Cleaning Surface Preparation
2. SSPC-SP-2 Hand Tool Cleaning Surface Preparation
3. SSPC-SP-3 Power Tool Cleaning Surface Preparation
4. SSPC-SP-5 White Metal Abrasive Blast Surface Preparation
5. SSPC-SP-6 Commercial Abrasive Blast Surface Preparation
6. SSPC-SP-10 Near White Metal Abrasive Blast Surface Preparation
7. SSPC-SP-11 Power Tool to Bare Metal

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit catalog cuts and other manufacturer's performance information for products proposed that demonstrate compliance with the Specifications herein described. Provide a copy of approved coating system submittals to the coating applicator. Provide Paint System Data Sheets (PSDS) and/or Material Safety Data Sheets (MSDS) for coating and lining materials.
- C. Quality Control Submittals
 1. Applicator's experience with list of references substantiating compliance.
- D. If the manufacturer of field-applied coating differs from that of the shop-applied primer, furnish written confirmation from both manufacturers that the 2 coating materials are compatible.

1.5 QUALITY ASSURANCE

- A. All inspection for quality assurance shall ultimately be the responsibility of CONTRACTOR. OWNER retains the right to observe, accept, or reject the work based on the results of CONTRACTOR's inspection or observations by ENGINEER, at OWNER's discretion, in accordance with the specifications.

- B. Coating applicator shall have a minimum of 2 years of experience applying the specified coating system and the application supervisor (Certified Applicator) for the coating application personnel shall have a minimum of 5 years practical experience in application of the indicated products.
- C. Coating and/or lining manufacturer technical representative shall be present for a minimum of 3 days to furnish technical assistance and instruction at the start of coating and/or lining operations within the shop and at the Site. During these visits, the technical representative shall observe surface preparation and coating application and conduct tests of the coating to insure conformance with application instructions, recommended methods, and conditions.
- D. Coating and/or lining manufacturer shall furnish 8 hours per month of field or shop coating technical support if requested by ENGINEER.
- E. Technical representative shall provide a written report to ENGINEER for each visit. Report shall include copies of test data collected, description of observations, and recommended corrective actions. Report shall be submitted within 10 working days after the visit. When deemed necessary by ENGINEER, work will not be permitted to proceed until the recommended corrective actions have been implemented. After corrective recommendations have been implemented, the manufacturer representative shall return and certify that the application complies with the manufacturer's coating application recommendations.
- F. Additional visits by the manufacturer's representative shall be made at sufficient intervals during surface preparation and coating or lining as may be required for product application quality assurance and to determine compliance with manufacturer's instructions, and as may be necessary, to resolve problems attributable to or associated with, manufacturer's products furnished for this project.
- G. Repair and recoat all runs, overspray, roughness, or any other signs of improper application in accordance with paint manufacturer's instructions and as reviewed by ENGINEER.
- H. CONTRACTOR shall notify OWNER and minimum of 14 days prior to the commencement of any work. CONTRACTOR shall provide OWNER and/or ENGINEER with full access to facilities and application documentation. Observation by OWNER and/or ENGINEER, or the waiver of inspection of any particular portion of the work, shall not be construed to relieve CONTRACTOR of his responsibility to perform the work in accordance with these specifications.

1.6 DEFINITIONS

- A. **Manufacturer's Representative:** Employee of coating manufacturer who is factory trained and knowledgeable in technical aspects of manufacturer's products and systems. Sales representatives are not acceptable as technical representatives unless written authorization from the coating manufacturer is furnished stating the sales representative has full authority to act on behalf of the coating manufacturer.

1.7 ABBREVIATIONS

ANSI	American National Standards Institute
AWWA	American Water Works Association
MDFT	Minimum Dry Film Thickness
Mil	Thousandths of an Inch
OSHA	Occupation Safety and Health Act
SSPC	Society for Protective Coatings

1.8 SPECIAL WARRANTY REQUIREMENT

- A. CONTRACTOR and coating applicator shall warrant the work under this Section against defective workmanship and materials for a period of two (2) years commencing on the date of final acceptance of the pipeline.
- B. This warrantee shall be in addition to the prime CONTRACTOR's warrantee that covers repair of all defective work, including linings and coatings.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply paint in extreme heat, temperatures below 40 degrees F, nor in dust, smoke-laden atmosphere, damp, or humid weather.
- B. Do not perform abrasive blast cleaning whenever relative humidity exceeds 85 percent, nor whenever surface temperature is less than 5 degrees F above dew point of ambient air. Strictly adhere to manufacturer's recommendations.

PART 2 PRODUCTS

2.1 GENERAL

- A. Exterior and interior pipe and fitting surfaces shall be prepared and coated in accordance with referenced standards, written directions of the coating or lining manufacturers, and this Section, whichever is more stringent.
- B. Pipeline coating or lining materials shall be the products of a single manufacturer. Product substitutions during the project will not be considered or permitted.
- C. The coating applicator shall provide a monitoring system approved by the coating manufacturer that constantly records pipe and coating conditions during coating application. Recorded monitoring parameters shall include pipe temperature, line speed, surface preparation, holiday test and other parameters applicable to the type of coating.
- D. Coatings and linings will be stored, handled, and applied per the manufacturer's written directions.

2.2 CONTRACTOR FURNISHED TEST EQUIPMENT

- A. CONTRACTOR shall provide the following coating test equipment for field testing of pipe for holidays.
 - 1. Holiday Test Equipment:
 - a. Elcometer Model D236, 0 to 30 kV high voltage tester

- b. External Pipe rolling spring probe, sized for the Project pipe diameter.
- c. Right Angle Wire Brush Probe, 20 inches or larger.
- d. Telescopic probed extension handle, 2- to 4-foot length range.

2.3 SHOP-APPLIED BURIED COATINGS

A. General

- 1. Buried steel pipe shall be shop-coated with the required coating system and a 1-inch-thick cement mortar coating with $\pm 1/4$ " tolerance, as specified herein.
- 2. Buried coated pipe and fittings passing through a structure wall or floor shall be coated for a minimum of 2-inches beyond the interior wall or floor surface.
- 3. Pipe that is atmospherically exposed shall be shop primed as specified herein and in accordance with Section 09 91 00 – Painting and Finishes.

B. Cement Mortar Coat:

- 1. Apply cement mortar coat on steel pipe and fittings in accordance with AWWA C205, except as modified herein.
- 2. Shop Applied Coating System
 - a. Cement: Conform to ASTM C150, Type II or V.
 - b. Aggregate shall be silica sand or other aggregate that is not subject to leaching. Conform to ASTM C33.
 - c. Cement mortar mixture shall consist of 1 part cement to not more than 3 parts aggregate.
 - d. Water for cement mortar: Clean and free from organic matter, strong alkalis, vegetable matter, and other impurities. Use no more than 4-1/2 gallons of water per sack of cement.
 - e. Cement mortar coating: Nominal 1-inch-thick coating with permitted tolerance of $\pm 1/4$ inch.

2.4 EXTERIOR COATING FOR EXPOSED STEEL PIPE

A. Exterior Coating System

- 1. All atmospherically exposed or vault piping shall be shop primed with the coating system as specified in Section 09 91 00 – Painting and Finishes.
- 2. Exposed pipe to be shop primed per Section 09 91 00 – Painting and Finishes, with intermediate and finish coats to be applied in the field after installation is complete.
- 3. Shop applied inorganic zinc primer shall not be applied at thickness greater than recommended by manufacturer. Excess primer to be removed using a method recommended by coating manufacturer.
- 4. Manufacturer of shop-applied primer shall be coordinated with field application to provide a completed system by a single manufacturer as specified in Section 09 91 00 – Painting and Finishes. OWNER approval of a coating system with two or more coating manufacturers will require written approval from all coating manufacturers as to compatibility and acceptance under warranty.

2.5 INTERIOR SHOP-APPLIED LININGS

A. Cement Mortar Lining

1. Clean and cement mortar line steel pipe and fittings in accordance with AWWA C205.
2. Cement shall conform to ASTM C150, Type II.
3. Shop applied cement mortar lining shall be uniform in thickness over the full length of the pipe joint.
4. Aggregate shall be silica sand or other aggregate that is not subject to leaching. Conform to ASTM C33.
5. Water for cement mortar: Clean and free from organic matter, strong alkalis, vegetable matter, and other impurities.

B. Liquid Applied Epoxy Lining

1. Exposed steel pipe inside vaults shall be epoxy lined in accordance with Section 09 91 00 – Painting and Finishes, unless noted otherwise.
2. Provide liquid epoxy primer and lining in accordance with Section 09 91 00 – Painting and Finishes in all cement mortar lined metallic pipe at insulating joints for a minimum of two pipe diameters on each side of the insulated joint.
 - a. Epoxy shall be applied over the cement mortar lining where specified for the pipeline lining material.
 - b. Prepare the cement mortar lining by abrasive blasting to remove all laitance and provide a surface profile.
 - c. Cement mortar shall be allowed to cure for a minimum of 15 days prior to surface preparation and coating application or 7 days with steam curing.
 - d. Mortar lining shall be dry when epoxy lining is applied.
3. Epoxy coatings shall be NSF certified coatings suitable for potable water contact in accordance with ANSI/NSF Standards 60 and 61.

2.6 SPECIALS, FITTINGS, AND CONNECTIONS

- A. Coating and lining application for special sections, connections, and fittings shall conform to coating system and application requirements in this Section. Internal Mortar lining shall be applied to all specials, fittings, and pipes with outlets.
- B. Specials, fittings, and pipes with outlets shall be defined as any pipe section with turnouts for blowoffs, interconnects, any valve, or other appurtenances; tees; crosses; wyes; laterals; manholes; mitered angles or elbows; and pipes that require special fabrication that prevents mechanical production application of the indicated coating system from end to end of pipe joint as defined herein.
- C. In addition to the items listed above as specials, the following items shall also be considered as specials: Pipe joints with pass through holes.
- D. Hand-applied tape coatings will not be permitted on any specials, fittings, connections, pipes with outlets and elbow fittings.
- E. Provide cement mortar coating on specials, fittings, and connections to match pipeline, where pipeline coating requires a cement mortar coating.

2.7 EXTERIOR FIELD JOINT COATING

- A. Pipe joints shall be field coated after pipe assembly in accordance with AWWA C216, except as modified herein.

- B. Field joint coating shall be compatible with the shop-applied coating system and be provided by the same manufacturer or a manufacturer approved by the pipe coating manufacturer.
- C. Field joint coating materials shall be as follows or an equal.
 - 1. Heat Shrink Sleeves
 - a. Filler Material: Provide filler material for push-on, flange, and coupling type joints. Filler material shall adhere to pipe and heat shrink sleeves and shall not melt under joint welding temperatures. Size and type shall be as recommended by the sleeve manufacturer for type of pipe and joint. Filler material shall be applied in a manner and of sufficient thickness that no tenting or voids remain under the heat shrink sleeve. Filler material shall be **Canusa Aqua Seal SG79 or Raychem Covalence 939 Filler**.
 - b. Joint Coating: Heat shrink, cross-linked polyolefin wrap or sleeve with an adhesive, backing and sleeve with a total of 200-mils minimum thickness, suitable for pipeline operating temperature, as recommended by the manufacturer and shall meet the requirements of AWWA C 216.
 - c. Provide standard recovery sleeve for girth weld or bell and spigot steel pipe joints. High recovery sleeves shall be provided for flange joints, coupling style joints.
 - d. Width of heat shrink sleeves shall be sufficient to overlap existing coating 3 inches minimum. Overlap on tape coated steel pipe shall be based on a sequential 3-inch-wide step from outer wrap to middle wrap to inner wrap.
 - e. Consider sleeve shrinkage during installation and joint profile in determining sleeve width required. Overlapping of 2 or more heat shrink sleeves to achieve the necessary width on pipe joints will not be permitted without OWNER approval.
 - f. Manufacturers: **AquaSleeve by Canusa-CPS, Covalence by Berry CPG**, or approved equal.
 - 2. Hand Applied Tape Wrap – Not Allowed.
 - 3. Wax Tape Coating
 - a. Wax tape coatings shall be limited to field application on joints, fittings, or irregular shapes or complex configurations that are not suited for the use of heat shrink wrap coating systems.
 - b. Apply coating in accordance with AWWA C217, except as modified herein.
 - c. Provide filler material to fill and smooth irregular surfaces, such that no tenting or voids remain under the applied wax tape.
 - d. Protect coating from damage and provide special sand backfill protect wax coating from damage.
 - e. Coating System
 - 1) Surface Preparation: SP3 Power Tool or SP11 Power Tool to Bare Metal.
 - 2) Primer: Petroleum or petrolatum wax.
 - 3) Filler Material: Filled petroleum or petrolatum wax.
 - 4) Inner Tape: Petroleum or petrolatum wax impregnated fabric, 6-inch width maximum, 40-mils thick.
 - 5) Outer Wrap: PVC or tape suitable for application to inner tape.
 - f. Wax tape coating system shall be as manufactured by, or approved equal:

- 1) **Petrolatum Tapes by Denso North American**
- 2) **Wax-Tape by Trenton**

2.8 INTERIOR FIELD JOINT COATING

- A. Surface preparation and field lining of pipe joints shall be with the same coating system as the shop-applied lining.
- B. Field application shall be performed by qualified personnel trained on the proper application of the coating system.
- C. Field coating application requirements shall be the same as the shop-applied coating requirements. Provide heating and/or dehumidification equipment as required to meet the environmental conditions necessary for proper coating application.

2.9 REPAIR OF COATINGS AND LININGS

- A. General
 1. Coating or lining repair materials shall be compatible with the shop-applied coating or lining system and shall be approved by the coating or lining manufacturer.
- B. Coating Repair Materials
 1. Heat Shrink Sleeves (major repair)
 - a. Filler Mastic: Provide mastic filler to fill tape void as required.
 - b. Full Wrap Coating: Cross-linked polyolefin wrap with a mastic sealant, 85-mil thickness minimum, suitable for pipeline operating temperature, sleeve material recovery as recommended by the manufacturer. Sleeve length shall provide a minimum of 3-inches overlap onto intact pipe coating.
 - c. Manufacturers: **AquaSleeve by Canusa-CPS, Covalence by Berry CPG**, or approved equal.
 2. Heat-Applied Patches (minor repair)
 - a. Heat applied adhesive, polyolefin-backed, mastic coated tape, 12-inches maximum size.
 - b. Patch shall provide a minimum of 2-inches overlap onto intact pipe coating.
 - c. Manufacturers: **CRP patch by Canusa, PERP patch Berry CPG**, or approved equal.
- C. Exposed Pipe Coating System
 1. Touch-up repair all damage to primer and/or intermediate coats with the specified coating system prior to final coating of the pipeline in accordance with Section 09 91 00 – Painting and Finishes.

PART 3 EXECUTION

3.1 ENVIRONMENTAL LIMITATIONS

- A. General
 1. Products shall comply with federal, state, and local requirements limiting the emission of volatile organic compounds and worker exposure.

2. Comply with applicable federal, state, and local, air pollution and environmental control regulations for surface preparation, blast cleaning, disposition of spent aggregate and debris, and coating application.
3. Do not perform abrasive blast cleaning whenever the relative humidity exceeds 85 percent or whenever surface temperature is less than 5 degrees above the dew point of the ambient air.
4. Do not apply coatings when:
 - a. Surface and ambient temperatures exceed the maximum or minimum temperatures recommended by the coating manufacturer or these specifications.
 - b. In dust or smoke-laden atmosphere, blowing dust or debris, damp or humid weather, or under conditions that could cause icing on the metal surface.
 - c. When it is expected that surface temperatures would drop below 5 degrees above dew point within 4 hours after application of coating.
5. Where weather conditions or project requirements dictate, CONTRACTOR shall provide and operate heaters and/or dehumidification equipment to allow pipe surfaces to be abrasive blasted and coated as indicated and in accordance with the manufacturer's coating application recommendations.
6. Work activities may be restricted until adequate temperature and humidity controls are in place and functioning within the environmental limits given.
7. Coating applicator shall provide a monitoring system approved by the coating manufacturer that constantly records pipe and coating conditions during coating application. Recorded monitoring parameters shall include pipe temperature, line speed, surface preparation, holiday test, and other parameters applicable to the type of coating.

B. Temperature Control

1. In cold weather or if moisture collects on the pipe, if the temperature of the pipe is less than 45 degrees F, preheat the pipe to a temperature of 50 degrees F or 5 degrees above dew point, whichever is greater.
2. When temperatures are above or below the coating manufacturer's recommended application temperatures, CONTRACTOR shall provide temperature controls as necessary to permit the work to proceed within the manufacturer's temperature limitations.
3. Provide tenting, insulating blankets, baffles, or bulkheads as required to zone and control heating or cooling effectiveness.
4. Heating shall be with indirect propane fired heaters that do not increase humidity levels within the working area. Heaters shall be sized for the area to be heated.

C. Dehumidification

1. CONTRACTOR shall provide dehumidification equipment when necessary for shop or field environmental control during surface preparation and/or coating application. Dehumidification equipment shall be properly sized to maintain dew point temperature 5 degrees or more below surface temperature of metal surfaces to be cleaned and coated.
2. Cleaned metal surfaces shall be prevented from flash rusting throughout the project duration; condensation or icing shall be prevented throughout surface preparation and coating application.

3. Daily environmental condition monitoring and maintenance requirements of the equipment shall be documented in writing and posted near the equipment for review if required by ENGINEER.
4. Re-blasting of flash rusted metal surfaces or removal of damaged coatings because of equipment malfunction, shutdown, or other events that result in the loss of environmental control, will be at the sole expense of CONTRACTOR. Cleaned metal surfaces subject to flash rusting shall be cleaned to the same cleanliness as prior to the flash rust formation and shall be approved by ENGINEER.
5. If the required environmental conditions cannot be maintained throughout the coating process, CONTRACTOR will be required to provide the following:
 - a. CONTRACTOR shall provide and operate desiccant dehumidification equipment to maintain environmental conditions for 24 hours a day during abrasive blasting and coating application and cure. Liquid, granular, or loose lithium chloride drying systems will not be acceptable.
 - b. CONTRACTOR shall provide dehumidification equipment sized to maintain dew point temperature 5°F or more below surface temperature of metal surfaces to be cleaned and coated. System shall provide ventilation within the environmentally controlled areas to meet the following requirements:
 - 1) Two air exchanges per hour, minimum
 - 2) Maintenance of personnel exposure limits (PEL) at 50 percent of OSHA PEL limits for all chemicals used in the performance of the Work.
 - 3) Maintenance of lower explosive limits (LEL) to less than 50 percent of the most volatile solvent used in the performance of the Work.
 - c. Dehumidification equipment shall also provide ventilation at a minimum of 0.75 air exchanges per hour within all non-accessible work areas for worker protection or as required for maintaining PEL and LEL explosive limits as defined herein, whichever is more stringent.
 - d. Dehumidification equipment type, size, air flow, and power requirements shall be designed by a qualified company knowledgeable in dehumidification equipment, and its operation based on Project requirements and anticipated seasonal weather conditions for the Project schedule. Design to include evaluation of existing conditions, humidity, and temperature, proper air exchange requirements, ventilation requirements, ducting requirements for adequate air flow, and any other issues necessary to achieve the specified performance and environmental conditions throughout the duration of the Project.
 - e. CONTRACTOR to submit written recommendations from dehumidification Subcontractor for enclosure work area size, bulkhead venting, duct work for each bulkhead section, any secondary ventilation requirements for coating cure, dust collection equipment CFM requirements, and drying requirements for blast hose compressed air necessary to maintain environmental control as specified herein.
 - f. At a minimum, work area shall be separated into surface preparation work zones, coating application zones, and coating cure zones.
 - g. Dehumidification Subcontractor shall either operate the equipment or provide training to CONTRACTOR on the proper operation and setup of dehumidification equipment. Dehumidification Subcontractor shall provide a technical representative on-site for a minimum of two 8-hour days to ensure proper operation of the equipment, achievement of desired environmental control, and to insure CONTRACTOR can properly setup, operate, monitor, and maintain equipment.

3.2 OBSERVATION OF WORK

- A. CONTRACTOR shall give ENGINEER a minimum of 14 days advance notice of the start of any coating work to allow scheduling for shop or field observation. Notify ENGINEER a minimum of 3 days in advance of actual start of surface preparation and coating application Work.
 - 1. Provisions shall be made to allow ENGINEER full access to facilities and appropriate documentation regarding coating application.
 - 2. Observation by ENGINEER or the waiver of observation of any portion of the coating work shall not be construed to relieve CONTRACTOR of responsibility to perform the coating in accordance with these Specifications.
 - 3. Materials shall be subject to observation for suitability as ENGINEER may determine, prior to or during incorporation into the work.

3.3 SURFACE PREPARATION

A. General

- 1. Inspect and provide substrate surfaces prepared in accordance with these Specifications and the printed directions and recommendations of coating manufacturer whose product is to be applied.
- 2. Visible oil, grease, dirt, and contamination shall be removed in accordance with SSPC-SP1, solvent cleaning.
- 3. Surface imperfections such as metal slivers, burrs, weld splatter, gouges, or delaminations in the metal shall be removed by filing or grinding prior to abrasive surface preparation.
- 4. Protect prepared pipe from humidity, moisture, and rain. Flash rust, imperfections, or contamination on cleaned pipe surface shall be removed by reblasting.
- 5. Priming and coating of pipe shall be completed the same day as surface preparation.

B. Weld Surface Preparation

- 1. Application
 - a. Spray applied coating systems do not require weld grinding.
 - b. Grind welds on tape wrap coated pipe or apply weld stripe tape over the weld, at the pipe fabricator's option, unless otherwise indicated.
- 2. Weld Grinding: Under the weld grinding option, welds taller than 3/32-inch above pipe surface shall be ground to a tolerance of +3/32-inch to zero-inches above the pipe surface as measured on the highest side of the weld.
- 3. Weld Stripe Tape
 - a. Weld stripe tape shall be applied to primed metal.
 - b. Tape shall either have no polyethylene backing or be double sided adhesive tape to permit adhesion of the inner corrosion protection layer to the weld stripe tape.
 - c. Apply tape with a pressure roller to fully conform the tape to the weld surface.
 - d. Adhesion of the weld stripe tape shall be the same as for the coating system.

C. Steel Surface Preparation

1. Surface preparation of steel pipe shall be in accordance with SSPC surface preparation standards utilizing the degree of cleanliness appropriate to the coating system to be applied.
2. Grit and/or shot abrasive mixture and gradation shall be as required to achieve the degree of cleanliness and coating adhesion required.
3. Pipe cleaned by abrasive blasting with recyclable steel grit and/or shot or other abrasive shall be cleaned of debris and spent abrasive in an air wash separator.
4. Work shall be performed in a manner that does not permit the cleaned metal surface to rust back or flash rust.
5. Rust back or flash rust shall be fully removed with the steel surface cleanliness equal to the required metal surface cleanliness prior to rust back or flash rusting. Determination of the equivalent surface cleanliness shall be at ENGINEER'S sole discretion.

3.4 SHOP-APPLIED COATING SYSTEMS

A. Cement Mortar Coatings

1. Buried steel pipe shall have a cement mortar coating applied in accordance with AWWA C205, except as modified herein.
2. Cement Mortar Coating:
 - a. Reinforcement:
 - 1) For pipe and specials smaller than 48-inches in diameter, reinforce coating with spirally wound No. 12 gage steel wire spaced at 1-inch centers or with No. 4 gage steel wire at 1/2-inch centers positioned approximately in center of mortar coating.
 - 2) For pipe and specials 48-inches in diameter and larger, reinforce coating with 2 layers of spirally wound No. 12 gage steel wire spaced at 1-inch centers or with No. 4 gage steel wire at 1/2-inch centers positioned approximately in center of mortar coating.
 - 3) Lap ends of reinforcement strips 4-inches and tie or loop free ends to assure continuity of reinforcement.
 - 4) All steel wire reinforcement placed in the mortar coating shall be electrically isolated from the pipe. Electric isolation will be tested using high voltage spark test by the manufacturer prior to shipment to the project site. Provide certification that electrical isolation of reinforcement wire from steel pipe.
 - b. Specials Fittings:
 - 1) Special fittings shall be mortar coated as specified.
 - c. Coating Defects:
 - 1) Coating defects shall be repaired as specified in AWWA C205, except as modified herein.

B. Epoxy Coatings

1. Exposed steel pipe inside vaults shall have an epoxy coating per Section 09 91 00 – Painting and Finishes, unless noted otherwise.

3.5 EXTERIOR COATING HOLDBACK

- A. Coating holdbacks shall be straight and cut through the full thickness of the coating.
- B. Cutbacks shall be completed in a manner that permits field coating of joints in accordance with the manufacturer's recommendations and these requirements.
- C. Holdbacks shall be as required for proper jointing of pipe, considering joint welding requirements, and be as follows:

Mortar Coating	
All joints	As shown on the details
Epoxy coating	
Push-on joint, spigot	Flush with spigot end
Push-on, bell	Flush with bell end
Welded, spigot	3-inches, minimum
Welded, Bell	4-inches, minimum

- D. Holdback Corrosion Protection
 - 1. Holding primer for corrosion protection of cutbacks or holdbacks shall be compatible with the joint coating system, shall prevent corrosion of prepared pipe ends for duration of storage and construction, and be recommended for buried exposures.
 - 2. Primer shall be compatible with welding operations and shall not result in running or melting of the coating during welding operations.
 - 3. Application and thickness of holding primer shall be in accordance with the primer manufacturer's recommendations, but shall not impair the clearances required for proper joint installation.
 - 4. Any corroding holdback areas shall be abrasively blasted to SP10 or power tool cleaned to bare metal in accordance with SP11 prior to applying joint coating.

3.6 PIPE LINING APPLICATION

- A. Shop-Applied Cement Mortar Lining
 - 1. Place mortar lining used in steel piping and steel plate specials in pipe to thickness below.

Pipe Diameter, Inches	Lining Thickness, Inches	Tolerances, Inches
4 through 10	3/8	-1/16, +1/8
11 through 24	5/16	-1/16, +1/8
24 through 36	3/8	-1/16, +1/8
Greater than 36	1/2	-1/16, +3/16

2. Centrifugally line straight sections of pipe. Lining of special pieces or fittings shall be by mechanical, pneumatic, or hand placement. Provide cement mortar lining of uniform thickness. Finish to a smooth dense surface.
 - a. Steel plate specials larger than 16-inches in diameter shall have lining reinforced with 2-inch by 4-inch No. 13-gauge welded steel wire mesh.
 - b. Brace and support pipe during lining application to minimize pipe distortion or vibration. Bracing and supports shall not damage the pipe, coating, or lining.
 - c. Tightly close ends of pipe and fittings with plastic sheet caps within 30 minutes of lining application. Plastic end caps shall be of sufficient thickness and strength to resist shipping, handling, and storage stresses.
 - d. Damage to the cement mortar lining, including disbondment, cracking, or blistering, caused by improper curing, shipping, handling, or installation shall be repaired in accordance with AWWA specifications.
 - e. Other requirements of mortar lining materials and processes are in AWWA C205.

B. Liquid Epoxy Lining:

1. Epoxy lining shall be applied in accordance with Section 09 91 00 – Painting and Finishes.
2. Clean and coat the interior of cement mortar lined pipe at insulating joints or where specified with two coats of epoxy coating
 - a. Epoxy coating applied at insulating joints shall be applied to both sides of the insulating joint for a minimum of one pipe diameter. If only one side of the joint can be coated, the coating shall be applied for a minimum of two pipe diameters.
 - b. Mortar lining shall be allowed to cure 15 days or steam cured not less than 7 days prior to surface preparation of the mortar and epoxy coating application. Hand applied mortar lining shall be allowed to cure a minimum of 15 days or as required to meet the coating manufacturer's requirements for application on cement or concrete, whichever is greater.
 - c. Prepared mortar lining by abrasive blasting to remove all laitance and create a suitable anchor profile.
 - d. Epoxy coating shall be applied in two coats minimum, at a total coating thickness of 16 mils dry film thickness. Coating applied over cement mortar lining shall be applied in a manner that will minimize gassing and pinholes in the completed lining.
 - e. Mortar lining shall be dry during epoxy lining application.

3.7 FIELD COATING JOINTS

A. General

1. Remove oil or grease contamination by solvent wiping the pipe and adjacent coating in accordance with SSPC-SP1, Solvent cleaning.
2. Clean pipe surface and adjacent coating of mud, rust, and other foreign contaminants in accordance with SSPC-SP11, Power Tool Cleaning to Bare Metal or abrasively field blast joints in accordance with SSPC-SP10, near white blast, that exhibit any surface rust. Clean the full circumference of the pipe and a minimum of 6-inches onto the existing coating.
3. Remove loose or damaged pipe coating at joint and either repair the coating or increase the length of the joint coating, where reasonable and practical.
4. Complete joint bonding (where shown) of pipe joints before application of joint coating. Joint bonds shall be installed per Section 26 42 00 – Galvanic Cathodic Protection Systems. Joint bonds shall be low profile bonds, and gaps and crevices around the bonds shall be filled with mastic sealant.
5. CONTRACTOR shall electrically test completed joint coating for holidays with high voltage spark tester.

B. Post-Welding of Joints:

1. Post-welded joints are defined as welded pipe joints that are coated prior to completing interior welds.
2. Post welded joints shall be coated and protected as follows:
 - a. Joint coating shall be heat shrink joint sleeves only. Tape wrapped joints will not be acceptable.
 - b. Provide 6-inch wide non-shrinking layer centered over the interior weld location, such as **CRP patch by Canusa or PERP by Berry CPG** patch materials. Heat resistant tape will not be acceptable.
 - c. Finished external joint coatings shall be fully buried with a minimum of 12-inches of soil cover, prior to any interior welding.
3. CONTRACTOR shall demonstrate that the joint welding procedures will not significantly damage the coating by fully excavating the first 2 post-welded joints for inspection of the coating condition. Up to 3 additional post-welded joints for excavation by CONTRACTOR will be selected for inspection of joint coating condition.
4. Any damage to the external joint coating system will require the CONTRACTOR to modify welding methods and or coating materials until a non-damaged system is attainable. All weld damaged joint coatings shall be removed and replaced with the new suitable system.

C. Heat Shrink Sleeve Joint Coating

1. Store, handle, and apply field heat shrink sleeve coatings in accordance with AWWA C216 and these specifications.
2. Store sleeves in shipping box until use. Keep dry and sheltered from exposure to direct sunlight. Store off the ground or concrete floors and maintain at a temperature between 60 and 100 degrees F as recommended by the sleeve manufacturer.
3. Metal pipe surface shall be free of dirt, dust, and flash rusting prior to sleeve application. Surface preparation shall be in accordance with the joint coating manufacturer's recommendations. At a minimum, surfaces shall be prepared by

- abrasive blasting to SSPC-SP10 or by power tool cleaning to bare metal in accordance with SSPC-SP11.
4. Preheat pipe uniformly as recommended by the sleeve manufacturer. Monitor pipe temperature using a surface temperature gauge, infrared thermometer, or color changing crayons. Protect preheated pipe from rain, snow, frost, or moisture with tenting or shields and do not permit the joint to cool.
 5. Fill cracks, crevices, gaps, and step-downs greater than 1/4- inch with filler mastic in accordance with the manufacturer's recommendations for the full circumference of the pipe.
 6. Apply heat shrink sleeve when it is at a minimum temperature of 60 degrees F and while maintaining the pipe temperature above the preheat temperature above. Apply sleeve in accordance with the manufacturer's instructions and center the sleeve over the joint to provide a minimum 3 inch overlap onto the existing pipe coating.
 7. Completed joint sleeve shall be fully bonded to the pipe and existing coating surface without voids. Mastic beading shall be visible along the full circumference of the sleeve. There shall be no wrinkling or excessive burns on the sleeves. Sleeves that do not meet these requirements shall be removed and the joint recoated. Minor coating repairs may be made using heat applied patch material indicated.
 8. Allow the sleeve to cool before backfilling. In hot climates, provide shading from direct sunlight. Water quenching will be allowed only when permitted by the sleeve manufacturer.
 9. Heat shrink joint coatings which have become wrinkled or disbonded because of prolonged exposure to UV light or thermal cycling shall be removed and replaced.
 10. Double coating of defective or damaged heat shrink coatings will not be permitted. Any double coated heat shrink sleeves shall be immediately rejected and CONTRACTOR shall remove and recoat the joint.

D. Cement Mortar Coating

1. Field repair cement mortar coating in accordance with AWWA C205.
2. Joint Diapers
 - a. Polyethylene Foam:
 - 1) Cut into strips wide enough to match uncoated field joint area.
 - 2) Slit to thickness of 1/4-inch that will expose a hollow or open cell surface on one side.
 - 3) Foam liner shall be attached to fabric backing with open or hollow cells facing towards pipe.
 - 4) Foam strip shall cover full interior circumference of grout band with sufficient length to permit 8-inch overlap of foam at or near top of joint.
 - 5) Splices to provide continuity of material will be permitted.
 - 6) Protect polyethylene foam material from direct sunlight.

3.8 REPAIR OF COATING AND LININGS

A. General

1. Areas where holidays are detected or coating is visually damaged, such as blisters, tears, rips, bubbles, wrinkles, cuts, or other defects shall be repaired. Areas where no holidays are detected, but are visually damaged shall also be repaired.
2. Maximum defects allowable shall be as indicated for the coating system.

B. Cement Mortar Coating and Lining

1. Cement mortar coating that is cracked or disbonded shall be repaired in accordance with AWWA C205, except for mortar overcoat on tape wrapped steel.
2. Disbonded mortar coating shall be removed and patched.
3. Mortar coating with disbondment greater than 25 percent of the pipe surface shall be rejected and recoated.
4. Cracks in mortar coating and lining shall be repaired in accordance with AWWA C205.

C. Epoxy Coating and Lining

1. Epoxy coating and linings shall be repaired in accordance with Section 09 91 00 – Painting and Finishes.

3.9 INSPECTION AND TESTING

A. Inspection

1. Applicator shall inspect and test the coating system in accordance with referenced standards and these specifications, whichever is more stringent.
2. The frequency of the testing shall be determined by the applicator, but shall not be less than the requirements of this specification.
3. CONTRACTOR will conduct random independent inspections and tests for the final acceptance or rejection of pipe coating or lining.
4. CONTRACTOR to perform holiday testing in the field using equipment provided as specified in Paragraph 2.2. Tests will be completed in the presence of the OWNER's representative on each joint of pipe and fitting once the pipe has been lifted and lowered into the trench. Holidays shall be repaired as specified.

B. Surface Profile Testing

1. Surface profile of abrasive blasted surfaces to be tested with "Press-O-Film" tester tape or equivalent in accordance with NACE RP287.
2. Tester tape shall be suitable for the intended profile height.
3. Profile shall be measured to a minimum tolerance of 0.1 mils, maximum.
4. Electronic surface profilometers shall be used, as deemed necessary, to verify tester tape measurements.

C. Adhesion Testing, General

1. Adhesion testing shall be conducted at the shop prior to shipment. Pipe shipped without adhesion testing will be field-tested. Pipe rejected in the field will be returned to the shop for repair at the sole expense of CONTRACTOR.
2. A minimum of 2 pipes will be tested for adhesion from each lot of pipe coated up to 4,000 square feet of pipe. An additional adhesion test will be conducted on every increment up to 3,000 square feet of pipe coated in excess of the first 4,000 square feet of pipe. (i.e. if one workday of production is 8,000 square feet of pipe, 4 adhesion tests will be conducted on the pipe lot.
3. A pipe lot is defined as the quantity of pipe that is coated by a single crew within a work shift, but not to exceed 12 hours.
4. The pipe coating applicator shall repair coating damage from adhesion testing.

5. Adhesion tests will be performed not less than 24 hours after coating application. Tests conducted prior to 24 hours will be acceptable only if the test meets or exceeds the adhesion criterion and the test was requested by the pipe fabricator.
6. Pipe will be randomly selected for adhesion testing. OWNER reserves the right to perform adhesion testing at any time or location.
7. If any pipe tested fails the adhesion test, all pipes within the lot will be rejected. Each pipe within the rejected pipe lot will then be individually tested for adhesion and accepted or rejected on a pipe-by-pipe basis.
8. Rejected pipe shall have the coating fully removed from the pipe and the pipe abrasive blasted and recoated.

D. Holiday Testing

1. Coating thickness used for holiday testing shall be the minimum coating thickness.
2. Dry Film Thickness Testing
 - a. Coatings shall be tested for dry film thickness using a properly calibrated magnetic pull off or eddy current equipment.
 - b. Coating thickness measurements shall be conducted as necessary and without limitation. Testing conformance to the requirements of SSPC PA-2 is specifically excluded from this specification.

3.10 HANDLING, TRANSPORTATION, AND STORAGE

- A. Pipe shall be handled in such a manner as to protect the pipe and coating from damage.
- B. Coated pipe shall not be shipped or installed until coating has developed full adhesion and cure.
- C. During coating application, storage, loading, and transportation, every precaution shall be taken to protect and prevent damage to pipe, lining, and coating. Forklift equipment shall have load-bearing surfaces padded with suitable material. Lift pipe with web slings a minimum of 12-inches wide and of a type that will not damage the coating. Metal chains, cables, tongs, forklifts or other equipment likely to damage the coating will not be permitted. Dragging or skidding of pipe on grade or in the trench will not be permitted.
- D. Provide transportation vehicles with padded bolsters between each layer of pipe and heavy padding under load ties. Bolsters shall be curved to fit the outside of the pipe and 12-inches wide, minimum. Pipe contact locations shall be heavily padded with carpet and strips of the outer tape wrap material (adhesive side against the carpet) during shipment to the Site and from the storage yard to the point of installation.
- E. Pipe shall not be stored on rocks, gravel, or other hard materials that might damage the coating. Provide padded 12-inch wide skids and chucks, sand bags, select loamy or sand berms, or suspended from cutback ends, where possible, to minimize coating damage. Pipe shall not be laid on asphalt without suitable padding at contact points.
- F. Pipe shall be inspected by CONTRACTOR at the Site for damage. Any damage to the pipe, lining, or coating shall be repaired if a satisfactory repair can be made; otherwise, the damaged section shall be replaced at the sole expense of CONTRACTOR.
- G. No metal tools or heavy objects shall be permitted to come into contact unnecessarily with the finished coating. Workers shall not be permitted to walk on the coating except when

absolutely necessary. When required, shoes with rubber or composition soles and heels or other suitable footwear that will not damage coating shall be used.

- H. Long-term Exposure: Pipe shall either be provided with UV inhibitor for length of above grade exposure or covered to prevent UV degradation of outer wrap. Amount of UV stabilizers required shall depend on the project location, laying schedule, anticipated length of exposure, and type of outer wrap. Coating manufacturer shall be consulted for recommended UV inhibitors requirements or pipe shall be stored under a protective cover. Protective covering can be colored plastic sheeting, canvas, or other UV blocking material. Clear plastic sheets are not acceptable. Areas of coating that display UV degradation shall be removed and repaired at sole cost of CONTRACTOR.
- I. End Caps: Pipe ends of mortar lined pipe and fittings shall be tightly closed with a plastic wrap to aid in curing and to minimize drying out of and contamination of the lining. Plastic end cap shall consist of a minimum of one 10-mil sheet of polyethylene or other suitable material. End caps shall be substantial enough to resist shipment, handling, and storage loads and to remain firmly attached in place. The plastic end cap shall remain intact and in place until pipe installation. Damaged or missing plastic end caps shall be repaired or replaced.
- J. Bracing
 1. The manufacturer shall install adequate bracing or strutting to keep the pipe from becoming deformed or damage from occurring to the coating or linings. Strut-type bracing shall be installed as soon as possible after application of lining. Struts shall remain in place during handling, storage, transportation, and installation of pipe and fittings until after the pipe zone material is compacted. Adequate strutting shall be provided by pipe manufacturer, so that after completion of backfilling, pipe deflection or elongation shall not exceed one percent of the nominal inside diameter of cement-mortar-lined pipe.
 2. The minimum bracing shall consist of crossed struts (horizontal and vertical). The maximum spacing along the pipe shall be near each end and at the one-third points for each 48-foot section of pipe, with a minimum of 4 sets of struts per 48-foot section of pipe. Random lengths of pipe shall have an equivalent number of sets of struts, with a minimum of one set of struts in a 10-foot section of pipe
 3. The struts shall be installed with pads and wedges in such a manner that the pipe lining will not be damaged and the struts will not be dislodged during shipping and handling of the pipe. If struts are welded, they shall be installed and removed in such a manner to prevent damage to the steel cylinder, lining, or coatings. Damage shall be repaired to the satisfaction of ENGINEER.

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SECTION 11 54 00
PROCESS EQUIPMENT

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers the work necessary to install a ready to use and tested process and analysis system. The Contractor shall provide all components required for a complete and functional system.

1.2 SUBMITTALS

- A. Submit catalog cuts on all process equipment including: switches, meters, sensors, or other items shown on the Drawings referencing each item by mark number. Information shall indicate manufacture specification compliance and dimensional data.
- B. Contractor shall supply operation and maintenance manuals for all process equipment.

1.3 WARRANTY

- A. Manufacturer shall provide to the Owner written guarantee against defects in material or workmanship for a period of one (1) year.

1.4 DELIVERY AND STORAGE

- A. All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, or other contaminants.

1.5 MEASUREMENT AND PAYMENT

- A. There shall be no separate measurement and payment for any systems. Full compensation for the system shall be considered as included in the contract unit or lump sum bid prices for the various items of the contract to which it relates.

PART 2 PRODUCTS

2.1 TURBIDIMETER

- A. The turbidimeter shall be a low-range model with an accuracy of +/- 2% of reading from 0-10 NTU. The sensor shall be constructed of corrosion-resistant Fiber Reinforced polyester with a LED light source and detector. The turbidimeter shall be Lovibond, (Part # 6134684 PTV 1000) with Process Part # 48010235 and T-CALplus®, 5.0 NTU – for Calibration Part # 19806-056 Assembly, Fluidics Manifold Part # 19806-088 Panel, Instrument Sample Management, no approved equal.
- B. The turbidimeter shall include appurtenances needed for a complete and operable system, voltage shall be 120 VAC, output 4-20 mA isolated current output.

2.2 CHLORINE ANALYZER

- A. On-line Chlorine Monitors shall be provided to continuously measure free chlorine residual, where indicated on the drawings. Each Chlorine Monitor shall consist of a direct

measuring chlorine sensor, a clear constant-head flowcell, 25 feet of sensor interconnect cable (field verify length of cable before purchase) with quick disconnect plug, and an electronic monitor housed in a NEMA 4X enclosure suitable for wall, pipe, or panel mounting.

- B. The chlorine sensor shall be a direct measuring polarographic sensor utilizing a special polymeric membrane to isolate the sensing electrodes from the sample and eliminate the potential for electrode contamination. The membrane shall allow chlorine to diffuse into the sensor where it shall react with the sensing electrode, generating a signal that is linearly proportional to chlorine concentration. The sensor assembly shall also contain a precision RTD temperature sensor to continuously measure sample temperature to allow temperature compensation of the measured chlorine value. The chlorine sensor shall be constructed with a quick disconnect receptacle to allow easy sensor servicing or exchange. Chlorine sensors shall be supplied complete with at least 10 spare membranes, electrolyte, and a spare parts kit that includes all o-rings and special hardware.
- C. The flowcell assembly supplied with the monitor shall be constructed of clear material allowing the condition of the sensor membrane to be inspected without removal of the sensor. The sensor shall slide easily into the side of the flowcell, with a double o-ring seal to prevent water leakage. Flow to the sensor shall be regulated automatically through a constant-head overflow arrangement. Hose barbs for sample inlet (1/4" I.D. tubing) and drain (1/2" I.D. tubing) shall be supplied as part of the flowcell.
- D. Monitors shall be powered by 90-260 VAC single-phase line power. Monitor shall provide two isolated 4-20 mA outputs as standard, with an option for a third 4-20 mA output. Outputs shall be configurable for chlorine, pH, temperature, or PID control. Analog outputs shall be both ground isolated and isolated from each other.
- E. For alarm purposes, monitors shall contain three SPDT relays. Relay functions shall be programmable for control, alarm, or fail functions, and may be designed for either normal or failsafe operation. For monitors supplied with only 2 analog outputs, monitors shall have the option of an additional 3 low-power relays to allow for additional external alarm functions.
- F. The complete Chlorine Monitor shall be Series Q46-1-62-1A-1-1-A-1, residual chlorine monitor, 120-240v, free chlorine, sensor with constant head flowcell and 25-foot cable, no pH probe, no digital output, no optical output, no panel assembly as manufactured by Analytical Technology, Inc. (ATI), (no equal).
- G. On-site startup assistance and operator training shall be required.

2.3 pH MONITOR

- A. The pH Monitor shall be ATI's QRP -1-1P-WW-WW-WW-1-A, Q46 model, (P) Measurement, Power: 100-240v, 50/60 Hz, Cleaning System – none, Digital Output – none, Optical Output – none. The Sensor shall be Part No. 07-0051 Q25P2-1-1 Differential Sensor (P2) pH Municipal Glass, 1" NPT Convertible-style PEEK, with 15 ft cable. The Unit shall also include Sensor Tee Part No. 07-0221 1 1/2" NPT Union/Tee Mount, CPVC.
- B. On-site startup assistance and operator training shall be required.

2.4 CONDUCTIVITY TRANSMITTER/MONITOR

- A. The Water Conductivity Unit shall be ATI Model Q46 QB-1-C1-AC-1-A-1. It shall include the 4 Electrode Conductivity transmitter/monitor (100-240v, Convertible PEEK Body, 15 ft cable, Digital Output – none, Optical output – none) also include Sensor No. 07-0221 1/12” NPT Union/Tee mount and Part No. 09-0048 Conductivity Standard – 1,500 mS, 500 mL.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All equipment shall be mounted and installed as per manufacturer recommendations. Coordinate final location with Engineer/Owner.

3.2 TESTING

- A. After installation of the equipment is complete, operating tests shall be carried out to assure that the equipment operates properly. All piping shall be tested hydrostatically and for leaks. If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be conducted again.

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SECTION 22 10 10
PLUMBING PIPING AND SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A.CONTRACTOR shall furnish and install plumbing piping and specialties, complete and operable, as indicated on the Drawings and in accordance with the contract documents.

B.Plumbing piping and specialties include piping, pipe hangers, sleeves, supports, brackets, valves, drains, cleanouts, hose bibs, yard hydrants, and related items.

1.2 RELATED WORK

A.Related work specified in other sections includes but is not limited to:

- | | |
|---------------------|-----------------------------------|
| 1. Section 01 33 00 | Submittal Procedures |
| 2. Section 09 90 00 | Painting and Finishes |
| 3. Section 33 05 03 | Copper Pipe |
| 4. Section 33 12 00 | Mechanical Appurtenances |
| 5. Section 33 13 00 | Pipeline Testing and Disinfection |

1.3 REFERENCES

A.The latest edition of the following publications form a part of this specification to the extent referenced. The publication is referred to in the text by basic designation only.

B.AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

1. B31.1 Power Piping

C.AMERICAN STANDARDS FOR TESTING AND MATERIALS (ASTM)

1. ASTM A 74 Standard Specification for Cast Iron Soil Pipe and Fittings
2. ASTM B 43 Standards for Seamless Red Brass Pipe

D.CAST IRON SOIL PIPE INSTITUTE (CISPI)

1. CISPI 301 Standard Specification for Hub-less Cast-Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

E.INTERNATIONAL MECHANICAL CODE (IMC)

F.INTERNATIONAL PLUMBING CODE (IPC)

G. FACTORY MUTUAL INSURANCE COMPANY (FM GLOBAL)

1. FM 1680 Approval Standard for Couplings Used in Hubless Cast Iron Systems for Drain, Waste or Vent, Sewer, Rainwater or Storm Drain Systems Above and Below Ground, Industrial/Commercial and Residential

1.4 PIPING SYSTEM LAYOUTS

- A.Piping system drawings are diagrammatic and are intended to show the approximate location of equipment and piping. Verify dimensions, whether in figures or scaled, in the field. CONTRACTOR is responsible for the installation of complete and workable systems whether completely detailed on the plans or not.
- B.Ascertain locations of apparatus, fixtures, equipment, and piping in the field, and layout work accordingly. ENGINEER reserves the right to make minor changes in location of piping and equipment up to the time of installation without additional cost to OWNER.

1.5 SUBMITTALS

- A.Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B.Submit general arrangement drawings of system components.
- C.Submit product catalog cut sheets and other manufacturer information.

1.6 REQUIREMENTS OF REGULATORY AGENCIES

- A.Install work per applicable provisions of codes, rules, regulations, statutes, and ordinances of authorities having jurisdiction.

PART 2 PRODUCTS

2.1 GENERAL

- A.Plumbing piping and specialties shall be as recommended by the manufacturer for the intended use.
- B.Any pipe, plumbing fitting or fixture, solder, or flux used in the installation or repair of any potable water system shall be “lead free” except where necessary for the repair of leaded joints of cast iron pipes.

2.2 PIPING AND FITTINGS

- A.Cast iron sanitary, storm, vent pipe and fittings shall be manufactured in accordance with ASTM A 74.
- B.Hub-less cast-iron soil pipe and fittings with **Camp-All** type pipe couplings, or approved equal, shall be used for above ground sanitary, storm, and vent piping where approved for use by local authorities.
- C.Hub-less cast-iron soil pipe and fittings shall meet CISPI Standard 301.
- D.Pipe couplings shall have high torque capacity and shall meet FM Standard 1680.
- E.Copper tubing and fittings for potable water shall be in accordance with Section 33 05 03 – Copper Pipe.
- F.Brass piping shall match iron pipe size standards and meet ASTM B 43 Standards for Seamless Red Brass Pipe.

G. Stainless Steel Pipe shall be Type 304 Stainless Steel, unless otherwise specified, and shall be in accordance with Section 40 05 13.19 – Stainless Steel Process Pipe.

2.3 PIPE HANGERS AND SUPPORTS

A. Pipe hangers and supports shall meet the requirements of IMC Section 305 Pipe Support, and the following. If there is a discrepancy in the requirements of these documents the more stringent requirement shall apply.

B. Properly support, suspend, or anchor all piping and fittings to prevent sagging, over stressing, or longitudinal movement of piping, and to prevent thrust or loads on or against other equipment.

C. Support horizontal piping on adjustable split steel ring or clevis hangers. The following schedule shows minimum spacing.

1. Steel, Brass and Copper:
 - a. 1-1/4" and smaller 6'-0" on center
 - b. 1-1/2" thru 3" 8'-0" on center
 - c. 4" and larger 12'-0" on center
2. PVC, CPVC, AND ABS:
 - a. 1" and smaller 4'-0" on center
 - b. 1-1/4" thru 2" 5'-0" on center
 - c. 2-1/2" thru 4" 6'-0" on center
 - d. 5" and larger 8'-0" on center

D. Support insulated piping with pipe saddles and hangers that fit on the outside of insulation. Do not compress or damage pipe insulation with hangers or supports.

E. Provide all rigid hangers with a means of vertical adjustment after erection.

F. Use copper or copper plated hangers for supporting uninsulated copper pipes.

G. All vertical and horizontal piping supports shall be fiberglass **EnduroStrut by Enduro Systems, Inc.**, or approved equal.

H. Perforated strap hangers or wire supports will not be permitted.

2.4 INSERTS

A. Furnish and set inserts in concrete forms; provide reinforcing rods for pipe sizes over 3 inches or equivalent.

B. Furnish concrete inserts as follows: Black, malleable iron, universal type for threaded connections with lateral adjustment. Inserts shall be galvanized unless noted otherwise on the Drawings.

2.5 INSULATION

A. Hot water piping, valves, fittings, and exposed horizontal sanitary, storm, and vent piping shall be provided with one-inch-thick insulation.

B. Covering valves, flanges, fittings, and ends of insulation with pre-molded high- and low-temperature PVC fitting cover, end cap, or similar pre-formed unit. The pre-formed unit covers shall be sized to receive the same thickness insulation as used in adjacent piping.

C. Exposed supply and drain piping for lavatories shall be insulated under the wash basins in order to prevent burns and abrasions to handicapped persons. Removeable insulated covers shall be **Handy-Shield Type by Plumberex Specialty Products**, or approved equal.

2.6 SHIELDS

A. Provide shields to protect insulation in all areas.

B. Provide approved galvanized form shields to isolate pipe in contact with hangers and supports.

C. Furnish low compressive insulation protector shields. Size the shields per the manufacturer's recommendations.

2.7 SLEEVES

A. Where pipes pass through floors, footings, foundations, walls, or ceilings, furnish and install pipe sleeves. Sleeves for concealed piping shall be of Schedule 40 galvanized steel pipe one size larger than the pipe passing through. For exposed piping Schedule 40 black steel pipe installed so as to be completely covered by escutcheons. Extend sleeves through floors 1/2 inch above finish floor.

2.8 ESCUTCHEONS

A. Fit pipe passing through walls, floors, or ceilings with escutcheons with set screws.

B. Use prime painted escutcheons where surface is to receive a paint finish; otherwise, use escutcheons that are nickel or chromium plated.

C. Where piping is insulated, use escutcheon outside the insulation.

2.9 JOINTS

A. For screwed pipe make ends with sharp, clean tapered threads using teflon tape on the male thread only. Do not use mill cut threads. Ream cut pipe to full inside diameter.

B. Welding may be done by either the arc or acetylene process conforming to the requirements for the ASME B31.1.

C. For solder joints use fittings specifically made for soldering. Clean all burrs and roughen pipe to clean; solder complete around joint.

D. For grooved pipe jointing systems use mechanical pipe couplings and fittings.

E. For no-hub cast iron soil pipe use double screw joint neoprene coupler.

2.10 UNIONS

A.Furnish and install unions for each valve or piece of equipment to permit easy installation and removal of equipment.

2.11 VALVES

A.Water shutoff valves shall be the gate or ball type as designated on the drawings, except on fixture supply piping where globe style valves shall be used.

B.Hose Bibbs shall be provided where indicated on the Drawings. The hose nipple shall be a female iron pipe thread inlet with hose thread outlet. Hose bibbs shall be 3/4-inch size unless noted otherwise on the Drawings.

C.Gate and ball valves shall be in accordance with Section 33 12 00 – Mechanical Appurtenances.

2.12 FLOOR DRAINS IN CONCRETE FLOORS

A.Floor drains in concrete floors shall be constructed of cast iron of the size indicated on the Drawings and provided with sediment buckets.

B.Each floor drain located on an upper floor shall have a clamping collar with 4 pound sheet lead flashing 12 inches minimum all around. Where flashing does not comply with local code use epoxy waterproofing membrane.

C.Floor drains shall be **Z520-Y by Zurn Industries, 32100-AE-81 by Josam Company, Figure 2350 by Jay R Smith Mfg. Co.**, or approved equal.

2.13 FLOOR CLEANOUTS

A.Cleanouts in concrete floors shall be heavy plugs with tapered shoulder against heavy brass plugs.

B.Cleanout shall have a minimum diameter of 3-inches.

C.Floor cleanouts shall be fabricated from cast iron with gas and watertight ABS tapered thread plug.

D.Floor cleanout shall be **Z1400 by Zurn Industries, 55000 Series by Josam Company, 4237 Series by Jay R Smith Mfg. Co.**, or approved equal.

2.14 NON-FREEZE HYDRANTS

A.Hydrants in exposed locations subject to freezing shall be the non-freeze type. Hydrant shall have a brass pipe outer casing, brass operating rod, and brass male hose nozzle. Hydrants shall be **Model Iowa Y1 by Woodford Manufacturing Co.**, or approved equal.

2.15 GAS LINE PIPING

A.General - Gas line piping shall be installed where shown on the plans.

1. When connecting to existing piping at the 700 East site Contractor shall coordinate gas line shutdown and relocation of the existing meter with Dominion Energy and install new piping below grade to match the existing system.
2. When connecting to existing piping at the 1000 East site Contractor shall coordinate gas line shutdown with Dominion Energy and install new piping below grade to the new Well House.

B.Piping shall be 1 1-1/2" MPT x 1-1/2" IPS SDR11 PE 36" Rise x 26" Gas Anodeless Meter Riser YELLOW MDPE

1. Butt Fusion x Epoxy Coated Carbon Steel Male Threaded
2. Butt Yellow PE2406/2708 Fusion End
3. Can be joined using butt fusion, electrofusion, socket fusion or constab type fittings
4. Conforms to ASTM D2513 Category 1
5. Meter risers shall be used to transition from below ground polyethylene pipe to above ground metallic pipe.

C.Meter Risers shall be designed to join pipe meeting ASTM D2513 Cat 1

1. Pressure rating 125 psig
2. Rigid Anodeless meter risers meet ASTM F1973 "Standard Specification for Factory Assembled Anodeless Risers and Transition Fittings in Polyethylene (PE) Fuel gas Distribution Systems"
3. Meet ASTM F2509 "Standard Specification for Field-assembled Anodeless Riser Kits for Use on Outside Diameter Controlled Polyethylene Gas Distribution Pipe and Tubing"
4. No cathodic protection required
5. Size Range — 1/2" to 2"
6. Meets NFPA 58 and NFPA 54
7. Third party tested to Uniform Plumbing Code (UPC) & CSA

D.Above ground gas piping and fittings shall be black steel Schedule 40 pipe painted to meet OSHA standards.

E.Piping shall be as manufactured by Manufactured by Continental or approved equal

2.16 PREPARATION

A.Prior to installation of piping, verify that it will not interfere with clearances required for the erection and finish of structural members, architectural members, electrical, sprinkler, or mechanical items.

B.Hang or support piping materials from roof support system whenever possible.

C.Do not cut any structural members for installation of piping.

2.17 INSERTS

A.Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.

B.Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 3 inches in diameter.

C.Where concrete slabs form finished ceiling, finish inserts flush with slab surface.

D.Where inserts are omitted, drill through concrete slab from below and provide rod with recessed squared steel plate and nut above slab.

2.18 SLEEVES

A.Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.

B.Extend sleeves through potentially wet floors 1 inch above finished floor level. Caulk sleeves full depth and provide floor plate.

C.Where piping passes through floor, ceiling, or wall, close-off space between pipe and construction with noncombustible insulation. Provide tight-fitting metal caps on both sides and caulk.

2.19 PIPE HANGERS AND SUPPORTS

A.Support all piping and make adequate provisions for expansion, contraction, slope and anchorage.

B.The use of pipe hooks, chains, or perforated metal for pipe support will not be permitted.

C.Suspend all piping in the building as indicated.

D.Install hangers to provide minimum 1/2-inch clear space between finished covering and adjacent work.

E.Place a hanger within 1 foot of each horizontal elbow.

F.Use hangers which are vertically adjustable 1-1/2 inch minimum after piping is erected.

G.Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

H.Where practical, support riser piping independently of connected horizontal piping.

2.20 PIPING INSTALLATION

A.Cut piping accurately for fabrication to measurements established at the construction site and work into place without springing or forcing.

B.Remove burrs and cutting slag from pipe by reaming or other approved cleaning methods.

C.Make changes in direction with proper fittings.

- D. Arrange piping so as not to interfere with the removal of other equipment, ducts, or devices. Do not block doors, windows, or access openings. Provide unions in the piping at connections to all equipment. Unions must be accessible.
- E. Cap or plug open ends of pipes and equipment with PVC caps or expanding neoprene plugs to keep dirt and other foreign materials out of the system. Plugs of rags, wool, cotton, waste, or similar materials are not acceptable.
- F. Install all piping systems so they can easily be drained. Provide anti-siphon hose bibbs at low points on water lines.
- G. Slope all soil and waste lines within the building at 1/4 inch per foot fall in the direction of flow unless indicated otherwise.

2.21 PRIMING AND COATING

- A. Prime coat exposed steel hangers and supports and hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces in accordance with Section 09 90 00 – Painting and Finishes.

2.22 PIPE LABELING

- A. Exposed pipe shall be labeled in accordance with Utah State Regulation R309-525-8, Section 33 05 26 – Utility Identification, and the IPC.

1. Labeling shall include direction arrows for flow.

2.23 DISINFECTION AND TESTING

- A. CONTRACTOR shall perform such tests as are required by local ordinances and codes in the presence of the local governing authority inspector to show that piping is tight, leak free, and otherwise satisfactory, and shall perform such tests as ENGINEER may direct to ensure that fixtures and equipment operate properly.
- B. Disinfect potable water piping in accordance with Section 33 13 00 - Pipeline Testing and Disinfection.
- C. Test all potable water piping.
- D. Repair defects which develop under tests promptly and repeat tests. No caulking or screwed joints, cracks, or holes will be permitted. Replace pipe or fitting or both with new material when repairing leaks in screwed joints.
- E. Repair leaks in copper tubing by melting out joint, thoroughly cleaning both tubing and fitting, and resoldering.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install to local codes.

- END OF SECTION -

SECTION 22 11 24
PUMP AND PUMP MOTOR

PART 1 GENERAL

1.01 DESCRIPTION

- A. CONTRACTOR shall furnish a deep well oil lubricated-line-shaft vertical turbine pump, with above ground discharge and furnished with suitable driver and accessories to meet the requirements herein or as shown on the Contract Drawings.

1.02 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract:
1. American National Standards Institute (ANSI):
 - a. B16.1, Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.
 - b. HI 9.6.4, Rotodynamic Pumps for Vibration Measurements and Allowable Values.
 2. ASTM International (ASTM):
 - a. A36, Structural Steel.
 - b. A48, Gray Iron Castings.
 - c. A53, Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - d. A108, Steel Bars, Carbon, Cold Finished, Standard Quality.
 - e. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - f. A536, Standard Specification for Ductile Iron Castings.
 - g. A582, Standard Specification for Free-Machining Stainless Steel Bars.
 - h. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
 3. American Water Works Association (AWWA):
 - a. C651, Standard for Disinfecting Water Mains.
 - b. C654, Standard for Disinfecting of Wells.
 - c. E103, Standard Specifications for Horizontal and Vertical Turbine Line- Shaft Pumps.
 4. National Sanitation Foundation (NSF):
 - a. NSF/ANSI 60, Drinking Water Treatment Chemicals.
 - b. NSF/ANSI 61, Drinking Water System Components – Health Components.
 - c. NSF/ANSI 372, Drinking Water System Components – Lead Content.

1.03 SUBMITTALS

- A. CONTRACTOR shall submit for review to, sufficient literature, detailed specifications, and drawings to show dimensions, make, style, speed, size, type,

horsepower, head-capacity, efficiency, materials used, design features, internal construction, weights, and any other information required by ENGINEER for review of all pumping equipment. No pumping equipment will be accepted, and installation will not be allowed until such review has been completed. All submittals shall clearly state any deviations from the specified requirements. The following shall also be furnished with the submittal:

1. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. Equipment manufactured shall indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at specified design point.
2. Equipment manufactured shall provide complete and detailed information regarding the installation of pumps. Any installation requirements or operating conditions which supplier or manufacturer feel to be critical to the safe and reliable operation of the pumps should be identified and described in detail.
3. Shop Drawings submitted for review also shall include detailed description of motor, including electrical diagrams, schematic control diagrams, and a detailed description of how the control system is to function, where applicable.

1.04 OPERATING CONDITIONS

A. Table 1 indicates the operating conditions of the pumps.

Table 1 Operating Conditions Deep Well Turbine Pumps		
Description	700 East Well	1000 East Well
Design capacity of pump (gpm)	1400	3400
Design total dynamic head at discharge bowl assembly (feet)	626	615
Pump Setting Depth (feet)	390	390
Nominal Operating Speed (rpm). Note, both pumps will be operated with a VFD.	1770	1770
Minimum Efficiency at Design Point	83.0%	82.0%
Maximum NPSHR at Design Point	12 feet	31 feet
Minimum Motor Horsepower	300	700
Column Size (diameter)	10-inch	12-inch

Table 1 Operating Conditions Deep Well Turbine Pumps		
Description	700 East Well	1000 East Well
Minimum Shaft Size (inches)	1-15/16 (SS 416)	2-1/4 (SS 416)
Diameter of Well Casing	20-inch (19.25" I.D.)	20-inch (19.25" I.D.)
Maximum Bowl Diameter	14.13 in.	15.63 in.
Approx. Elevation (ft. above MSL)	4451	4502
Model No.: National	M14MC	H14XHO
Utility Power (volts, phase, hertz)	480,3,60	4160,3,60

1.05 MECHANICAL DEFECTS AND REJECTIONS

- A. CONTRACTOR furnished pumps that have mechanical defects or do not meet the requirements for head-capacity, horsepower, efficiency, and vibration requirements will be rejected, and shall be replaced without additional cost to OWNER for furnishing, removal, reinstallation, and retesting. Mechanical defects shall include excessive vibration, improper balancing of any rotating parts, improper tolerances, binding, excessive bearing or motor heating, defective materials, including materials that do not conform to the Specifications, improper fitting of parts, and any other defect which will in time damage pump or unreasonably impair its efficiency or operation.

1.06 WARRANTY

- A. CONTRACTOR furnished equipment covered by these specifications shall be warranted against defective parts due to faulty material or workmanship for 1 year after date of start-up. CONTRACTOR shall guarantee to replace any defective parts within the period of time specified at no additional cost to OWNER. If CONTRACTOR must pull pump to replace defective parts, CONTRACTOR shall guarantee to pull and replace pump at no additional cost to OWNER.

1.07 FACTORY TESTING

- A. Equipment shall be factory tested and inspected as specified hereinafter. All costs for the tests shall be borne by CONTRACTOR. CONTRACTOR shall submit the complete shop test procedures to ENGINEER for approval at least 30 days prior to the shop test. In the event any equipment fails to meet the performance values set forth in this specification, the equipment shall be modified and retested or replaced with equipment that performs in accordance with this specification.
1. Impeller, motor rating and electrical connections shall be checked for compliance with the customer's purchase order.

2. Pump and motor shall be performance tested as specified hereinafter. Three copies of certified test reports, including actual test records, shall be submitted, and approved by ENGINEER prior to shipment of the equipment.
- B. Any deficiencies identified shall be corrected and appropriate testing redone. A certified test report on the results of the factory testing shall be supplied with each pump at the time of shipment.
 - C. Factory tests of the pumping equipment shall be made in accordance with the Test Code of Hydraulic Institute 14.6-2011 Test Acceptance Grade 1U. Each pump shall be tested for performance at the factory to determine the head vs. capacity, motor total electrical power draw (kVA), and motor active electrical power draw (kW) for the full speed at which the pumps are specified and shown on a performance test curve, certified by a registered professional engineer, as continuous functions throughout the pump's performance range. Tests of models, prototypes or similar units will not be acceptable. All tests shall be run in accordance with the test code for centrifugal pumps of the Standards of Hydraulic Institute, latest edition.
 - D. Conduct the following minimum tests and submit the test results:
 1. Hydrostatic Test.
 2. Performance Test:
 - a. Conduct performance test at maximum speed, obtain a minimum of 5 hydraulic test readings between shutoff head and 25 percent beyond the maximum indicated capacity, and record on data sheets as defined by the Hydraulic Institute standards.
 - b. For variable speed pumps, test each pump between maximum and minimum speed at 100 rpm increments.
 - c. Submit pump curves showing head vs. flow, bhp, KVA, KW, and efficiency results.
 3. Mechanical Test:
 - a. Submit certification signed by a senior official of the pump manufacturer that the pump shaft horsepower demand did not exceed the rated motor horsepower of 1.0 service rating at any point on the curve.
 - b. Submit test results to ENGINEER for review prior to delivery of the pumps to the Site.
 - E. In the event of failure of any pump to meet any of the requirements, make necessary modifications, repairs, or replacements to conform to the requirements of this Section and re-test the pump until found satisfactory.
 - F. Three notarized copies of certified factory performance test curves for each pump shall be furnished and approved before shipment of the pumps to the Site.
 - G. Pumps shall have design and operational characteristics which provide for maximum efficiency and minimum hydraulic turbulence in the pump casing at the design capacity of the pump and design total dynamic head specified in Table 1, Operating Conditions Deep Well Turbine Pump. Each pump shall operate without excessive noise, vibration, heating, cavitation, or damage to the pump. Actual

certified pump capacities shall at a minimum meet the design conditions specified in Table 1.

PART 2 PRODUCTS

2.01 DEEP WELL VERTICAL TURBINE PUMP

- A. Pumps shall be of deep well, oil lubricated, vertical turbine type suitable for pumping culinary water. Material, manufacturing, and performance standards shall be in compliance with AWWA E103, NSF 60, NSF 61 and NSF 372, as applicable.
- B. Performance Requirements
 - 1. Pump Speed: Pumps shall operate as specified in Table 1.
 - 2. Pump Characteristics: Pump shall be characterized by head capacity curves of steadily decreasing head with increasing capacity. Maximum head shall be at zero flow. Pump shall have a minimum efficiency as provided in Table 1 during operation against the system head. Pump head capacity curves shall indicate that these losses have been included. Pumps shall have head-capacity curves similar to that of the specified pump. Pumps having curves that show a flatter or near horizontal slope over a section in the head; capacity curve will not be accepted. Curves with head-capacity curves with slopes of the curve flatter than that shown for the specified pump will not be accepted.
 - 3. Pump and motor shall be capable of producing the flow rate and total dynamic heads indicated in Table 1.
 - 4. Motor Characteristics: Under no operating conditions shall the required pump brake horsepower exceed the nameplate rating of the motor being furnished.
 - 5. Pump shall be designed to operate throughout its entire range without excessive vibration or noise. Pump shall meet the requirements of the Hydraulic Institute (2016) Paragraph 9.6.4 vibration limits.
- C. Vertical Turbine Pump Components:
 - 1. Pumps:
 - a. Vertical turbine pump for wells shall be manufactured **by National Pump Company, Weir Floway, FlowServe** or approved equal and shall be a multi-stage oil lube bowl assembly (“or-equal”).
 - b. Unless otherwise stated herein, the pump shall in all respects conform to the American National Standard ANSI/AWWA E103 for “Horizontal and Vertical Turbine Line Shaft Pumps” and shall comply with all local and state sanitary and safety regulations.
 - 2. Discharge Head:
 - a. Discharge head shall be fabricated steel (ASTM A53 Grade B Pipe and ASTM A36 Steel Plate), accurately machined and with a surface discharge. Discharge flange shall be machined and drilled to ANSI standards for 150-pound rating and shall be sized to match the specified system. The design shall allow for the head shaft to couple above the tube tension assembly. The tube tension assembly shall consist of a bronze CDA836 tension bearing installed in top of oil tube,

and threaded tension nut to apply proper tension on the oil tube. Sealing between tension nut and discharge head shall be accomplished with "o" rings. Locknut with "o" ring and set screw to lock tension assembly after proper tension is accomplished. Top of the discharge head shall have a rabbet fit to accurately locate the vertical hollow shaft driver and have a diameter equal to the driver base diameter (BD). Lifting lugs of sufficient strength to support the weight of the complete unit shall be provided. Base shall be round or square. Head must be able to accept the monitoring tube and well vent, and other tubing as shown on the Contract Drawings. CONTRACTOR shall modify the well base dimensions on the Contract Drawings to match supplied head.

- b. Discharge head shall be furnished with one gallon oil reservoir with copper tubing, with a 120-V ac electronic solenoid valve (with manual bypass) that shall be controlled by a relay in the RTU, and feed drip oiler.
 - c. The tube tension assembly shall consist of a bronze CDA836 tension bearing installed in the top oil tube, threaded tension nut to apply proper tension on oil tube, sealing between tension nut and discharge head shaft be accomplished with "o" rings. Locknut with "o" ring and setscrew to lock tension assembly after proper tension is accomplished.
 - d. The top line shaft (head shaft) shall be of A582 Grade Type 416 stainless steel and shall not exceed 10 feet in length. Impeller adjustment shall be provided at the top of the head shaft by means of a bronze adjusting nut of ASTM B584 alloy C876/C90300 which shall be positively locked in position.
 - e. Lifting soleplate shall be supplied and installed, if required by the pump manufacturer.
 - f. Pump manufacturer shall include the method of adjusting the pump impellers at the top of the head shaft.
 - g. CONTRACTOR shall be responsible for ensuring that the discharge head is structurally and mechanically adequate for the provided and installed pump configuration.
3. Column Assembly:
- a. The line shaft for well shall be of A582 Grade Type 416 stainless steel (118,000 psi min.) and shall be furnished in interchangeable sections not over 20 feet in length.
 - b. Butting faces shall be machined square to the axis of the shaft, with maximum permissible axial misalignment of the thread axis with the shaft axis 0.002 inch in 6 inches. Size of shaft shall be no less than that determined by ANSI/AWWA E103 Specifications, Section 4.4.2.2 - Line Shaft, for C1045 line shaft, adjusted for A582 Grade Type 416 stainless steel material, and shall be such that elongation due to hydraulic thrust will not exceed the axial clearance of the impellers in the pump bowls. Maximum runout in 10 feet shall not exceed 0.005 inch.
 - c. Line shaft bearings shall be C-844 bronze, internally grooved to allow proper lubrication to enclosed line shaft and threaded externally for connecting oil tube sections.

- d. Shaft enclosing tubes shall be ASTM A53 Grad A schedule 80 steel pipe with ends machined square and parallel and shall butt to ensure proper alignment and sealing. They shall be straight within 0.005-inch total indicator reading for a 5-foot section. Threaded internally to receive the line-shaft bearings. The enclosing tube shall be stabilized and centered in the column pipe by rubber centering spiders spaced at 40-foot intervals throughout the column pipe assemblies.
 - e. Outer column piping shall be of ASTM A53 Grade B Standard Wall steel pipe in interchangeable sections not over 20 feet in length with the ends of each section faced parallel and machined with eight straight threads per inch permitting the ends to butt and ensuring alignment when connected by standard mill steel couplings. Weight of the column pipe shall be no less than that stated in ANSI E 103, Section E.3 Table E.1, "Diameters and Weights of Standard Discharge Column Pipe Sizes". Top and bottom sections of column pipe shall not exceed 5 feet in length. CONTRACTOR shall be responsible for ensuring the column piping is structurally and mechanically adequate for provided and installed pump configuration.
4. Pump Bowl Assembly:
- a. Pump bowl castings shall be of close-grained cast iron ASTM A48 Class 30 or ASTM A536 ductile iron Class 60-40-18 where required to meet the hydrostatic pressure criteria listed below. Water passages shall be free of blowholes, sand holes, and other detrimental defects, shall be lined with porcelain enamel, and shall be accurately machined and fitted. Finished bowls shall be capable of withstanding a hydrostatic pressure equal to twice the head at rated capacity or equal to or greater than the shut-off head, whichever is greater.
 - b. The top bowl shall have an extra-long throttle bearing with two seals to minimize the amounts of leakage through the drain ports.
 - c. Impellers shall be ASTM B584 alloy C87600 lead free bronze, enclosed type, and shall be statically balanced, and shall be fastened securely to the impeller shaft with Type 316 stainless steel collets. Impellers shall be adjustable vertically by an external means. Impeller skirt and series case throat area shall be thick enough to allow for machining and wearing at the time of repair. *The bowl wear rings shall be hardened 17-4 stainless steel with a Rockwell C-Scale Hardness number of 40 and impeller wear rings shall be hardened 17-4 stainless steel with a Rockwell C-Scale Hardness number of 32.*
 - d. Pump shaft shall be of ASTM A564 17-4 stainless steel turned, ground and polished. Bearings shall be Morse or Durmax Marine Bearings consisting of sleeve bearings with a Naval Brass outer shell super-bonded to a fluted rubber bearing surface (or approved equal) above and below each impeller. Size of the shaft shall be no less than that determined by ANSI/AWWA Specifications E103.
 - e. Discharge case shall be cast with by-pass ports to allow release of fluids through the throttle bearing. The discharge case shall be fitted with a Bowl Adapter Tube for connection to the enclosing tube and threaded for connection to the discharge column pipe. The Bowl Adapter Tube shall have a bronze sleeve bearing in the bottom and threaded for a bronze line shaft bearing on top. The discharge case shall be threaded on the outside for column sizes up to 14 inches and

fitted with a cast iron ASTM A48 Class 30 column adaptor of the proper size to connect to the column selected. Likewise, the suction case shall also be threaded on the I.D. and fitted with a cast iron or steel suction adaptor.

5. Suction Pipe and Strainer:
 - a. Suction pipe shall not be required.
 - b. A *Type 316 stainless steel* cone strainer shall be provided having a net inlet area equal to at least four times the suction pipe area. The maximum opening size shall not be more than 75 percent of the minimum opening of the water passage through the bowl or impeller.

2.02 ANALYSIS

- A. Tests may be conducted with shop motor to facilitate the manufacturing process.
- B. Minimum speed curve shall be plotted on the performance curve, based on the affinity laws and the test data.
- C. Gauges shall be calibrated annually per Hydraulic Institutes and certified calibration data shall be provided. Flow meters and other test instruments shall be calibrated as required by ANSI/HI standards.
- D. To ensure that neither harmful nor damaging vibrations occur to the pump structure at any speed within the specified operating range, the following analysis shall be required:
 1. Pump manufacturer shall perform a structural frequency analysis of the above ground structural components utilizing a FEA method to ensure that no structural natural frequencies are excited to a degree that would cause measured vibration amplitudes at the top of the discharge head to exceed the requirements of ANSI/HI 9.6.4-2009. When deemed necessary by the experience of the manufacturer, the below ground structural components shall also be included in the analysis.
 2. FEA method should include the use of ProE/Mechanica or an equivalent software. All pump assembly components, including the motor, shall be represented as solid elements, and if idealizations are used in place of solid elements, then a complete description of method for the idealization shall be included in the report. Analysis shall also include all modes of interest and pictorially represent each mode shape. Modes of interest are defined as those structural frequencies that exist below 120 percent of the maximum operating speed. When significant modifications are required to lower the system's natural frequency, the pump structure's stresses and deflections shall also be reviewed. Analysis reports shall conclude acceptable operation at the analyzed operating speeds. design critical frequency shall be at least 20 percent above or below the operating range of the pump.
- E. Manufacturer to provide documentation of the analysis ensuring that the specified requirements have been met, and that documentation should be signed and stamped by the professionally licensed engineer who performed the analysis work.

- F. When measured in the direction of maximum amplitude on the pump and motor bearing housings, shall not exceed limits given in the latest ANSI/HI nomograph for the applicable pump type.

2.03 MOTOR

- A. Pump motor shall be a vertical hollow shaft, premium efficiency, inverter duty, WP1 enclosure, electric motor, and shall be sized as noted in Table 1. Motor shall have a non-reverse ratchet, P-base, squirrel cage induction design. Motor shall have Class F insulation with temperature rise as specified by NEMA standards for class of insulation used and shall have a 1.15 service factor. Pump motor will be operating in an ambient temperature range of 50 degrees F to 110 degrees F.
- B. Pump motors shall be provided with an electronic vibration switch which uses 24 VDC power with 4-20 mA analog and relay output. House switch in weatherproof enclosure. Metrix-PMC model 440SR-2020-0220.
- C. Pump motors shall have over temperature protection, which shall consist of a minimum of six RTDs embedded in the motor windings and one RTD at each of the two bearings. Wiring to an external junction box shall be provided. RTDs shall be 100-ohm platinum three-wire elements.
- D. Thrust bearing shall be chosen to handle the continuous down-thrust as specified by the pump manufacturer with an AFMBA L-10 bearing life of 40,000 hours and an L-50 of 200,000 hours. Provisions shall be made for momentary up-thrust equal to 30 percent of rated down-thrust.
- E. Motor shall be suitable for across-the-line starting, soft start, inverter duty, and shall be capable of reduced-voltage starting.
- F. Motor rating shall be such that at design it will not be loaded beyond nameplate rating and at no place on the pump curve shall the loading exceed the service factor.
- G. Motor temperature shall be rated no higher than the allowable operating temperature of the motor thrust and radial bearings and in no case shall it exceed the temperature rating of the insulation class used to wind the motor.
- H. Junction box shall be oversized to accommodate wiring connection for 480-volt motor with two 3-inch conduit penetrations on the bottom for the motor conduits. Junction box shall be a standard box for the 4,160-volt motor with one 4-inch conduit penetration on the bottom for the motor conduit.
- I. Motors connected to VFDs shall have factory installed shaft grounding rings. Supplier shall provide a warranty against VFD-induced bearing damage or failure for the life of the motor. Motor shall also include insulated bearings to prevent circulation and other bearing currents. *Grounding rings shall be stainless split-type. Ground rings shall be connected to the electrical ground system for the facility. Ground ring manufacturer shall be Aegis PRO or approved equal. The insulating bearing material shall be alumina oxide or ceramic. Insulated bearing manufacturer shall be SKF, NTN Corporation, GMN Bearing USA, or approved equal.*

- J. Water-cooled motors are not allowed.
- K. Motors shall be equipped with 120V heaters to keep windings dry when motor is not in use.
- L. Motors shall be manufactured by US Motors, General Electric, or approved equal.

2.04 APPURTENANCES

- A. Well Monitoring Tube:
 - 1. CONTRACTOR shall furnish and install three 1-1/2-inch diameter well monitoring tubes in each well consisting of Schedule 80 PVC pipe. Tubes shall be furnished in sections not over 20 feet in length and shall be joined with flush threaded couplings.
 - 2. PVC tube shall be joined and banded to the pump column with stainless steel bands at maximum of 10 feet. A minimum of two 1/4-inch diameter vent holes for every 10 feet of length shall be provided throughout the entire length of the monitoring tube. The depth of the monitoring tube shall be as indicated on the Contract Drawings. Bottom end shall be capped.
- B. Well Vent: Well vent shall consist of galvanized steel 1-inch diameter pipe through well surface plate extended up to 18 inches above the bottom plate of pump discharge head with a 180-degree bend made of two steel ells. The outlet end of vent pipe shall be covered with No. 14 stainless steel wire mesh securely fastened by a stainless-steel band. The lower end of vent pipe shall be threaded into well surface plate and provide water-tight seal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install pump and motor at the location shown on the Contract Drawings and according with manufacturer's recommendations.
- B. All pumps, complete with drive system, in place at Job Site, shall not exceed acceptable field vibration limits given in latest revisions of Hydraulic Institute Standards. Pumps shall be free of static unbalance; shall be free of dynamic unbalance up to the maximum speed of the pump and drive system; shall be free of torsional vibration from 10 percent below the minimum speed to 10 percent above the maximum speed of the pump and drive system; and shall be free of apparent unbalance caused by defective bearings, by close fittings parts which may rub on the rotating parts intermittently, or by loose discs or rotor parts, or unbalanced loads.
- C. Motor/discharge head assembly shall be shimmed with respect to the well casing flange to bring the motor/discharge assembly into optimum alignment with any variations that the pump column and line shaft may exhibit from being truly plumb. Such shims must be structurally sound and securely attached. Water-tight seal between discharge head and well casing flange must be maintained.

- D. Pumps shall not be installed in the wells prior to within 3 months when power is available to start the pumps.

3.02 FIELD TESTS

- A. After installation, the pump shall be given an operating test to demonstrate freedom from mechanical defects, excessive noise, and vibration. The test shall include operating pump continuously while throttling discharge as needed. Operating test shall be performed for a minimum of one hour, or as directed by ENGINEER. Pumps with variable speed drives shall be tested at maximum speed, and at the average and minimum speeds listed under the specification for the pumps. Copy of actual test data shall be furnished to ENGINEER.
- B. Tests for acceptable vibration shall be made, at no additional cost to OWNER, in the field on each pump system, which in the opinion of ENGINEER, seem to have excessive vibration. Field tests shall be running tests with pump pumping the product for which it is intended, and each pump system shall be tested separately with no other pumps running. Testing shall be done in the presence of ENGINEER. Amplitude as used in this Specification, shall mean total peak-to-peak displacement. Required test for acceptable vibration will be the measurement of this peak-to-peak displacement and will be performed with an IRD Vibration Meter, Model 306; Bently-Nevada TK-8; "Or-equal."

3.03 PROTECTIVE COATINGS AND LININGS

- A. *Coat the pump bowls in accordance with NSF Epoxy System 1 per Specification Section 09 91 00.*
- B. *The Discharge Head shall be lined with NSF Epoxy System 1 and coated with System 3 per Specification Section 09 91 00.*

3.04 DISINFECTING

- A. Source of Water: CONTRACTOR shall assume all responsibility to obtain necessary water supplies for disinfection of pumping system.
- B. Testing Procedure:
 - 1. Leakage and pressure testing must be completed, and all leaks repaired prior to disinfection procedures.
 - 2. Pump and related piping installed under this Contract shall be disinfected using an approved disinfection method in accordance with the American Water Works Association Standard for Disinfecting Water Mains (AWWA C651) and American Water Works Association Standard for Disinfecting Wells (AWWA C654).
 - 3. Heavily chlorinated water shall not be discharged onto the ground. Upon completion of disinfection, Sodium Bisulfate (NaHSO_3) shall be applied to the heavily chlorinated water to neutralize thoroughly the chlorine residual remaining. Water shall be neutralized to less than 1 ppm.

4. After completion of the disinfection, CONTRACTOR shall flush the new system until the chlorine residual is a maximum of 0.3 ppm after which bacteriological test will be performed by OWNER.
5. At the end of 24 hours after the first sample is taken, a second bacteriological test will be performed by OWNER to insure adequate disinfection. If initial or second disinfection fails to provide satisfactory bacteriological results, or shows presence of coliform, then well line and related piping shall be re-chlorinated, flushed, and retested until satisfactory results are obtained at expense to the CONTRACTOR.

- END OF SECTION -

SECTION 22 11 25
SUBMERSIBLE SUMP PUMPS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section includes submersible sump pumps intended for operation with clear liquids. CONTRACTOR shall provide pumps and appurtenances for complete and operable installations according to the contract documents.

1.2 RELATED SECTIONS

- A. Related Work in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
 2. Division 26 Electrical Provisions

1.3 SYSTEM DESCRIPTION

- A. Pumps shall be suitable for use in pumping drainage from floor drains and equipment drains which may contain small quantities of dirt, oil and grease. Pumps shall be suitable for heavy-duty continuous service.
- B. All submersible sump pumps shall have the following operating characteristics.

Parameters	Valve Vault
1. Pump capacity, gpm	40
2. Head, ft	15
3. Minimum rated HP	0.5

1.4 ENVIRONMENTAL CONDITIONS

- A. Sump pumps will be located within the vaults as shown. The expected temperature range of water is between 40- and 75-degrees F.

1.5 SUBMITTALS

- A. The following information shall be provided in accordance with Section 01 33 00 - Submittal Procedures Catalog information describing the pump as well as head, capacity, level control switch, and power ranges.

PART 2 PRODUCTS

2.1 MATERIAL

- A. Each pump shall be of the completely immersible type designed to operate completely submerged but capable of intermittent operation with the motor exposed. The motor chamber shall be oil filled and hermetically sealed. The shaft bearings shall be oil lubricated and designed for the radial and thrust loads imposed by the specified operating conditions. The motor impeller shall be mounted on a common steel shaft with a mechanical seal and shall be designed to be completely removable from the motor end of the pump. The impeller shall be capable of passing a 3/4-inch diameter sphere.
- B. Pumps shall be suitable for automatic operation using an attached level-controlled switch. The power cable shall be sealed at the motor bell and of sufficient length to reach, without splices to the junction box shown. The pumps shall be designed for operation of 120-volt, single phase, 60 hertz electric service.

2.2 MANUFACTURER

- A. The pumps shall be **Tsurumi HS (Z) 2.4S-62 - 0.5 HP**, or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Sump pumps shall be installed where shown in strict accordance with the pump manufacturer's recommendations.

- END OF SECTION -

SECTION 26 05 00
ELECTRICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 DESCRIPTION

- A. It is the intent of this part of the Contract Documents to cover all work and materials necessary for erecting complete, ready for continuous use, a tested and working electrical system, substantially as indicated on the Plans and as hereinafter specified.

1.2 GENERAL PROVISIONS

- A. Minimum sizes of equipment, electric devices, etc., are indicated but it is not intended to show every offset and fitting, nor every structural or mechanical difficulty that will be encountered during the installation of the work.
- B. All work indicated on the Plans is approximately to scale, but actual dimensions and detailed drawings should be followed as closely as field conditions permit. Field verification of scale dimensions on Plans is directed since actual locations, distances, levels, etc. will be governed by field conditions.
- C. Discrepancies indicated on different Plans, between Plans and actual field conditions, or between Plans and Contract Documents shall be promptly brought to the attention of ENGINEER for a decision.
- D. The alignment of equipment and conduit shall be varied due to architectural changes, or to avoid work of other trades, without extra expense to OWNER.
- E. CONTRACTOR shall furnish and install all parts and pieces necessary to the installation of equipment in accordance with the best practice of the trade and in conformance with the requirements of these Contract Documents.
- F. All items not specifically mentioned in these Contract Documents or noted on the Plans or accepted shop drawings, but which are obviously necessary to make a complete working installation, shall be deemed to be included herein.
- G. CONTRACTOR shall lay out and install electrical work prior to placing floors and walls. He shall furnish and install all sleeves and openings through floors and walls required for passage of all conduits. Sleeves shall be rigidly supported and suitably packed or sealed to prevent ingress of wet concrete.
- H. CONTRACTOR shall furnish and install all inserts and hangers required to support conduits and other electrical equipment. If the inserts, hangers, sleeves, etc. are improperly placed or installed, CONTRACTOR shall do all necessary work, at his own expense, to rectify the errors.
- I. All electrical equipment shall be capable of operating successfully at full-rated load, without failure, at an ambient air temperature of 40 degrees C, and specifically rated for an altitude of 4500 feet.

- J. CONTRACTOR shall submit shop drawings, data and details to ENGINEER on all controls, fixtures, wiring, electrical equipment, conduit, etc. for review and acceptance prior to use of any components in the work.
- K. All materials, equipment, and parts comprising any unit or part thereof specified or indicated on the Plans shall be new and unused, of current manufacturer, and of highest tgrade consistent to the state of the art. Damaged materials, equipment and parts are not considered to be new and unused and will not be accepted.

1.3 REGULATIONS AND CODES

- A. Electrical work, including connection to electrical equipment integral with mechanical equipment, shall be performed in accordance with the latest published regulations of each of the following as well as all State and local codes.
 - 1. NATIONAL ELECTRICAL CODE (NEC)
 - 2. NATIONAL ELECTRICAL SAFETY CODE (NESC)
 - 3. INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)
 - 4. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
 - 5. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 6. INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)
 - 7. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
 - 8. NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)
 - 9. FEDERAL OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA)
 - 10. UNDERWRITERS' LABORATORIES, INC. (UL).

1.4 COORDINATION OF THE ELECTRICAL SYSTEM

- A. CONTRACTOR shall verify all actual equipment and motor full-load and locked-rotor current ratings. The necessary minimum equipment, wire, and conduit sizes are indicated on the Plans. If CONTRACTOR furnishes equipment of different ratings, CONTRACTOR shall coordinate the actual current rating of equipment furnished with the branch circuit conductor size, the overcurrent protection, the controller size, the motor starter, and the branch circuit overcurrent protection. The branch circuit conductors shall have a carrying capacity of not less than 125 percent of the actual full-load current rating. The size of the branch circuit conductors shall be such that the voltage drop from the overcurrent protection devices up to the equipment shall not be greater than 2 percent when the equipment is running at full-load and rated voltage.

1.5 TEST

- A. The electrical work shall be free from improper grounds and from short circuits. The correctness of the wiring shall be verified first by visual comparison of the conductor connections with connection diagrams. Individual circuit continuity checks shall next be made by using electrical circuit testers. Last, the correctness of the wiring shall be verified by the actual electrical operation of the electrical and mechanical devices. Any deviation from the wiring indicated on the Plans or accepted drawings shall be corrected and indicated on the Plans.

1.6 CONFORMS TO RECORD DOCUMENTS DRAWINGS

- A. Prior to completion of the Contract, CONTRACTOR shall furnish ENGINEER with a set of electrical plans marked with any changes, deviations or additions to any part of the electrical work.
- B. Each conductor shall be identified as required by the Contract Documents. This identification shall be indicated on the record documents drawings to enable rapid and accurate circuit tracing by maintenance personnel.

1.7 SUBMITTALS

- A. Submittals shall be in accordance with Section 01 33 00, SUBMITTAL PROCEDURES.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Where indicated on the Plans and where required by applicable codes, CONTRACTOR shall furnish and install nameplates which shall be black lamicaid with white letters. The nameplates shall be fastened to the various devices with round head brass screws. Each disconnect means for service, feeder, branch, or equipment conductors shall have nameplates indicating its purpose. All nameplates shall have 3/8-inch high lettering.

2.2 AUTOMATIC EQUIPMENT WARNING SIGNS

- A. Permanent warning signs shall be mounted at all mechanical equipment which may be started automatically or from remote locations. Signs shall be in accordance with OSHA regulations and shall be suitable for exterior use. The warning signs shall be fastened with round head brass screws or bolts, located and mounted in a manner acceptable to ENGINEER.
- B. Warning signs shall be 7 inches high by 10 inches wide, colored yellow and black, on not less than 18 gauge vitreous enameling stock. Sign shall read:

CAUTION
THIS EQUIPMENT STARTS
AUTOMATICALLY
BY REMOTE CONTROL

PART 3 EXECUTION - Not Used

- END OF SECTION -

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SECTION 26 05 05
ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section includes general electrical equipment used to complete the electrical system.
- B. Related work includes but is not limited to,
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 01 60 00 - Product Requirements
 - 3. Section 26 05 00 - Electrical General Requirements
 - 4. Section 26 05 13 - Conductors and Cables
 - 5. Section 26 05 33 - Conduit and Raceways
 - 6. Section 26 05 34 - Electrical Boxes and Fittings

1.2 SUBMITTALS

- A. Submittals will be required for all electrical equipment and shall be made in accordance with Section 01 33 00 - Submittal Procedures.

PART 2 MATERIALS

2.1 LIGHTING SWITCHES

- A. Manufacturers:
 - 1. Hubbell 1221W (white)
 - 2. P&S 20AC1W (white)
 - 3. Leviton 1221-2W (white)
 - 4. Or approved equal
- B. Specification Grade: Snap switches shall have the number of poles as indicated on the drawings, white, rated at 20 ampere.
- C. Device Cover Plates:
 - 1. Indoor Industrial Areas: Stainless steel cover plates shall be utilized.
 - 2. Outdoor: Weatherproof cover plates.
 - 3. Indoor in fluoride and hypochlorite rooms: White plastic cover plates.

2.2 SENSOR SWITCH

- A. Manufacturers
 - 1. Lutron, Maestro Series
 - 2. Or Equal.

- B. Switch shall include passive infrared occupancy or vacancy sensor. The unit shall detect heat from within the area and control the light fixtures.
- C. Field of View: 180 degrees.
- D. Distance: up to 30-ft x 30-ft
- E. Operation: Auto-On / Auto-Off
- F. Adjustable timeout 1, 5, 15 or 30 minutes.
- G. Suitable for LED fixtures.

2.3 RECEPTACLES

- A. Manufacturers:
 - 1. Hubbell IG5352W (white)
 - 2. P&S No. 5352-W (white)
 - 3. Leviton 8300-W (white)
 - 4. Or approved equal
 - 5. Specification Grade: Outlets shall be duplex white receptacles and shall be 2-pole, 3-wire grounded, 125 volts, industrial, rated at 20 amperes.
- B. Special receptacles, covers, etc. shall be as specified herein or as indicated on the Plans.
- C. Device Cover Plates:
 - 1. Indoor Industrial Areas: Stainless steel cover plates shall be utilized.
 - 2. Outdoor: Weatherproof cover plates which also protect outlet when in use.
 - 3. Indoor in Fluoride and Hypochlorite rooms: White plastic cover plates.
- D. Ground Fault Interrupter Receptacles (GFI): GFI outlets shall be duplex ivory GFI receptacles, 2-pole, 3-wire grounded, 125 volts AC, rated at 20 amperes.
 - 1. Manufacturers:
 - a. Hubbell No. GF5262W (white)
 - b. General Electric,
 - c. P&S 2091-W (white)
 - d. Leviton 5362-WGI (white)
 - e. Or approved equal.

2.4 ENCLOSURES

- A. Manufacturers:
 - 1. Hammond Manufacturing,
 - 2. Nvent Hoffman, Inc.
 - 3. Rittal North America, LLC
 - 4. Or approved equal.

- B. This specification includes enclosures to house electrical controls, instruments, terminal blocks, etc. If not indicated otherwise they shall be NEMA 12 for indoor and NEMA 3R for outdoor installations.
- C. A rolled lip shall be provided around three sides of the door and around all sides of the enclosure opening. The gasket shall be attached with oil-resistant adhesive and held in place with steel retaining strips. Exterior hardware, such as clamps, screws, and hinge pins, shall be of stainless steel for outdoor installations. A hasp and staple shall be provided for padlocking. Each enclosure shall have a print pocket.
- D. Enclosures shall be from 14 gauge steel with seams that are continuously welded. Doors shall have full length piano hinges with the door removable by pulling the hinge pin.
- E. Finish - Steel: Finish shall be white enamel interior, light grey enamel, ANSI 61 exterior, over phosphatized surfaces. Special finishes and colors shall be furnished for wet locations. Plans should be checked for special conditions.

2.5 DISCONNECT SWITCHES (INDIVIDUAL)

A. Manufacturers:

1. Eaton.
2. General Electric Co.
3. Siemens, Inc.
4. Square D Co.
5. Or approved equal.

- B. Disconnect switches shall be heavy-duty safety switches with a quick-make, quick-break operating mechanism, full cover interlock and indicator handle. The disconnect switches shall be furnished with fuses of the size indicated on the Plans. One set of spare fuses shall be furnished for each fused disconnect switch.

2.6 CIRCUIT BREAKERS - LOW VOLTAGE (INDIVIDUAL)

- A. All circuit breaker frame and trip ratings shall be as indicated on the Plans, except that they shall be coordinated with the ratings of the equipment actually furnished and shall be modified where necessary to suit this equipment. Circuit breakers to be used in motor control centers shall be as indicated on the Plans. When no indication of type is given on the Plans, the following shall govern:

1. Circuit breakers protecting motors rated 7.5 horsepower or less shall be motor circuit protectors, all other circuit breakers shall be molded case circuit breakers.

B. Manufacturers:

1. Eaton
2. General Electric
3. Siemens
4. Square D Company

5. Or approved equal.

2.7 FULL-VOLTAGE, NON-REVERSING MOTOR CONTROLLERS

A. GENERAL

1. Provide each motor with a suitable controller and devices that will function as specified for the respective motors and meeting NEMA ICS 2, the NEC, and UL.
2. Provide each motor controller with thermal overload protection in all ungrounded phases. Use protection consisting of thermal overload relays meeting NEMA ICS 2 which are sensitive to motor current and mounted within the motor controller, or a combination of thermal protectors embedded within the motor windings and controller-mounted overload relays, as indicated. Use overload protection devices of the inverse-time-limit type.
3. Provide controller-mounted overload relays of the manual-reset type with externally operated reset button when used without motor thermal protectors; when used in conjunction with thermal protectors, provide the automatic reset type. Select and install overload relay heaters after the actual nameplate full-load current rating of the motor has been determined.
4. Install and connect any required thermal protector monitoring relay provided by motor manufacturer in motor-control circuit and provide manual reset function. Fuse thermal-protector circuits according to the manufacturer's recommendations.
5. The Booster Pump controller shall be provided with two sets of thermal overload devices, rated for the full load current of the existing motors. The controller shall have a selection switch on the front selecting which thermal overload will be in service.

B. FULL VOLTAGE MAGNETIC STARTERS

1. Provide starters meeting NEMA ICA 2, Class A, with the rating and enclosure shown.
2. Supply individual control power transformers where indicated. The transformers shall have sufficient capacity to serve the connected load and limit voltage regulation to 10-percent during contact or pickup. Fuse one side of the secondary winding and ground the other side. Provide primary, current limiting fuses on all control power transformers.
3. For nonhazardous, indoor, dry locations, provide heavy-duty, LED indicating lights, selector switches, and stations. Utilize General Electric Type CR 104P, or equivalent by Square D, Cutler-Hammer, or other acceptable manufacturer. The use of other manufacturer's names referenced to materials herein, shall indicate the quality of material to be provided.

2.8 FUSES, 0-600 VOLTS

- A. Provide a complete set of current-limiting fuses wherever fuses are indicated. Supply a set of six spare fuses of each type and each current rating installed. Utilize fuses that fit mountings specified with switches and which provide features rejecting Class H fuses. Provide the following types:

1. For 0- to 600-volt motor and transformer circuits, 0- to 600 amps, UL Class RK-1 with time delay, Bussmann Type LPS-RK, Shawmut Type A6D, or equal.
2. For 0- to 250-volt motor and transformer circuits, 0- to 600 amps, UL Class RK-1 with time delay, Bussmann Type LPN-RK, Shawmut Type A2D-R, or equal.
3. For 0- to 600-volt feeder and service circuits, 0 to 600 amps, UL Class RK-1, Bussmann Type KTS-R Shawmut Type A6K-R, or equal.
4. For 0- to 250-volt feeder and service circuits, 0 to 600 amps, UL Class RK-1, Bussmann Type KTN-R, Shawmut Type A2K-R, or equal.

2.9 MODULAR OVERLOAD RELAYS

- A. Where called for on the Plans, modular overload relays shall be provided with the motor starters. The modular overload relays shall be 3-pole solid state devices set by one plug-in heater and shall protect all 3 phase of the motor in ambient temperatures ranging from -20 degrees to +70 degrees C.
- B. The jam modules shall plug in the modular overload relays and shall provide for instantaneous trip of the overload relay should the current exceed a preset value at any time after the motor has accelerated. The modules shall be adjustable to any value between 150 percent and 400 percent of the motor full-load current.
- C. The underload modules shall plug in the MOR and shall provide for overload relay trip whenever the current falls below a set value after the motor has accelerated. The modules shall be adjustable between 50 percent and 90 percent of the full load value of the motor full load current.

2.10 LIGHTING

- A. Lighting fixtures shall be as described below and as indicated on the Plans.
- B. Fixtures shall include lamps, ballasts, poles, mounting hardware, etc. to provide complete operating units.
- C. Fixtures shall be LED type.
- D. Catalog data including applicable coefficients of utilization tables, isolux chart of illumination on a horizontal plane, beam efficiency, horizontal and vertical beam spread, and beam lumens shall be submitted to the ENGINEER for review and acceptance for all fixtures before fixtures are manufactured. Substitutions will be permitted only if acceptable to the ENGINEER.
- E. Light Emitting Diode(LED) Lighting
 1. The LED Fixture shall consist of a LED Luminaire Assembly, LED Driver and mounting hardware.
 2. LED Fixture requirements are as described below:
 - a. The input to the LED Lighting Fixture shall be 120 to 277VAC ($\pm 10\%$), 60HZ or as indicated in the Contract Document.
 - b. Correlated Color Temperature (CCT) shall be minimum 4000K or as indicated in the Contract Document.

- c. Color Rendering Index (CRI) shall be 70.
- d. A minimum of 50,000 operating hours before reaching the L70 lumen output degradations point without catastrophic failure, or as indicated in the Contract Document.
- e. Conform with UL 8750.
- f. Compliance to FCC CFR Section 15.
- 3. LED Luminaire Assembly
 - a. Definition: Luminaire Assembly is the LED assembly without LED driver.
 - b. Input voltage shall be 24VDC, 36VDC or as indicated in the Contract Document.
 - c. CCT, CRI, Minimum life and UL conformity requirements are as defined in above article LED Lighting Fixture.
- 4. LED Driver
 - a. Must operate input voltage between 120VAC to 277VAC ($\pm 10\%$).
 - b. Operating frequency must be 60Hz.
 - c. Must be rated to operate between -40°C to $+50^{\circ}\text{C}$.
 - d. Must have a minimum efficiency of 85%.
 - e. Self protected including short circuit protection.
 - f. Compliance to FCC CFR Section 15.
 - g. Driver must have a Power Factor (PF) of 0.90.

F. Types and ratings: As shown on "Lighting Fixture Schedule" on Drawings.

2.11 CONTROL PANELS

A. Enclosure Manufacturers:

- 1. Hammond Manufacturing,
- 2. Nvent Hoffman, Inc.
- 3. Rittal North America, LLC
- 4. Or approved equal.

B. ENCLOSURES:

- 1. This specification includes enclosures to house electrical controls, instruments, terminal blocks, etc. If not indicated otherwise they shall be NEMA 12 for indoor and NEMA 3R for outdoor installations.
- 2. A rolled lip shall be provided around three sides of the door and around all sides of the enclosure opening. The gasket shall be attached with oil-resistant adhesive and held in place with steel retaining strips. Exterior hardware, such as clamps, screws, and hinge pins, shall be of stainless steel for outdoor installations. A hasp and staple shall be provided for padlocking. Each enclosure shall have a print pocket.
- 3. Enclosures shall be from 14 gauge steel with seams that are continuously welded. Doors shall have full length piano hinges with the door removable by pulling the hinge pin.
- 4. Finish - Steel: Finish shall be white enamel interior, light grey enamel, ANSI 61 exterior, over phosphatized surfaces. Special finishes and colors shall be furnished for wet locations. Plans should be checked for special conditions.

C. PILOT DEVICES:

1. Manufacturers:
 - a. Allen-Bradley, Bulletin 800T, 30 mm
 - b. Eaton
 - c. Square D, Type K, 30 mm - Class 9001
 - d. Or equal.
2. Indicating lights, pushbuttons and selector switches shall be miniature oiltight units. Contact blocks in control circuits shall be NEMA ICS, B150, rated 5 amperes inductive at 120 volts AC. Contact blocks for signal circuits shall be rated 0.06 amperes at 30 volts AC or DC and shall be hermetically sealed and reed switches. Pilot lights for 120 volt AC circuits shall be LED type. Where group lamp test circuits are not specified, individual pilot light assemblies shall be "push-to-test" type. Pilot lights shall be capable of being changed from the front of the panel without special tools.

D. TERMINAL BLOCKS:

1. Manufacturers:
 - a. Allen-Bradley
 - b. Buchanan
 - c. Eaton
 - d. Entelec (ABB) M4/6
 - e. Square D Co.
 - f. Weidmuller
 - g. Or equal
2. Terminal blocks shall be of the size required for conductors therein and a minimum of 50 percent spares shall be provided in each terminal box.

E. FUSE BLOCKS:

1. Manufacturers:
 - a. Entelec (ABB), M10/13.SF2
 - b. Or approved equal.
2. DIN rail mounted.
3. Terminals shall accommodate 22-10 AWG solid or stranded wires.
4. Provide terminals rated for 600 VAC/VDC and 15 amperes.
5. Device shall be UL listed.

F. TIMING RELAYS:

1. Manufacturer:
 - a. Allen-Bradley,
 - b. Square D Company
 - c. Approved equal.
2. Timing relays shall be heavy-duty industrial 600 volt, 10 amperes.

G. CONTROL RELAYS:

1. Manufacturer:
 - a. Allen-Bradley
 - b. Idec RH series

- c. Or equal.
2. Control relays shall be general purpose "midget" relays, 10 ampere contact rating, with 1, 2, 3 or 4 Form C contacts as shown on the drawings.
3. Relay shall be provided with blade style terminals.
4. Provide LED indicator light with relay.
5. Provide a standard DIN rail mount relay socket.
6. Relay life expectancy shall be in excess of 500,000 operations at 120 VAC.
7. Device shall be UL listed.

H. TIME CLOCK

1. Manufacturer/Model:
 - a. Tork/8009A
 - b. No Equal.
2. 24-hr time duty cycle time switch.
3. Flexible Scheduling: Minimum ON and OFF cycle of 15 minutes (minimum), with 1 to 48 ON/OFF operations per day.
4. Duty Cycle: Adjustable from 1/2, 1, 2, 3, 4, 5, 6, 12 and 24 hours.
5. Power: 120 VAC, 1-phase.
6. Switch: SPDT.
7. Contact Ratings: 20 Amp, 125/250/480 VAC.

I. DIN RAIL CIRCUIT BREAKERS

1. Manufacturer/Model:
 - a. Eaton/FAZ-NA
 - b. LS Electric
 - c. Approved Equal.
2. DIN Rail mounted.
3. Trip Characteristics: UL C or D.
4. UL Listed under UL 489.
5. Dual rated for AC or DC applications.
6. Single-pole, two-pole or three-pole models.
7. Current limiting design.
8. Thermal-magnetic overcurrent protection.
9. Trip-free design.

J. DIN-RAIL DUPLEX RECEPTACLE

1. Manufacturer/Model:
 - a. Phoenix Contact/EM-DUO
 - b. Approved Equal.
2. Color: Ivory.
3. UL: 508
4. Voltage: 125 VAC
5. Amps: 15A.
6. Mounting: Din rail.

2.12 PROCESS SWITCHES

A. LEVEL SWITCH - FLOAT

1. Manufacturer/Model:
 - a. IMO Industries, Inc. Gems Sensors Division, LS-270.
 - b. No Equals.
2. Stem: 316 Stainless steel
3. Float: Buna N
4. Operating Temperature:
 - a. Water: to 180-degrees F.
5. Minimum Liquid Specific Gravity: .65
6. Pressure (MAX): 150 PSI
7. Switch Rating: 20 VA
8. Electrical Termination: No. 22 AWG, 24-inches long, Polymeric Lead Wires.
9. Selectable Normally Open (NO) or Normally Closed (NC) by inverting float on unit stem.

B. ELECTRO-OPTIC LIQUID LEVEL SWITCH

1. Manufacturer/Model:
 - a. Gems ELS Series Level switches w/Opto-Pak Controller
 - b. Approved Equal.
2. Switch shall be small size with no moving parts. Unit to be installed in the inner spatial space in the storage tank. Unit shall offer ± 1 mm repeatability.
3. Unit shall operate with an infrared LED light source and receiver.
4. Unit shall provide TTL signal to an Electro-Optic Converter.
5. The Opto-Pak controller shall convert 120 VAC to the power requirement for the optical sensor. The unit shall have a SPDT, 5 amp relay output. Unit shall be supplied with a self-contained NEMA 4X enclosure.
6. Install optical sensor in tank inner spatial space. Install optical relay in the control panel and/or RTU enclosure.

C. PRESSURE SWITCH

1. Manufacturer:
 - a. Mercoid: Model DAW-23-8S: 0-200 PSIG
 - b. Ashcroft B424B.
 - c. Or approved equal.
2. Stainless steel bourdon tube material
3. Pressure: 10-200 psig
4. Minimum Deadband (psig): 8.
5. Switch: SPDT, closes on increase pressure, 10A, 120 VAC, Adjustable Deadband.
6. Application:
 - a. PSH-1: Pump High Discharge Pressure.

D. FLOW SWITCH

1. Manufacturer:
 - a. Gems FS-200
 - b. Approved Equal.
2. Housing Material: Bronze
3. Setting Type: Adjustable, Range; 1.0 - 6.0 gpm

4. Port Size: 1-inch
5. Shuttle: Teflon
6. Spring: Stainless steel
7. Pressure Rating:
 - a. Operating: 400 psig
 - b. Proof: 800 psig
8. Operating Temperature: -20-deg F to 200 deg F
9. Repeatability: 1% Maximum
10. Set Point Accuracy: ± 10 -percent
11. Switch: SPDT, 20 VA
12. Electrical Termination: No. 18 AWG, 24" long (NC: Red, Common: Black, NO: Orange)

2.13 MISCELLANEOUS

A. HATCH POSITION SWITCH

1. Manufacturer:
 - a. Square D Company
 - b. Or approved equal.
2. Heavy duty turret head lever arm type switch. Provide a offset type lever arm with sufficient length to contact hatch lid.
3. Rated NEMA 6P
4. Rated: 120 VAC, 6 amps.
5. Application:
 - a. Roof Hatches

B. MAGNETIC DOOR SWITCH (MAN-DOOR)

1. Manufacturer
 - a. Ademco, 7939GY
 - b. Edwards, Model 60
 - c. Substitutions: Refer to Section 01600 - Product Requirements
2. Provide a gray Normally Open (NO) magnetic door switch, where the switch closes when the magnet engages. Provide appropriate hardware to install on door.

C. TEMPERATURE INDICATING TRANSMITTER

1. Manufacturer/Model:
 - a. Devar Inc./d-RTTI.
 - b. No Equal.
2. Loop powered two-wire temperature sensor/transmitter that mounts on a single-gang outlet box.
3. Voltage: Operates on 24VDC.
4. Output: Provide 4-20 mA DC output.
5. Indication: Four digit LED with 0.4" high red characters.
6. Range: -40 to +180 deg F., Accuracy: ± 1 Deg, C or ± 2 Deg F.

D. POWER AND ENERGY MONITOR

1. Manufacturer/Model:
 - a. Electro Industries/Gauge Tech, Shark 250
 - b. No Equal
2. Basic Features:
 - a. 0.2% class revenue certifiable Energy and Demand metering
 - b. Meets ANSI C1202 and IEC 687
 - c. Multifunction Measurement
 - d. 3 line 0.56" LED display
 - e. % of Load Bar for analog perception
 - f. Standard RS485 Modbus.
 - g. IrDA port for PDA Read
3. Unit shall measure the following parameters:
 - a. Voltage L-N.
 - b. Voltage L-L.
 - c. Current.
 - d. +/- Watts
 - e. +/- Wh
 - f. +/- VARs
 - g. +/- VARh
 - h. VA
 - i. VAh
 - j. PF
 - k. Frequency
 - l. %THD
 - m. %Load Bar
4. Communications: unit shall include 100BaseT Ethernet Capability.
5. Unit shall include V-Switch Pack: Power Quality Harmonics.
6. Provide two units to JVWCD. When installed in RTU Enclosure, it will be installed by the Owner. When not installed in the RTU Enclosure, install in the VFD enclosure or in a separate enclosure adjacent to the RTU.

PART 3 INSTALLATION

- A. Installation shall be per manufacturers specifications.

- END OF SECTION -

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SECTION 26 05 13
MEDIUM-VOLTAGE CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This section includes specifications for medium-voltage cables, grounding conductors, cable connectors, termination and splice kits, lugs and markers and pulling compound.

- B. Related Work includes but is not limited to:
 - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems
 - 2. Section 26 05 33 - Conduit and Raceway
 - 3. Section 26 05 34 - Electrical Boxes and Fittings
 - 4. Section 26 12 19 - Pad-Mounted, Medium Voltage Transformers
 - 5. Section 26 13 00 - Medium-Voltage Switchgear
 - 6. Section 31 23 15 - Excavation and Backfill for Buried Pipelines
 - 7. Section 32 12 16 - Hot-Mix Asphalt Concrete Paving
 - 8. Section 32 91 13 - Finish Grading and Soil Preparation

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers (IEEE)
 - 1. IEEE 48 – Standard Test Procedures and Requirements for High-Voltage Alternating-Current Cable Terminations 2.5kV through 765kV.
 - 2. IEEE 386 – Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
 - 3. IEEE 404 – Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2.5kV through 500kV.
 - 4. ANSI/IEEE C2 – National Electrical Safety Code

- B. National Fire Protection Association (NFPA)
 - 1. ANSI/NFPA 70 – National Electrical Code

- C. Underwriters Laboratories (UL)
 - 1. UL 44 – Thermoset-Insulated Wires and Cables
 - 2. UL 486A-486B – Wire Connectors
 - 3. UL 486C – Standard for Splicing Wire Connections
 - 4. UL 1072 – Standard for Medium-Voltage Power Cables

- D. National Electrical Manufacturers Association (NEMA)
 - 1. NEMA 250 – Enclosures for Electrical Equipment.
 - 2. NEMA CC 2 – Electric Power Connectors for Substations.
 - 3. NEMA WC 71 – Standard for Nonshielded Cables Rated 2001-5000 Volts for Use in Distribution of Electric Energy.

4. NEMA WC 74 – 5-46kV Shielded Power Cable for Use in Transmission and Distribution of Electric Energy.
- E. ASTM International (ASTM)
1. ASTM B3 – Standard Specification for Soft or Annealed Copper Wire.
 2. ASTM B8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 3. ASTM B263 – Standard Test Method for Determination of Cross-Sectional Area of Stranded Conductors.

1.3 SUBMITTALS

- A. Submittals shall be in accordance with the requirements of Section 01 33 00 – Submittals and Submittal Procedures.
- B. Product Data: Provide manufacturer data sheets and catalog pages for all materials and components.
- C. Shop Drawings: Cable and conduit routing plans shall be provided by CONTRACTOR per Section 26 05 33 for review by ENGINEER prior to installation.
- D. Calculations: Cable pulling calculations shall be submitted to ENGINEER and reviewed before cable installation. Provide cable pulling calculations for medium-voltage cable runs which cannot be pulled by hand and single conductors #4/0 and larger.
- E. Test and Evaluation Reports: Cable testing form for Owners approval. Cable testing form shall detail tests to be performed with space to include detailed results for each test.
- F. Manufacturers' Instructions: Submit instructions for storage, preparation, and installation of exothermic connectors and electrodes.

1.4 PROJECT CLOSEOUT SUBMITTALS

- A. Section 01 78 50 – Project Closeout.
- B. Manufacturer Data: Submit original manufacturer manuals and data sheets for products purchased.
- C. Record Documentation: Provide accurate as-built record drawings in paper and electronic format.
- D. Certificate of Compliance: Provide approval of construction and installation by government authority having jurisdiction.

1.5 QUALITY ASSURANCE

- A. All Work shall be performed and materials provided in accordance with NFPA 70 -

National Electrical Code (NEC), the National Electrical Safety Code (NESC), and other codes and standards as applicable. Where required by the Authority Having Jurisdiction (AHJ), equipment and materials shall be listed or labeled by Underwriters Laboratory (UL) or by a nationally recognized testing laboratory acceptable to the AHJ. CONTRACTOR shall be responsible for all costs associated with obtaining the required listing.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in manufacturer's packaging and inspect for damage.
- B. Store and protect in accordance with manufacturer's instructions and in accordance with Section 01 60 00 - Product Requirements.
- C. Protect from weather. Provide adequate ventilation to prevent condensation.
- D. Wire and cables shall be delivered in full reels and shall be protected against injury. UL approved tags showing the manufacturer's name and type of insulation, size, and length of wire in each coil or reel shall be attached.

1.7 SITE CONDITIONS

- A. General
 - 1. CONTRACTOR shall make all necessary field measurements to verify that equipment will fit in allocated space in full compliance with minimum required clearances specified in National Electrical Code.
- B. Construction Materials
 - 1. Refer to contract plans for NEMA rating requirements for equipment in each area.
 - 2. Construction shall conform to the requirements of the plans and per Section 26 05 00 - Electrical General Requirements.

PART 2 PRODUCTS

2.1 15 kV CABLES

- A. EPR Insulated Cable:
 - 1. Extrusion: Single-pass, triple-tandem, of conductor screen, insulation, and insulation screen.
 - 2. Type: 15kV, shielded, UL 1072, Type MV-105.
 - 3. Conductors: Copper, concentric lay Class B round stranded in accordance with ASTM B3, ASTM B8, and ASTM B263.
 - 4. Conductor Screen: Extruded, semiconducting ethylene-propylene rubber in accordance with NEMA WC 71 and AEIC CS 6.
 - 5. Insulation: 133 percent insulation level, ethylene-propylene rubber (EPR), containing no polyethylene in accordance with NEMA WC 71, and AEIC CS 6.

6. Insulation Thickness: 220-mil nominal.
7. Insulation Screen: Thermosetting, semiconducting ethylene-propylene rubber (EPR), extruded directly over insulation in accordance with NEMA WC 74 and AEIC CS 6.
8. Metallic Shield: Uncoated, 5-mil, copper shielding tape, helically applied with 17-1/2 percent minimum overlap.
9. Jacket: Extruded polyvinyl chloride (PVC) compound applied over the metallic shield in accordance with NEMA WC 71.
10. Operating Temperature: 105 degrees C continuous normal operations, 130 degrees C emergency operating conditions, and 250 degrees C short-circuit conditions.
11. Manufacturers:
 - a. Okonite Co.
 - b. Pirelli Wire and Cable.
 - c. General Cable.
 - d. Kerite.
 - e. Southwire Co.

2.2 GROUNDING CONDUCTORS

- A. Equipment: Stranded copper with green, Type USE/RHH/RHW-XLPE insulation.

2.3 ACCESSORIES FOR 15 kV cable

- A. Heat Shrinkable Splice Kits:

1. Components necessary to provide insulation, metallic shielding and grounding systems, and overall jacket.
2. Capable of making splices with a current rating equal to, or greater than the cable ampacity, conforming to IEEE 404.
3. Class 15 kV, with compression connector, splice insulating and conducting sleeves, stress-relief materials, shielding braid and mesh, and abrasion-resistant heat shrinkable adhesive-lined re-jacketing sleeve to provide a waterproof seal.
4. Manufacturers:
 - a. Raychem.
 - b. 3M Co.

- B. Termination Kits:

1. Capable of terminating 15 kV, single-conductor, polymeric-insulated shielded cables plus a shield ground clamp.
2. Capable of producing a termination with a current rating equal to, or greater than the cable ampacity, meeting Class 1 requirements of IEEE 48.
3. Capable of accommodating any form of cable shielding or construction without the need for special adapters or accessories.
4. Manufacturers:
 - a. Raychem.
 - b. 3M Co.

C. Bus Connection Insulation:

1. Heat shrinkable tubing, tape, and sheets of flexible cross-linked polymeric material formulated for high dielectric strength.
2. Tape and sheet products to have coating to prevent adhesion to metal surfaces.
3. Insulating materials to be removable and reusable.
4. Manufacturer: Raychem.

D. Cable Lugs:

1. Manufacturers and Products, Uninsulated Compression Connectors and Terminators:
 - a. Burndy; Hydent.
 - b. ILSCO.
 - c. Thomas & Betts; Color-Keyed.
2. In accordance with NEMA CC1.
3. Rated 15 kV of same material as conductor metal.

2.4 PULLING COMPOUND

A. Manufacturers:

1. Ideal Co.
2. Cable Grip Co.
3. Polywater, Inc.

B. Nontoxic, noncorrosive, noncombustible, nonflammable, water-based lubricant; UL listed.

C. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable.

D. Approved for intended use by cable manufacturer.

E. Suitable for zinc-coated steel, aluminum, PVC, bituminized fiber, and fiberglass raceways.

2.5 SOURCE QUALITY CONTROL

A. Test medium-voltage cable in accordance with Section 26 08 01 Testing.

PART 3 EXECUTION

3.1 EXAMINATION

A. Refer to Section 26 05 00 for examination requirements of cable and wiring systems.

3.2 PREPARATION

A. Refer to Section 26 05 00 for preparation requirements of cable and wiring systems.

3.3 INSTALLATION

A. Refer to Section 26 05 00 for installation requirements of cable and wiring systems.

3.4 FIELD QUALITY CONTROL

A. Refer to Section 26 05 00 for field quality control and testing requirements of cable and wiring systems.

- END OF SECTION -

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Installation of wires or cables required for power distribution, service, feeders, and branch circuits.
- B. Related work includes but is not limited to,
 - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems
 - 2. Section 26 05 33 - Conduit and Raceway
 - 3. Section 26 05 34 - Electrical Boxes and Fittings
 - 4. Section 31 23 15 - Excavation and Backfill for Buried Pipelines
 - 5. Section 32 12 16 - Hot-Mix Asphalt Concrete Paving
 - 6. Section 32 91 13 - Finish Grading and Soil Preparation

1.2 REFERENCES

- A. NFPA 70: National Electrical Code.
- B. UL: Underwriters Laboratories, Inc.

1.3 SUBMITTALS

- A. Field Test Data: Submit megohmmeter test data for circuits under 600 volts.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Building Conductors: Copper, 600 Volt insulation, THW.
- B. Branch Circuit Conductors and All Conductors: Copper conductor, with THHN, or THWN insulation #10 AWG and smaller, and THW larger than #10 AWG, where ambient temperature conditions exceed 140 deg. F.
 - 1. All conductors shall be stranded.
 - 2. Size all conductors per NFPA 70.
 - 3. Minimum size to be #12 AWG.
 - 4. For outlets to fixtures, and in fixture channels (in dry areas); THHN insulated conductor.
 - 5. In damp locations, under slabs, on exterior provide THWN.
- C. Provide permanent plastic name-tag indicating load feed.
- D. Use type XHHW conductors for water pumping and regulator stations.

E. Cable Supports: OZ cable supports for vertical risers, type as required by application.

2.2 INSTRUMENTATION

- A. Instrumentation cable shall have the number of twisted pairs indicated on the Plans and shall be insulated for not less than 600 volts. Unless otherwise indicated, conductor size shall be as shown on the drawings.
- B. The jacket shall be flame retardant Flamenal or Okoseal, 90 degrees C temperature rating. The cable shield shall be minimum of 2.3 mil aluminum or copper tape overlapped to provide 100 percent coverage and a tinned copper drain wire.
- C. The conductors shall be bare soft annealed copper, Class B, 7 strand minimum concentric lay with Okoseal or Vulkene, 15 mils nominal thickness, nylon jacket, 4 mil nominal thickness, 90 degrees C temperature rating. One conductor within each pair shall be numerically identified.

2.3 ETHERNET CONDUCTORS

- A. Manufacturers:
 - 1. Belden 7940 Inside (4 pair, 24 gauge)
 - 2. Belden 7953A Outside (for CCTV cameras)
 - 3. Or Approved Equal

2.4 MODBUS RS485 CABLE

- A. Manufacturers/Model
 - 1. Belden 9841
 - 2. Or approved equal
- B. Provide low-capacitance computer cable for EIA RS-485 signal transmission. Cable shall be AWG #24 stranded (7x32), with polyethylene insulation, twisted-pairs with overall shield (100% coverage) and #24 AWG drain wire.

2.5 COLOR AND CODING OF CONDUCTORS

- A. 120/240 volt.
 - 1. A-Phase - Black
 - 2. B-Phase - Red
 - 3. Neutral - White
 - 4. Ground - Green
- B. 208Y/120 volt.
 - 1. A-Phase - Black
 - 2. B-Phase - Red

3. C- Phase - Blue
4. Neutral - White
5. Ground - Green

C. 480Y/277 volt.

1. A-Phase - Brown
2. B-Phase - Orange
3. C- Phase - Yellow
4. Neutral - White
5. Ground - Green

PART 3 EXECUTION

3.1 INSTALLATION

- A. Make conductor length for parallel feeders identical.
- B. Lace or clip groups of feeder conductors at distribution center, pull-boxes, and wireway. Neatly arrange wiring within cabinets, junction boxes, fixtures, etc.
- C. Provide copper grounding conductors and straps.
- D. Install wire and cable in code conforming raceway.
- E. Use non-detrimental wire pulling lubricant for pulling No. 4 AWG and larger wire.
- F. Install wire in conduit runs after concrete and masonry work is complete and after moisture is swabbed from conduits.
- G. Color code conductors to designate neutral conductor and phase.
- H. Furnish necessary reels, reel jacks, and other pulling aids required to prevent damage to wires and cable.
- I. Splicing:
 1. Install wires and cables continuous without splices from sources of supply to distribution equipment and from source of supply to motor, lighting, or power outlet.
 2. Do not use pull boxes for making splices.
 3. Do not install splices in conduits.
- J. Install all wiring per NFPA 70.
- K. Use of cable with more conductors than specified; CONTRACTOR's option. When done, tape off and label extra conductors as spares.

3.2 CONDUCTOR CONNECTIONS

- A. Use approved pressure type solderless connectors and lugs for service entrance, feeder, equipment connections and terminal posts.
- B. Use connectors of a type compatible to conductors, locations, and load.
- C. Make neutral connection and taps individually in order to prevent the possibility of an "open-neutral".
- D. Make branch circuit connections with UL approved solderless connectors. Do not depend solely upon a single insulating material to secure connection as well as to insulate it.
- E. After first either silverplating the bars or applying suitable non-oxidizing agents, bolt bus bar connections with adequate nonferrous bolts, washers, and lockwashers.
- F. Insulate joints and taps with patented or molded plastic insulators. Use tapes compatible with conductor jackets, temperature, and other conditions.

3.3 AFTER INSTALLATION TEST FOR CABLE 600 VOLTS AND BELOW

- A. Prior to energization, test cable and wire for continuity of circuit for short circuits. Megger all circuit of 100 amp and greater rating.
- B. Correct malfunctions.
- C. Submit record of megaohmmeter readings to ENGINEER.

3.4 IDENTIFICATION OF FEEDERS

- A. Affix a marker stamped or embossed on each cable at each entry to and exit for each manhole, pullhole, pullbox, cable tray, switchgear and switch, identifying circuit; i.e. "MCCI", "PANEL L" "NO 1" etc.
- B. Identification letters to be 1/8 inch size minimum.
- C. Markers to be rigid, noncorrosive, attached to feeder cables with feeder identification.
- D. Nylon straps to be used to tie the markers.

- END OF SECTION -

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. This section includes specifications for grounding of electrical systems and equipment.
- B. Related work includes but is not limited to,
 - 1. Section 26 05 13 - Medium-Voltage Cables
 - 2. Section 26 05 19 - Low-Voltage Power Conductors and Cables
 - 3. Section 26 09 26 - Panelboards
 - 4. Section 26 12 16 - Dry Type Transformers
 - 5. Section 26 12 19 - Pad-Mounted, Medium Voltage Transformers
 - 6. Section 26 18 39 - Medium-Voltage VFD
 - 7. Section 26 29 13.16 - Reduced Voltage Starters

1.2 SUBMITTALS

- A. Submit "Letter of Conformance" in accordance with Section 01 33 00 indicating specified items selected for use in Project with the following supporting data:
 - 1. Product Data: For the following:
 - a. Ground rods.
 - b. Grounding conductors

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. Comply with UL 467.
- B. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.
- C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. Grounding Conductors, Cables, Connectors, and Rods:
 - a. Chance/Hubbell (573-682-5521)
 - b. Copperweld Corp. (931-433-7177)
 - c. Thomas & Betts, Electrical (800-816-7809)

- d. Approved equals.

2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Section 26 05 19 - "Low-Voltage Electrical Power Conductors and Cables."
- B. Material: Copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
- E. Grounding Electrode Conductors: Stranded cable.
- F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- G. Bare Copper Conductors: Comply with the following:
 - 1. Solid Conductors: ASTM B3.
 - 2. Assembly of Stranded Conductors: ASTM B8.
 - 3. Tinned Conductors: ASTM B33.
- H. Copper Bonding Conductors: As follows:
 - 1. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
 - 2. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- I. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.
- J. Equipment Ground Conductor (Green) shall be included with all circuit conductors. In addition, provide a neutral conductor where applicable.

2.3 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: copper-clad steel. Size: 120" long by 3/4" in diameter.

- B. UFER: 25-feet of bare copper conductor installed in the footing or foundation wall. Connect copper to structural support steel.
- C. Metal Water Pipes: Where metal water piping is used, provide grounding electrode conductor to metal water piping. Use UL listed connection devices as required.

PART 3 EXECUTION

3.1 APPLICATION

- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- B. In raceways, use insulated equipment grounding conductors.
- C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.
- D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

3.2 EQUIPMENT GROUNDING CONDUCTORS

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Install equipment grounding conductors in all feeders and circuits.
- C. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.
- D. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- E. SCADA RTU: For signal and data, systems, provide No. 4 AWG minimum insulated grounding conductor from grounding electrode system to the SCADA RTU.

3.3 INSTALLATION

- A. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.
 - 1. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 - 2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

- C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- D. Metal Water Service Pipe: If metal water pipe is installed, provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- E. Water Meter Piping: If metal water piping is used, use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
- F. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

3.4 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Non-contact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A .

- F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.5 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
 - 1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.
 - 3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
 - a. Equipment Rated 500 kVA and Less: 10 ohms.
 - b. Manhole Grounds: 10 ohms.
 - 4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Owner representative promptly and include recommendations to reduce ground resistance.

- END OF SECTION -

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SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Hangers and supports for electrical equipment and systems.
- B. Related work includes but is not limited to,
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 26 05 33 - Conduit and Raceway
 - 3. Section 26 05 34 - Electrical Boxes and Fittings

1.2 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this project, with a minimum structural safety factor of five (5) times the applied force.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 - Submittal Procedures.
- B. Product Data: For the following:
 - 1. Steel slotted support systems.
- C. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include product data for components.
2. Steel slotted channel systems. Include product data for components.
3. Equipment supports.

D. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.1.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07.

PART 2 PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 4. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting

of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

- E. Structural Steel for Fabricated Supports and Restraints: ASTM A36, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - (1) Hilti Inc.
 - (2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - (3) MKT Fastening, LLC.
 - (4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - (1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - (2) Empire Tool and Manufacturing Co., Inc.
 - (3) Hilti Inc.
 - (4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - (5) MKT Fastening, LLC.
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A325.
 - 6. Toggle Bolts: All-steel springhead type.
 - 7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 for steel shapes and plates.

PART 3 EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT and RMC as required by NFPA 70. Minimum rod size shall be 1/4-inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with single-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 3. To Existing Concrete: Expansion anchor fasteners.
 - 4. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete four (4) inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than four (4) inches thick.
 - 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69
 - 6. To Light Steel: Sheet metal screws.
 - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks

attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Division 09 painting sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

- END OF SECTION -

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SECTION 26 05 33
CONDUIT AND RACEWAY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flexible or rigid conduits, couplings, supports, and nonmetallic ducts.
- B. Related work includes but is not limited to,
 - 1. Section 26 05 13 - Medium Voltage Cables
 - 2. Section 26 04 34 - Electrical Boxes and Fittings
 - 3. Section 31 23 15 - Excavation and Backfill for Buried Pipelines
 - 4. Section 32 12 16 - Hot-Mix Asphalt Concrete Paving
 - 5. Section 32 91 13 - Finish Grading and Soil Preparation

1.2 REFERENCES

- A. ANSI C80.1: Rigid Steel Conduit - Zinc-Coated.
- B. ANSI C80.3: Electrical Metallic Tubing - Zinc-Coated.
- C. FS W-F-406: Fittings for Cable, Power, Electrical and Conduit, Metal, Flexible.
- D. FS WW-C-566: Conduit, Metal, Flexible.
- E. NEMA TC6: PVC and ABS Plastic Utilities Duct for Underground Installation.
- F. NEMA TC9: Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation.
- G. NFPA 70: National Electrical Code.
- H. UL: Underwriters Laboratories, Inc.

PART 2 PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) as indicated; with minimum trade size of 3/4 inch.
- B. Rigid Metal Conduit (RMC): ANSI C80.1.
- C. Intermediate Metal Conduit (IMC): ANSI C80.1.
- D. Rigid and Intermediate Steel Conduit Fittings: Provide fully threaded malleable steel couplings; raintight and concrete tight where required by application. Provide

double locknuts and metal bushings at conduit termination, use OZ type B bushings on conduits 1-1/4 inch and larger.

- E. Electrical Metallic Tubing (EMT): ANSI C80. 3.
- F. EMT Fittings: Provide insulated throat non-indenter type malleable steel fittings; concrete tight where required by application. Install OZ type B bushings on conduits 1-1/4 inches and larger.
- G. Flexible Metal Conduit (FMC): FS WW-C-566, Zinc-coated steel.
- H. Flexible Metal Conduit Fittings: FS W-F-406, Type 1, Class 1, Style A.
- I. Liquid Tight Flexible Metal Conduit: Provide liquid-tight, flexible metal conduit; constructed of single strip, flexible continuous, interlocked, and double-wrapped steel; galvanized inside and outside; coated with liquid-tight jacket of flexible polyvinyl chloride (PVC).
- J. Liquid-Tight Flexible Metal Conduit Fittings: FS W-F-406, Type1, Class 3, Style G.
- K. Expansion Fittings: OZ Type AX, or equivalent to suit application.

2.2 NON-METALLIC CONDUIT AND DUCTS

- A. General: Minimum trade size: 3/4 inch.
- B. Underground PVC Plastic Utilities Duct: NEMA TC6, Type I for encased burial in concrete, Type II for direct burial.
- C. Duct Fittings: NEMA TC9, match to duct type and material.

2.3 CONDUIT, TUBING, AND DUCT ACCESSORIES

- A. Provide conduit, tubing and duct accessories of types and sizes, and materials, complying with manufacturer's published product information, which mate and match conduit and tubing. Provide manufactured spacers in all duct bank runs.

2.4 LOCKNUTS, BUSHINGS, CONNECTORS, COUPLINGS, AND SUPPORTS

- A. General: Provide malleable bushings, except that plastic bushings may be used in lieu of phenolic-lined malleable bushings where "insulating bushings" are required.
- B. Provide "double-locknut" system (2 locknuts) throughout, each being tightened wrench tight as to effectively bond outlet box or cabinet to conduit.
- C. Sealing Bushing: OZ Type FSK, WSK, or CSMI as required by application. Provide OZ type CSB internal sealing bushings.
- D. Provide insulated-through type ground bushing of the malleable type.

- E. Provide connectors or couplings that are proper for the conduit they are used with. Make watertight when required.
- F. Provide cadmium plated or galvanized fittings.
- G. Provide fittings with die-cut threads unless approved otherwise.
- H. EMT connectors used with #4 and larger cable shall have throat liners of suitable plastic insulation.

2.5 CONDUIT OUTLET BOXES

- A. Refer to Section 26 05 34.

2.6 SCHEDULE OF LOCATIONS

- A. Chemical Rooms (Fluoride & Chlorine): Solvent welded PVC Schedule 80.
- B. Exposed: Galvanized steel conduit.
- C. Ceiling Attic: Electrical metallic tubing shall be permitted.
- D. Underground or Underslab: Use rigid, threaded, galvanized steel conduit, or PVC Schedule 40 solvent welded conduit
- E. Make connections to motors and equipment with PVC jacketed flexible conduit and liquid tight connectors. Provide 1/2 inch minimum size for motor connections.

PART 3 EXECUTION

3.1 PREPARATION

- A. Excavate; Section 31 23 15 - Excavation and Backfill for Buried Pipelines

3.2 INSTALLATION

- A. Install conduit concealed in all areas, excluding mechanical and electrical rooms, connections to motors, and connections to surface cabinets.
- B. For exposed runs attach surface-mounted conduit with clamps.
- C. Coordinate installation of conduit in masonry work.
- D. Unless indicated otherwise, do not install conduit larger than 2-1/2 inches in concrete slabs. Provide a minimum concrete cover around conduits of 2-inches.
- E. Install conduit free from dents and bruises. Plug ends to prevent entry of dirt and moisture.
- F. Clean out conduit before installation of conductor.

- G. Alter conduit routing to avoid structural obstructions, minimizing crossovers.
- H. Fill end of conduit with fiberglass where conduits leave heated area and enters unheated area.
- I. Provide flashing and pitchpockets, making watertight joints where conduits pass through roof or waterproofing membranes.
- J. Install UL approved expansion fittings complete with grounding jumpers where conduits cross building expansion joints. Provide bends or offsets in conduit adjacent to building expansion joints where conduit is installed above suspended ceilings.
- K. Route all exposed conduits parallel or perpendicular to building lines.
- L. Make interconnections between difference types of raceways with manufactured fittings approved by UL.
- M. Size raceways per NFPA 70 tables. Do not reduce from any sized indicated.
- N. Do not exceed sizes permitted in slabs or walls.
- O. Do not exceed number of bends allowed in conduit by NFPA 70.
- P. Make joints wrench tight or otherwise with minimum resistance to the flow of fault currents.
- Q. Use furred spaces and chases to an advantage in concealing conduits.
- R. Make field bends only where needed and then carefully to minimize wire pulling tensions and for best appearance in exposed runs.
- S. Test conduit runs with lignum vitale ball (mandrel) of 85-percent of conduit diameter.
- T. Cut conduit with hacksaw or other approved pipe cutting tool and ream ends to clean out all burrs before connecting.
- U. Keep conduits at least 6-inches away from steam or hot water pipes, breaching, and boilers, but in no case permit conductors to reach higher than rated temperatures. Avoid traps in runs and slope conduit to drain.
- V. Fasten raceways securely in place. Firmly fasten conduit within 3-feet of each outlet, junction box, cabinet, or fitting. Support metallic conduit, rigid (heavy wall) and EMT at least every 10-feet. Support rigid nonmetallic conduit in strict accordance with NFPA 70. Use raceway fasteners designed for the purpose.

3.3 PULL BOXES, WIREWAYS, AND GUTTERS

- A. Furnish as indicated, plus any such items required to assemble conduits and other

raceways. Provide Section 26 05 34 pull boxes as dictated by wire pulling requirements.

- B. Construction: Code gage galvanized sheet steel and sized strictly in conformance with NFPA 70 requirements.
- C. Finish: Free of burrs, sharp edges, un-reamed holes, and sharp-pointed screw or bolts. Paint both inside and out.
- D. Coating: When mounted direct to concrete or masonry walls that are below grade or where there will be sweating or other moisture present on wall surface, coat backs of boxes with a heavy coat of black asphalt paint before mounting.
- E. Protection: Adequate provisions for preventing damage to conductors either during pulling-in or from weights and tensions when in place.
- F. Weatherproof, rain-tight, or special type when indicated or when required by NFPA 70.

3.4 ANCHORS, FASTENERS, AND MISCELLANEOUS SUPPORTS

- A. Use compatible anchors in roof or ceiling slabs of concrete from which a load is suspended and anchors used to fasten heavy equipment without lead in their construction.
- B. Make exposed conduit fastenings with one-piece, malleable conduit clamps. Two hole, galvanized sheet metal pipe straps may be used on all concealed installations.
- C. Use companion bases or backs with conduit clamps when conduit is exposed to weather or continuous moisture.
- D. Use ring type hangers on individual runs of conduit 3-inches and larger if suspended, complete with threaded rods. Use adjustable turnbuckles when specified or otherwise as an option.
- E. Support multiple runs of suspended conduits from trapeze style hangers suspended with rigid threaded steel rods and with suitable conduit clamps or straps of the same make as cross channels used.
- F. Mount multiple runs of conduit on ceiling or wall surfaces.
- G. Do not hang or support electrical equipment and materials from roof decks.

- END OF SECTION -

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SECTION 26 05 34
ELECTRICAL BOXES AND FITTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Types of electrical boxes and electrical fitting work.

1.2 RELATED SECTIONS

- A. Section 26 05 19 - Low-Voltage Power Conductors and Cables
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems
- C. Section 26 05 33 - Conduit and Raceway.

1.3 REFERENCES

- A. NEMA OS 1: Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- B. NEMA OS 2: Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
- C. NFPA 70: National Electrical Code.
- D. UL: Underwriters Laboratories, Inc.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70 as applicable for installation of electrical boxes and fittings.
- B. Comply with NEMA OS 1 and NEMA OS 2 as applicable for outlet boxes, device boxes, covers and box supports.
- C. Provide electrical boxes and fittings which have been UL-listed and labeled.

PART 2 PRODUCTS

2.1 INTERIOR OUTLET BOXES

- A. One piece, cast iron or cast aluminum outlet wiring boxes, of types shapes and sizes, including box depths, to suit each respective location and installation. If of aluminum, essentially "copper free". Do not use on conduits of dissimilar metals, except with written permission.
- B. Construct with stamped knockouts in back and sides, and with threaded screw holes with corrosion-resistant screws for securing box and covers and wiring devices.
- C. Minimum depth 1-1/4 inches or 2-1/8 inch depth for boxes with 3 or more conduit

entries.

- D. Use in combination with factory or field bends when indicated or advised. Complete outlet boxes with mounting brackets, hangers, extension rings, fixture studs, cable clamps, metal straps, gaskets, cover, hubs, reducers, and other accessories.

2.2 WEATHERPROOF OUTLET BOX

- A. Corrosion-resistant cast-metal of types, shapes and sizes (including depth) required.
- B. Threaded conduit ends, cast-metal face plates with spring hinged waterproof caps suitably configured for each application, with faceplate gaskets and corrosion-resistant fasteners.

2.3 JUNCTION AND PULL BOXES

- A. Building Structure Type: Code-gage sheet steel with screw-on covers; of types, shapes and sizes to suit each respective location and installation; with welded seams and equipped with galvanized steel bolts, nuts and accessories.
- B. Buried Type: Plastic body and cover, or pre-cast concrete with screw-on traffic rated cast iron covers; of types, shapes and sizes to suit each respective location and installation; equipped with stainless steel bolts, nuts and accessories.

PART 3 EXECUTION

3.1 PREPARATION

- A. Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work.
- B. Provide knockout closures to cap unused knockout holes where blanks have been removed.

3.2 INSTALLATION

- A. A. Install where indicated, complying with manufacturer's written instruction, applicable requirements of NFPA 70 and NEMA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
- B. Install coverplates for all boxes; weatherproof outlets for interior and exterior locations exposed to weather or moisture.
- C. Install boxes and fittings to ensure ready accessibility of electrical wiring. Install recessed boxes with face of box or ring flush with adjacent surface.
- D. Fasten boxes rigidly to substrates or structural surfaces to which attached, or solidly embed boxes in concrete or masonry. Use bar hangers for stud construction. Use of nails for securing boxes is prohibited. Set boxes on opposite sides of common wall

with minimum 10-inches of conduit between them.

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SECTION 26 05 43
UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This Section includes specifications for underground electrical conduits, ductbanks, and underground utility structures.
- B. Related work includes but is not limited to,
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 26 05 13 - Medium Voltage Cables
 - 3. Section 26 04 34 - Electrical Boxes and Fittings
 - 4. Section 31 23 15 - Excavation and Backfill for Buried Pipelines
 - 5. Section 32 12 16 - Hot-Mix Asphalt Concrete Paving
 - 6. Section 32 91 13 - Finish Grading and Soil Preparation

1.2 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM C33 Specification for Concrete Aggregates

1.3 SUBMITTALS

- A. Refer to Section 01 33 00, Submittal Procedures for submittal requirements and procedures.
- B. Shop Drawings:
 - 1. Submit shop drawings for fabrication and installation of precast concrete structures, cast-in-place concrete structures, ductwork, including the following:
 - a. Excavation and shoring plans with required structural calculations;
 - b. Shop drawing information may be combined on a single drawing if clarity is not thereby impaired.
 - 2. Submit shop drawings which fully demonstrate that the work to be performed and the materials to be provided comply with the provisions of these Specifications
- C. Product Data. Submit the following:
 - 1. Complete materials list of items proposed to be provided under this Section.
 - 2. Manufacturers' specifications and other data required to demonstrate compliance with these Specifications.
 - 3. Catalog cuts for the following products:
 - a. Raceways.
 - b. Trench and wireway covers including composition of FRP materials, divider partition panels, method of joining sections, expansion joint

- mounting, and support details.
4. Certificates of Compliance: Provide for specified products.

1.4 QUALITY ASSURANCE

A. Qualification of Manufacturers:

1. Select manufacturers of the products specified for work under this Section who are in the business of manufacturing similar products and are able to provide a history of successful production of the specified products.
2. Inspection: Ensure completed facilities are approved by the Resident Engineer before installation of cable and equipment. Perform corrective work at no additional cost to Owner.

PART 2 PRODUCTS

2.1 RACEWAYS

- A. Conduit and duct: In accordance with Section 26 05 34 - Conduit and Raceways.

2.2 PRECAST CONCRETE ELECTRICAL BOXES, PULLBOXES, AND VAULTS

- A. Reinforce concrete in a manner which is regularly provided in standard products of the manufacturer.
- B. Standard manufactured structures which meet project requirements will be acceptable.
- C. Provide concrete inserts for mounting cable support brackets as indicated.
- D. Provide pullbox covers with two lifting eyes and two holddown bolts.

2.3 SAND

- A. Clean, graded, washed, passing a No. 4 U.S. sieve, and conforming generally to ASTM C33 for fine aggregate.

2.4 WARNING TAPE

- A. Heavy gage, yellow, plastic for direct burial, material resistant to corrosive soil, 6-inch minimum width, minimum 4 mils thick.
- B. Printed with warning that an electrical circuit is located beneath the tape.

PART 3 EXECUTION

3.1 PREPARATION

- A. Before beginning construction or installation of a section of underground conduit or ductwork, verify that the site is in suitable condition for installing conduit or ductwork as indicated.

3.2 EXCAVATION, TRENCHING AND BACKFILLING

- A. Perform excavation, bedding, and backfilling for underground conduits and structures in accordance with Section 31 23 15 - Excavation and Backfill for Buried Pipelines and as indicated.

3.3 DUCTBANKS

- A. Group individual conduits together to form a ductbank in conformance with the requirements specified herein.
- B. Inspect ducts and couplings to ensure that only clean and undamaged pieces are incorporated in the work.
- C. Install ducts, joints, and space separators according to manufacturer's printed instructions and recommendations.
- D. Do not use spacers or space separators which transmit any vertical load to the conduit.
- E. Install ductbanks or conduits with a minimum slope of 3 inches to each 100 feet away from buildings and towards manholes, pull boxes, and handholes.
- F. Terminate conduits and ducts in end-bells in vaults.
- G. Where ductbank enters rigid underground structures, provide reinforcing steel to tie the ductbank to the structure.
- H. Protection: when installation of conduits and ducts is temporarily suspended or terminated, close ends of ducts with caps or plugs fitted to prevent entry of water or debris. Use caps or plugs designed for that purpose by the conduit manufacturer.
- I. Mandrelling: As each section of a duct line is completed between manholes, handholes, or pullboxes, use testing mandrel not more than 1/4 inch less than the size of the conduit to draw through each conduit, after which draw a brush with stiff bristles through until the conduit is clear of particles of earth, sand, or gravel. Install conduit caps or plugs immediately thereafter. Notify the Resident Engineer prior to mandrelling any conduit and submit a written report providing a conduit identification number, size, material, location, the type and size of mandrel used, and indicate whether the conduit is tagged. Verify the report also indicate the acceptance date and initials of the accepting inspector and be verified by the Contractor's foreman.
- J. Install 1/8 inch or larger diameter polypropylene pulling cord in ducts including innerducts. Fasten each cord to pull iron anchorage in pull box, manhole, or vault with 2 feet minimum slack.

3.4 PRECAST CONCRETE STRUCTURES

- A. Install precast electrical boxes, pullboxes, handholes, manholes, and vaults as

indicated.

- B. Place boxes on 4 inches of compacted sand bedding.
- C. Place manholes on 6 inches of compacted aggregate base.
- D. Seal unused openings with cement mortar.

- END OF SECTION -

SECTION 26 05 73
SHORT-CIRCUIT/COORDINATION STUDY/ARC FLASH HAZARD ANALYSIS

PART 1 GENERAL

1.1 SCOPE

- A. The contractor shall furnish short-circuit and protective device coordination studies which shall be prepared by the equipment manufacturer.
- B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.5 and Informative Annex D. The arc flash hazard analysis shall be performed according to the IEEE Standard 1584 - 2002, the IEEE Guide for Performing Arc-Flash Calculations.
- C. Related work includes but is not limited to:
 - 1. Section 26 05 05 - Electrical Equipment
 - 2. Section 26 05 13 - Medium-Voltage Cables
 - 3. Section 26 05 19 - Low-Voltage Power Conductors and Cables
 - 4. Section 26 12 19 - Pad-Mounted, Medium Voltage Transformers
 - 5. Section 26 29 26 - Panelboard
 - 6. Section 26 29 13.16 - Reduced Voltage Soft Starters
 - 7. Section 26 18 39 - Medium Voltage VFD

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
 - 2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - 3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
 - 4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
 - 5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
 - 6. IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations
- B. American National Standards Institute (ANSI):
 - 1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
 - 2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
 - 3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers

- Rated on a Symmetrical Current Basis
4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories
 5. ANSI C37.5 – Methods for Determining the RMS Value of a Sinusoidal Current Wave and Normal-Frequency Recovery Voltage, and for Simplified Calculation of Fault Currents
- C. The National Fire Protection Association (NFPA)
1. NFPA 70 - National Electrical Code, latest edition
 2. NFPA 70E – Standard for Electrical Safety in the Workplace

1.3 SUBMITTALS FOR REVIEW/APPROVAL

- A. The short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.4 SUBMITTALS FOR CONSTRUCTION

- A. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. No more than five (5) bound copies of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of the report will be provided without the section containing the computer printout of the short-circuit input and output data. Additional copies, where required, shall be provided on CD in PDF format.
- B. The report shall include the following sections:
1. Executive Summary including source of information and assumptions made.
 2. Descriptions, purpose, basis and scope of the study.
 3. One-line diagram showing protective device ampere ratings and associated designations, cable size & lengths, transformer kVA & voltage ratings, motor & generator kVA ratings, and switchgear/switchboard/panelboard designations.
 4. Tabulations of the worst-case calculated short circuit duties as a percentage of the applied device rating (automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward-adjusted for X/R ratios that are above the device design ratings.
 5. Protective device time versus current coordination curves with associated one line diagram identifying the plotted devices, tabulations of ANSI protective relay functions and adjustable circuit breaker trip unit settings.
 6. Multi-function relay setting file printouts including all ANSI protective relay functions and associated logic and control. Metering, communication, and control logic settings not associated with ANSI protective functions are not required.
 7. Fault study input data, case descriptions, and current calculations including a definition of terms and guide for interpretation of the computer printout
 8. Incident energy and flash protection boundary calculations.

9. Comments and recommendations for system improvements, where needed.

1.5 QUALIFICATIONS

- A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies. The Registered Professional Electrical Engineer shall be a full-time employee of the Engineering Services Organization.

PART 2 PRODUCTS

2.1 STUDIES

- A. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer. By using the equipment manufacturer the study allows coordination of proper breakers, fuses, and current transformers. The coordination study shall begin with the utility company's feeder protective device and include all of the electrical protective devices down to and include the largest feeder circuit breaker and motor starter in the 480 Volt motor control centers and power distribution panelboards. The study shall also include variable frequency drives, harmonic filters, power factor correction equipment, transformers and protective devices associated with variable frequency drives, emergency and standby generators associated paralleling equipment and distribution switchgear.
- B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.5 and Informative Annex D.

2.2 DATA COLLECTION

- A. Contractor shall furnish all field data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to eliminate unnecessary delays and assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- B. Source combination may include present and future utility supplies, motors, and generators.
- C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner or Contractor.
- D. Include fault contribution of existing motors in the study, with motors < 50 hp grouped together. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.3 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

- A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standards 141, latest edition.
- B. Transformer design impedances and standard X/R ratios shall be used when test values are not available.
- C. Provide the following:
 - 1. Calculation methods and assumptions
 - 2. Selected base per unit quantities
 - 3. One-line diagram of the system being evaluated with available fault at each bus, and interrupting rating of devices noted
 - 4. Source impedance data, including electric utility system and motor fault contribution characteristics
 - 5. Typical calculations
 - 6. Tabulations of calculated quantities
 - 7. Results, conclusions, and recommendations
- D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
 - 1. Electric utility's supply termination point
 - 2. Incoming switchgear
 - 3. Unit substation primary and secondary terminals
 - 4. Low voltage switchgear
 - 5. Motor control centers
 - 6. Standby generators and automatic transfer switches
 - 7. Branch circuit panelboards
 - 8. Other significant locations throughout the system
- E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.
- F. Protective Device Evaluation:
 - 1. Evaluate equipment and protective devices and compare to short circuit ratings
 - 2. Adequacy of switchgear, motor control centers, and panelboard bus bracing to withstand short-circuit stresses
 - 3. Adequacy of transformer windings to withstand short-circuit stresses
 - 4. Cable and busway sizes for ability to withstand short-circuit heating
 - 5. Notify Owner in writing, of existing, circuit protective devices improperly rated for the calculated available fault current

2.4 PROTECTIVE DEVICE COORDINATION STUDY

- A. Proposed protective device coordination time-current curves shall be graphically displayed on log-log scale paper.
- B. Include on each curve sheet a complete title and one-line diagram with legend

identifying the specific portion of the system covered.

- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
- D. Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- E. Plot the following characteristics on the curve sheets, where applicable:
 - 1. Electric utility's protective device.
 - 2. Medium voltage equipment relays
 - 3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
 - 4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
 - 5. Transformer full-load current, magnetizing inrush current, and ANSI transformer withstand parameters
 - 6. Medium voltage conductor damage curves
 - 7. Ground fault protective devices, as applicable
 - 8. Pertinent motor starting characteristics and motor damage points
 - 9. Pertinent generator short-circuit decrement curve and generator damage point
 - 10. Other system load protective devices for the largest branch circuit and the largest feeder circuit breaker in each motor control center
- F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.
- G. Select each primary protective device required for a delta-wye connected transformer so that the characteristics or operating band is within the transformer parameters which includes a parameter equivalent to 58% of the ANSI withstand point to afford protection for secondary line-to-ground faults.
- H. Separate low voltage power circuit breakers from each other and the associated primary protective device by a 16% current margin for coordination and protection in the event of secondary line-to-line faults.
- I. Engineer shall provide settings file printouts for all multifunction relays supplied under this contract including all ANSI protective relay functions and associated logic and control. Metering, communication, and control logic settings not associated with ANSI protective functions are not required.

2.5 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2012, Informative Annex D.
- B. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods shall be presented in the proposal.

- C. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
- D. The Arc-Flash Hazard Analysis shall include all MV, 575v, & 480v locations and significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA.
- E. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
- F. The Arc Flash Hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
- G. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
- H. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location in a single table. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum. Conversely, the maximum calculation will assume a maximum contribution from the utility. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable as well as any stand-by generator applications.

The Arc-Flash Hazard Analysis shall be performed utilizing mutually agreed upon facility operational conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.

- I. Arc flash computation shall include both line and load side of main breaker calculations, where necessary.
- J. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on busses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors should be decremented as follows:
 - 1. Fault contribution from induction motors should not be considered beyond 5 cycles.
 - 2. For each piece of ANSI rated equipment with an enclosed main device, two calculations shall be made. A calculation shall be made for the main cubicle,

sides, or rear; and shall be based on a device located upstream of the equipment to clear the arcing fault. A second calculation shall be made for the front cubicles and shall be based on the equipment's main device to clear the arcing fault. For all other non-ANSI rated equipment, only one calculation shall be required and it shall be based on a device located upstream of the equipment to clear the arcing fault.

- K. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- L. Arc-Flash calculations shall be based on actual overcurrent protective device clearing time. A maximum clearing time of 2 seconds will be used based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.6 REPORT SECTIONS

A. Input Data:

1. Utility three-phase and line-to-ground available contribution with associated X/R ratios
2. Short-circuit reactance of rotating machines with associated X/R ratios
3. Cable type, construction, size, # per phase, length, impedance and conduit type
4. Bus duct type, size, length, and impedance
5. Transformer primary & secondary voltages, winding configurations, kVA rating, impedance, and X/R ratio
6. Reactor inductance and continuous ampere rating
7. Aerial line type, construction, conductor spacing, size, # per phase, and length

B. Short-Circuit Data:

1. Source fault impedance and generator contributions
2. X to R ratios
3. Asymmetry factors
4. Motor contributions
5. Short circuit kVA
6. Symmetrical and asymmetrical fault currents

C. Recommended Protective Device Settings:

1. Phase and Ground Relays:
 - a. Current transformer ratio.
 - b. Current setting.
 - c. Time setting.
 - d. Instantaneous setting.
 - e. Specialty non-overcurrent device settings.
 - f. Recommendations on improved relaying systems, if applicable.

2. Circuit Breakers:
 - a. Adjustable pickups and time delays (long time, short time, ground).
 - b. Adjustable time-current characteristic.
 - c. Adjustable instantaneous pickup.
 - d. Recommendations on improved trip systems, if applicable.
- D. Incident energy and arc flash boundary calculations.
 1. Arcing fault magnitude
 2. Device clearing time
 3. Duration of arc
 4. Arc flash boundary
 5. Working distance
 6. Incident energy
 7. Recommendations for arc flash energy reduction

PART 3 EXECUTION

3.1 FIELD ADJUSTMENT

- A. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
- B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Notify Owner in writing of any required major equipment modifications.
- D. Following completion of all studies, acceptance testing and startup by the field engineering service division of the equipment manufacturer, a 2-year warranty shall be provided on all components manufactured by the engineering service parent manufacturing company.

3.2 ARC FLASH WARNING LABELS

- A. The vendor shall provide a 4 in. x 4 in. thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. The label shall have an orange header with the wording, "WARNING, SHOCK & ARC FLASH HAZARD", and shall include the following information:
 1. Location designation
 2. Nominal voltage
 3. Arc flash boundary
 4. Personnel Protective Equipment category
 5. Incident energy (cal/cm²)
 6. Working distance
 7. Shock Boundaries

- 8. Engineering report number, revision number and issue date
- C. Labels shall be machine printed, with no field markings
- D. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
 - 1. For each 600, 480 and applicable 208 volt panelboards and disconnects, one arc flash label shall be provided
 - 2. For each motor control center, one arc flash label shall be provided
 - 3. For each low voltage switchboard, one arc flash label shall be provided
 - 4. For each switchgear, one flash label shall be provided
 - 5. For medium voltage switches one arc flash label shall be provided
- E. Labels shall be field installed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

3.3 ARC FLASH TRAINING

- A. The equipment vendor shall train personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures in accordance with the requirements of NFPA 70E, Standard For Electrical Safety Requirements For Employee Workplaces, shall be provided in the equipment manuals. The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET).

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SECTION 26 09 26
PANELBOARD

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical distribution panelboards.
- B. Connections between fixtures, equipment and panelboards.
- C. Related work includes but is not limited to,
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 26 05 19 - Low-Voltage Power Conductors and Cables
 - 3. Section 26 05 26 - Grounding and Bonding for Electrical Systems
 - 4. Section 26 05 29 - Hangers and Supports for Electrical Systems
 - 5. Section 26 05 33 - Conduit and Raceway

1.2 REFERENCES

- A. NEMA 1: Instructions for Safe Installation. Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- B. NEMA 250: Enclosures for Electrical Equipment (1000 Volt Maximum).
- C. NFPA 70: National Electrical Code.
- D. UL: Underwriters' Laboratories Inc.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer data including specifications, installation instructions and general recommendations, for each type of panelboard required.
- B. Shop Drawings. Submit showing accurately scaled layouts of enclosures and required individual panelboard devices. Show circuit breakers, fusible switches, fuses, ground-fault circuit interrupters, and accessories.

1.4 QUALITY ASSURANCE

- A. Construct panelboards to NEMA 1 and NEMA 250 Standards and provide UL labels.
- B. Comply with NFPA 70 pertaining to installation of wiring and equipment in hazardous locations.
- C. Make all grounding tight and secure throughout.

PART 2 PRODUCTS

2.1 PANELBOARD - GENERAL

- A. Provide panel boards of the same make and key alike with a master key arrangement.
- B. Use dead front panelboards with one-piece cabinets constructed from code gage steel. Cabinets shall have knockouts and minimum gutter space of 4- inches on all sides.
- C. Provide branches with automatic circuit breakers. thermal-magnetic type, unless indicated otherwise. Multi-pole breakers shall automatically open all poles when an overload occurs in any pole. Branch circuit breakers used for switching duty shall be UL listed as SWD type. Ground fault circuit interrupter protection as required by NFPA 70 shall be provided by ground fault circuit interrupting breakers. Circuit breakers shall have positive trip indication as well as clear "off" and "on" indication.
- D. Use factory assembled panelboards with amp rating units indicated. Provide spare units and blank spaces as indicated. Main circuit breaker or lugs only as indicated.
- E. Affix large, permanent individual numbers to each breaker on panel board face in a uniform position. Number starting at the top, with odd numbers used in sequence down left hand side and even numbers used in sequence down right hand side.
- F. Use fronts manufactured with code gage steel, finished with rust inhibiting primer and baked enamel finish and manufacturer's standard color. Provide doors with flush tumbler type locks. Provide a circuit directory frame and card with a clear plastic covering inside the door.
- G. Furnish locking clips for " off" position only, with " on" trip free travel and installed in all circuits so indicated.
- H. Label panel with black phenolic or acceptable alternate engraved nameplate with 1/4 inch high lettering on the interior of each panelboard; including panel name and voltage.
- I. For outside locations use a NEMA 3R cabinet.

2.2 PANELBOARD - 480 VOLT

- A. Voltage: 480Y/277 volts, 3 phase, 4 wire, S/N, equipped with automatic circuit breaker.
- B. Amp Rating: As shown on the Panelboard Schedules on the drawings.
- C. Circuit Breakers: Minimum interrupting capacity of 14,000 amps at 277 volts.

Use breakers that are UL rated for use as switches.

- D. Locking Clips: 5 minimum per panel.

2.3 PANELBOARD - 240 VOLT

- A. Voltage: 240/120 volts, 1 phase, 3 wire, S/N, equipped with automatic circuit breakers.
- B. Circuit Breakers: Minimum interrupting capacity of 10,000 amps at 120 volts.

2.4 PANELBOARD - 208 VOLT

- A. Voltage: 208Y/120 volts, 3 phase, 4 wire, S/N, equipped with automatic circuit breakers.
- B. Circuit Breakers: Minimum interrupting capacity of 10,000 amps at 120 volts.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Provide mounting brackets, bus bar drillings and filler pieces for unused spaces.
- B. Prepare and affix typewritten directory to inside cover of panelboard indicating loads controlled by each circuit.
- C. Install per NFPA 70, NEMA. manufacturer's instructions and authorities having jurisdiction.

- END OF SECTION -

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SECTION 26 12 16
DRY TYPE TRANSFORMERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes two-winding transformers.
- B. Related Sections:
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 01 45 00 - Quality Control and Materials Testing
 - 3. Section 01 60 00 - Product Requirements
 - 4. Section 01 78 50 - Project Closeout

1.2 REFERENCES

- A. National Electrical Manufacturers Association
 - 1. NEMA ST 1 (National Electrical Manufacturers Association) - Specialty Transformers (Except General-Purpose Type).
 - 2. NEMA ST 20 (National Electrical Manufacturers Association) Dry-Type Transformers for General Applications.
- B. International Electrical Testing Association
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Product Data: Submit outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.
- C. Test Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 78 50 - Project Closeout.
- B. Project Record Documents: Record actual locations of transformers.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 TWO-WINDING TRANSFORMERS

- A. Manufacturers:
 - 1. Acme Transformer
 - 2. General Electric
 - 3. Square D Company
 - 4. Approved equal.
- B. Product Description: NEMA ST 20, factory assembled, air-cooled, dry type transformers, ratings as indicated.
- C. Primary Voltage: 480 volts, 3 phase or 480 volts, 1 phase as shown on the drawings.
- D. Secondary Voltage: 208Y/120 volts, 3 phase or 240/120 volts, 1 phase as shown on the drawings.
- E. Insulation system and average winding temperature rise for rated kVA as follows:
 - 1. 1-15 kVA: Class 185 with 115 degrees C rise.
 - 2. 16-500 kVA: Class 220 with 115 degrees C rise.
- F. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point at full load.
- G. Winding Taps:
 - 1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
 - 2. Transformers 15 kVA and Larger: NEMA ST 20.
- H. Sound Levels: NEMA ST 20.

- I. Basic Impulse Level: 10 kV.
- J. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- K. Mounting:
 - 1. 1-15 kVA: As shown on drawings.
- L. Coil Conductors: Continuous copper windings with terminations brazed or welded.
 - 1. Enclosure: NEMA ST 20, Type 1 ventilated. Provide lifting eyes or brackets.
 - 2. Isolate core and coil from enclosure using vibration absorbing mounts.
 - 3. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.2 SOURCE QUALITY CONTROL

- A. Productions test each unit according to NEMA ST20.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 60 00 - Product Requirements.
- B. Verify mounting supports are properly sized and located including concealed bracing in walls.

3.2 INSTALLATION

- A. Provide seismic restraints.
- B. Provide grounding and bonding in accordance with NFPA 70.

3.3 FIELD QUALITY CONTROL

- A. Section 01 45 00 - Quality Control and Materials Testing. Testing and inspection services Testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.2.1.

3.4 ADJUSTING

- A. Section 01 78 50 - Project Closeout: Testing, adjusting, and balancing.
- B. Measure primary and secondary voltages and make appropriate tap adjustments.

- END OF SECTION -

SECTION 26 12 19
PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of the pad-mounted, liquid-filled, medium-voltage transformers, indicated as transformers in this section.
- B. Related work includes but is not limited to:
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 03 30 00 - Cast-In-Place Concrete
 - 3. Section 26 05 13 - Medium-Voltage Cables
 - 4. Section 26 05 19 - Low-Voltage Power Conductors and Cables
 - 5. Section 26 05 26 - Grounding and Bonding for Electrical Systems
 - 6. Section 26 05 43 - Underground Ducts and Raceways for Electrical Systems
 - 7. Section 26 05 73 - Short-Circuit Coordination and Arc Flash

1.2 QUALITY ASSURANCE

- A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.3 FACTORY TESTS

- A. Factory Tests shall be required.
- B. Factory Tests:
 - 1. Transformers shall be thoroughly tested at the factory to ensure that there are no electrical or mechanical defects. Tests shall be conducted per IEEE Standards. Factory tests shall be certified. The following tests shall be performed:
 - a. Perform insulation-resistance tests, winding-to-winding and each winding-to-ground.
 - b. Perform turns-ratio tests at all tap positions.

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section -01 33 00 Submittal Procedures and the following requirements:
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.

- b. Include electrical ratings, nameplate data, impedance, outline drawing with dimensions and front, top, and side views, weight, mounting details, decibel rating, termination information, temperature rise, no-load and full-load losses, regulation, overcurrent protection, connection diagrams, and accessories.
 - c. Complete nameplate data, including manufacturer's name and catalog number.
 - d. Certification from the manufacturer that representative transformers have been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.
2. Manuals:
- a. When submitting the shop drawings, submit companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
 - (1) Identify terminals on wiring diagrams to facilitate installation, maintenance, and operation.
 - (2) Indicate on wiring diagrams the internal wiring for each piece of equipment and interconnections between the pieces of equipment.
 - (3) Approvals will be based on complete submissions of manuals, together with shop drawings.
 - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
 - (1) Update the manual to include any information necessitated by shop drawing approval.
 - (2) Show all terminal identification.
 - (3) Include information for testing, repair, troubleshooting, assembly, disassembly, and recommended maintenance intervals.
 - (4) Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.

B. Certifications:

- 1. Two weeks prior to the final inspection, submit the following certifications.
 - a. Certification by the manufacturer that the transformers conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the transformers have been properly installed, connected, and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Society for Testing and Materials (ASTM):

D3487-16 Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus

C. Institute of Electrical and Electronic Engineers (IEEE):

- 48-09 Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5kV Through 765kV or Extruded Insulation Rated 2.5kV Through 500kV
- 386-16 Separable Insulated Connector Systems for Power Distribution Systems Above 600 V
- 592-07 Exposed Semiconducting Shields on High-Voltage Cable Joints and Separable Connectors
- C2-17 National Electrical Safety Code
- C37.47-11 Specification for High Voltage (>1000V) Distribution Class Current-Limiting Fuses and Fuse Disconnecting Switches
- C57.12.00-15 Liquid-Immersed Distribution, Power and Regulating Transformers
- C57.12.10-13 Liquid-Immersed Power Transformers
- C57.12.25-90 Pad-Mounted, Compartmental-Type, Self-Cooled, Single-Phase Distribution-Transformers with Separable Insulated High Voltage Connectors; High Voltage, 34500 Grd Y/19920 Volts and Below; Low-Voltage 240/120 Volts; 167 kVA and Smaller Requirements
- C57.12.28-14 Pad-Mounted Equipment - Enclosure Integrity
- C57.12.29-14 Pad-Mounted Equipment – Enclosure Integrity for Coastal Environments
- C57.12.34-15 Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 5 MVA and Smaller; High Voltage, 34.5 kV Nominal System Voltage and Below; Low Voltage, 15kV Nominal System Voltage and Below
- C57.12.90-15 Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
- C62.11-12 Metal-Oxide Surge Arresters for AC Power Circuits

D. International Code Council (ICC):

IBC-15 International Building Code

E. National Electrical Manufacturers Association (NEMA):

TR 1-13 Transformers, Regulators, and Reactors

F. National Fire Protection Association (NFPA):

70-23 National Electrical Code (NEC)

G. Underwriters Laboratories Inc. (UL):

467-13 Grounding and Bonding Equipment

H. United States Department of Energy (DOE):

PART 2 PRODUCTS**2.1 GENERAL REQUIREMENTS**

- A. Transformers shall be in accordance with ASTM, IEEE, NFPA, UL, as shown on the drawings, and as specified herein. Each transformer shall be assembled as an integral unit by a single manufacturer.
- B. Transformers shall be complete, outdoor type, continuous duty, integral assembly, grounded, tamper-resistant, and with liquid-immersed windings.
- C. Ratings shall not be less than shown on the drawings.
- D. Completely fabricate transformers at the factory so that only the external cable connections are required at the project site.
- E. Thoroughly clean, phosphatize, and finish all the metal surfaces at the factory with a rust-resistant primer and dark green enamel finish coat, except where a different color is specified in Section 09 06 00, SCHEDULE FOR FINISHES. All surfaces of the transformer that will be in contact with the concrete pad shall be treated with corrosion-resistant compounds and epoxy resin or a rubberized sealing compound.

2.2 COMPARTMENTS

- A. Construction:
 - 1. Enclosures shall be weatherproof and in accordance with IEEE C57.12.28.
 - 2. The medium- and low-voltage compartments shall be separated with a steel barrier that extends the full height and depth of the compartments.
 - 3. The compartments shall be constructed of sheet steel (gauge to meet ANSI requirements) with bracing and with reinforcing gussets using jig welds to assure rectangular rigidity.
 - 4. All bolts, nuts, and washers shall be zinc-plated steel.
 - 5. Sufficient space shall be provided for equipment, cabling, and terminations within the compartments.
 - 6. Affix transformer nameplate permanently within the low-voltage compartment. Voltage and kVA rating, connection configuration, impedance, date of manufacture, and serial number shall be shown on the nameplate.
- B. Doors:
 - 1. Provide a separate door for each compartment with provisions for a single padlock to secure all doors. Provide each compartment door with open position doorstops and corrosion-resistant tamperproof hinges welded in place. The medium-voltage compartment door shall be mechanically prevented from opening unless the low-voltage compartment door is open.
 - 2. The secondary compartment door shall have a one-piece steel handle and

- incorporate three-point locking mechanisms.
3. Owner will provide a 50 mm (2 inches) size padlock for each assembly. Padlocks shall be keyed to the OWNERS established key set. Firmly attach the padlock to the door assembly.

2.3 BIL RATING

- A. 15 kV class equipment shall have a minimum 95 kV BIL rating.

2.4 TRANSFORMER FUSE ASSEMBLY

- A. The primary fuse assembly shall be a combination of externally replaceable Bay-O-Net liquid-immersed fuses in series with liquid-immersed current-limiting fuses.

2.5 PRIMARY CONNECTIONS

- A. Primary connections shall be 200A dead-front loadbreak wells and inserts for cable sizes shown on the drawings.
- B. Surge Arresters: Distribution class, one for each primary phase, complying with IEEE C62.11, elbow type.

2.6 MEDIUM-VOLTAGE TERMINATIONS

- A. Terminate the medium-voltage cables in the primary compartment with 200 A loadbreak premolded rubber elbow connectors, suitable for submersible applications. Elbow connectors shall have a semiconductive shield material covering the housing. The separable connector system shall include the loadbreak elbow, the bushing insert, and the bushing well. Separable connectors shall comply with the requirements of IEEE 386, and shall be interchangeable between suppliers. Allow sufficient slack in medium-voltage cable, ground, and drain wires to permit elbow connectors to be moved to their respective parking stands.
- B. Ground metallic cable shield with a cable shield grounding adapter, consisting of a solderless connector enclosed in watertight rubber housing covering the entire assembly, bleeder wire, and ground braid.

2.7 LOW-VOLTAGE EQUIPMENT

- A. The low-voltage leads shall be brought out of the tank by epoxy pressure tight bushings, and shall be standard arrangement.
- B. Tin-plate the low-voltage neutral terminal and isolate from the transformer tank. Provide a removable ground strap sized in accordance with the NEC and connect between the secondary neutral and ground pad.

2.8 TRANSFORMERS

- A. Transformer rating: 112.5 kVA and 300 kVA as shown on drawings. kVA ratings shown on the drawings are for continuous duty without the use of cooling fans.

- B. Temperature rises shall not exceed the NEMA TR 1 of 65-deg C (149-deg F) by resistance.
- C. Transformer insulating material shall be mineral oil in accordance with ASTM D 3487.
- D. Transformer impedance shall be not less than 4-1/2% for sizes 150 kVA and larger.
- E. Sound levels shall conform to NEMA TR 1 standards.
- F. Primary and Secondary Windings for Three-Phase Transformers:
 - 1. Primary windings shall be wye-connected.
 - 2. Secondary windings shall be wye-connected. Provide isolated neutral bushings for secondary wye-connected transformers.
 - 3. Secondary leads shall be brought out through pressure-tight epoxy bushings.
- G. Primary windings shall have four 2-1/2% full-capacity voltage taps; two taps above and two taps below rated voltage.
- H. Core and Coil Assemblies:
 - 1. Cores shall be grain-oriented, non-aging, silicon steel to minimize losses.
 - 2. Core and coil assemblies shall be rigidly braced to withstand the stresses caused by rough handling during shipment, and stresses caused by any possible short-circuit currents.
 - 3. Coils shall be continuous-winding type without splices except for taps. Material shall be copper.
 - 4. Coil and core losses shall be optimum for efficient operation.
 - 5. Primary, secondary, and tap connections shall be brazed or pressure type.
 - 6. Provide end fillers or tie-downs for coil windings.
- I. The transformer tank, cover, and radiator gauge thickness shall not be less than that required by ANSI.
- J. Accessories:
 - 1. Provide standard NEMA features, accessories, and the following:
 - a. No-load tap changer. Provide warning sign.
 - b. Lifting, pulling, and jacking facilities.
 - c. Globe-type valve for oil filtering and draining, including sampling device.
 - d. Pressure relief valve.
 - e. Liquid level gauge and filling plug.
 - f. A grounding pad in the medium- and low-voltage compartments.
 - g. A diagrammatic nameplate.
 - h. Dial-type liquid thermometer with a maximum reading pointer and an external reset.
 - 2. The accessories shall be made accessible within the compartments without disassembling trims and covers.

- K. Transformers shall meet the energy conservation standards for transformers per the United States Department of Energy 10 CFR Part 431.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install transformers outdoors, as shown on the drawings, in accordance with the NEC, and as recommended by the manufacturer.
- B. Anchor transformers with rustproof bolts, nuts, and washers not less than 12 mm (1/2 inch) diameter, in accordance with manufacturer's instructions, and as shown on drawings.
- C. In seismic areas, transformers shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.
- D. Mount transformers on concrete slab. Unless otherwise indicated, the slab shall be at least 200 mm (8 inches) thick, reinforced with a 150 by 150 mm (6 by 6 inches) No. 6 mesh placed uniformly 100 mm (4 inches) from the top of the slab. Slab shall be placed on a 150 mm (6 inches) thick, well-compacted gravel base. The top of the concrete slab shall be approximately 100 mm (4 inches) above the finished grade. Edges above grade shall have 12-1/2 mm (1/2 inch) chamfer. The slab shall be of adequate size to project at least 200 mm (8 inches) beyond the equipment. Provide conduit turn-ups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 75 mm (3 inches) above slab surface. Concrete work shall be as specified in Section 03 30 00 - Cast-In-Place Concrete.
- E. Grounding:
 - 1. Ground each transformer in accordance with the requirements of the NEC. Install ground rods per the requirements of Section 26 05 26- Grounding and Bonding for Electrical Systems, to maintain a maximum resistance of 5 ohms to ground.
 - 2. Connect the ground rod to the ground pads in the medium- and low-voltage compartments.
 - 3. Install and connect the cable shield grounding adapter per the manufacturer's instructions. Connect the bleeder wire of the cable shield grounding adapter to the loadbreak or deadbreak elbow grounding point with minimum No. 14 AWG wire, and connect the ground braid to the grounding system with minimum No. 6 AWG bare copper wire. Use soldered or mechanical grounding connectors listed for this purpose.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform manufacturer's required field tests in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical and mechanical condition. Check for damaged or cracked bushings and liquid leaks.
 - c. Verify that control and alarm settings on temperature indicators are as specified.
 - d. Inspect all field-installed bolted electrical connections, using the calibrated torque-wrench method to verify tightness of accessible bolted electrical connections, and perform thermographic survey after energization under load.
 - e. Vacuum-clean transformer interior. Clean transformer enclosure exterior.
 - f. Verify correct liquid level in transformer tank.
 - g. Verify correct equipment grounding per the requirements of Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - h. Verify the presence and connection of transformer surge arresters, if provided.
 - i. Verify that the tap-changer is set at rated system voltage.

3.3 FOLLOW-UP VERIFICATION

- A. Upon completion of acceptance checks, settings, and tests, the Contractor shall demonstrate that the transformers are in good operating condition and properly performing the intended function.

3.4 SPARE PARTS

- A. Deliver the following spare parts for the project to the Owner two weeks prior to final inspection:
 1. Six insulated protective caps.
 2. One spare set of medium-voltage fuses for each size and type of fuse used in the project.
 3. Six elbow parking stands.

3.5 INSTRUCTION

- A. The Contractor shall instruct maintenance personnel, for not less than one 2 hour period, on the maintenance and operation of the equipment on the date requested by the Resident Engineer.

- END OF SECTION -

SECTION 26 13 00
MEDIUM-VOLTAGE SWITCHGEAR

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pad-mounted switchgear.
- B. Related work includes but is not limited to,
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 01 60 00 - Product Requirements
 - 3. Section 03 30 00 - Cast-In-Place Concrete
 - 4. Section 01 78 50 - Project Closeout
 - 5. Section 26 05 13 - Medium-Voltage Cables
 - 6. Section 26 05 29 - Hangers and Supports for Electrical Systems
 - 7. Section 26 05 43 - Underground Ducts and Raceways for Electrical Systems
 - 8. Section 26 05 73 - Short-Circuit/Coordination Study and Arcflash Hazard Analysis
 - 9. Section 26 12 19 - Pad-Mounted, Medium Voltage Transformers
 - 10. Section 26 18 39 - Medium-Voltage VFD

1.2 REFERENCE STANDARD

- A. IEEE
 - 1. C37.20.1 - IEEE Standard for Metal-Enclosed Low-Voltage (1000 Vac and Below, 3200 Vdc and Below) Power Circuit Breaker Switchgear; 2015, with Amendment (2020).
 - 2. IEEE C37.20.2 - IEEE Standards for Metal-Clad Switchgear
 - 3. IEEE C37.20.3 - IEEE Standard for Metal-Enclosed Interrupter Switchgear.
 - 4. IEEE C37.62 - IEEE Standard for Pad-Mount, Dry Vault, Submersible and Overhead Fault Interrupters for Alternating Current Systems up to 38 kV.
 - 5. IEEE C37.74 - IEEE Standard Requirements for Subsurface, Vault, and Pad-mounted Load-Interrupter Switchgear and Fused Load-Interrupter Switchgear for Alternating Current Systems up to 38 kV.
- B. Metal-Enclosed Interrupter Switchgear.
- C. IEEE
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authorized Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 SUBMITTAL

- A. See 01 33 00 - Submittal Procedures for submittal procedures.
- B. Shop Drawings: Indicate electrical characteristics and connection requirements, outline dimensions, connection and support points, weight, specified ratings and materials.
 - 1. Identify mounting conditions required for equipment seismic qualification.
- C. Product Data: Provide electrical characteristics and connection requirements, standard model design tests, and options.
- D. Manufacturer's equipment seismic qualification certification.
- E. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.
- F. Manufacturer's Installation Instructions
- G. Manufacturer's Field Reports: Indicate activities on site, final adjustments and overcurrent protective device coordination curves, adverse findings, and recommendations.
- H. Project Record Documents: Include copy of manufacturer's certified drawings.
- I. Operation Data: Include operating instructions for manually and electrically opening and closing circuit breakers.
- J. Maintenance Data: Include maintenance instructions for cleaning methods; cleaning material recommended; instructions for circuit breaker removal, replacement, testing and adjustment, and lubrication.
- K. Maintenance Materials: Furnish the following for Owner's use in maintenance project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Tools: One each of every special tool required to operate and maintain switchgear.

1.4 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect products from weather and moisture by covering with heavy plastic or canvas and by maintaining heating within enclosure in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MANUFACTURES

- A. S&C Electric Company, or approved equal

2.2 DESCRIPTION

- A. The switchgear shall consist of a gas-tight tank containing SF6 gas, load-interrupter switches, resettable fault interrupters with visible open gaps and integral visible grounds, and a microprocessor based overcurrent control. Load-interrupter switch terminals shall be equipped with bushings rated 600 amperes continuous, and fault-interrupter terminals shall be equipped with bushing wells rated 200 amperes continuous or bushings rated 600 amperes continuous (as specified) to provide for elbow connection. Manual operating mechanisms and viewing windows shall be located on the opposite side of the tank from the bushings and bushing wells, so operating personnel shall not be required to perform any routine operations in close proximity to high voltage elbows and cables.
- B. High-Voltage Bus
 - 1. Bus and interconnections shall withstand the stresses associated with short circuit currents up through the maximum rating of the switchgear.
 - 2. Before installation of aluminum bus, all electrical contact surfaces shall first be prepared by machine-abrading to remove any oxide film. Immediately after this operation, the electrical contact surfaces shall be coated with a uniform coating of an oxide inhibitor and sealant.
- C. Provisions for Grounding
 - 1. One ground connection pad shall be provided on the gas-tight tank of the switchgear.
 - 2. The ground connection pad shall be constructed of stainless steel and welded to the gas-tight tank, and it shall have a short circuit rating equal to that of the switchgear.
 - 3. When an enclosure is provided, no less than one enclosure ground pad shall be provided.
 - 4. One ground-connection pad per way shall be provided.

2.3 SERVICE CONDITIONS

- A. Meet requirements for usual service conditions described in IEEE C37.20.1 and IEEE 37.74 for the specified unusual service conditions.
- B. Meet requirements for disconnecting means.

2.4 RATINGS

- A. Seismic Qualification: Provide switchgear and associated components suitable for

application under the seismic Zone III. Include certification of compliance with submittals.

B. Certification of Ratings

1. The manufacturer of the switchgear shall be completely and solely responsible for the performance of the load-interrupter switch and fault interrupter as well as the complete integrated assembly as rated.
2. The manufacturer shall furnish, upon request, certification of ratings of the load-interrupter switch, fault interrupter, and the integrated switchgear assembly consisting of switches and fault interrupters in combination with the gas-tight tank.

C. Nominal Voltage: 15 kV, three phase, 60 Hz.

D. Main Bus Ampacity: 600 amperes, continuous.

E. kV BIL Voltage, 95 kV.

F. The switchgear shall conform to or exceed the applicable requirements of the following standards and codes:

1. The applicable portions of ANSI C57.12.28, covering enclosure integrity for pad equipment.
2. The applicable portions of ANSI C37.71, ANSI C37.72, ANSI C37.73, IEC 56, and IEC 265-1 (Class A), which specify test procedures and sequences for the load-interrupter switches, fault interrupters, and the complete switchgear assembly.

G. Connections

1. For gear rated 12.5 kA short circuit, load-interrupter switches shall be equipped with 600 Ampere bushings, and fault interrupters shall be equipped with 200 Ampere bushing wells.
2. Bushings and bushing wells shall be located on one side of the gear to reduce the required operating clearance.
3. Fault interrupters shall be equipped with 600 Ampere bushings without studs.
4. Load-interrupter switches shall be equipped with 600 Ampere bushings with studs.

H. Bushings and Bushing Wells

1. Bushings and bushing wells shall conform to ANSI/IEEE Standard 386,
2. Bushings and bushing wells shall include a semiconductive coating.
3. Bushings and bushing wells shall be mounted in such a way that the semiconductive coating is solidly grounded to the gas-tight tank.

2.5 BASIC COMPONENTS

A. Load-Interrupter Switch

1. The three-phase, group-operated load-interrupter switches shall have a three-time and ten-time duty-cycle fault-closing rating as specified under "Ratings". This rating defines the ability to close the switch the designated number of times against a three-phase fault with asymmetrical (peak) current in at least one phase equal to the rated value, with the switch remaining operable and able to carry and interrupt rated current. Certified test abstracts establishing such ratings shall be furnished upon request.
2. The switch shall be provided with an integral ground position that is readily visible through the viewing window to eliminate the need for cable handling and exposure the high voltage to ground the equipment.
3. The ground position shall have a three-time and ten-time duty-cycle fault-closing rating.
4. The switch shall be provided with an open position that is readily visible through the viewing window to eliminate the need for cable handling and exposure to high voltage establish a visible gap.
5. The open gaps of the switch shall be sized to allow cable testing through a feedthru bushing or the back of the elbow.

B. Fault Interrupters

1. Fault interrupters shall have a three-time and ten-time duty-cycle fault-closing and fault interrupting rating as specified under "Ratings". This rating defines the fault interrupter's ability to close the designated number of times against a three-phase fault with asymmetrical (peak) current in at least one phase equal to the rated value and clear the resulting fault current, with the interrupter remaining operable and able to carry and interrupt rated current. Certified test abstracts establishing such ratings shall be furnished upon request.
2. The fault interrupter shall be provided with a disconnect with an integral ground position that is readily visible through the viewing window to eliminate the need for cable handling and exposure to high voltage to ground the equipment.
3. The ground position shall have a three-time and ten-time duty-cycle fault-closing rating.
4. The disconnect shall be provided with an open position that is readily visible through the viewing window, eliminating the need for cable handling and exposure to high voltage the establish a visible gap.
5. The fault interrupter, including its three-position disconnect, shall be a single integrate design so that operation between the closed and open positions or the open and grounded positions is accomplished with a single, intuitive movement.
6. The open gaps of the disconnect shall be sized to allow cable testing through a feedthru bushing or the back of the elbow.
7. An internal indicator shall be provided for each fault interrupter to show when it is in the tripped condition. The indicator shall be clearly visible through the viewing window.

C. Operating Mechanism

1. Load-interrupter switches and fault interrupter make, quick-break mechanism.
2. The manual handle shall charge the operating mechanism for closing, opening,

and grounding of the switches and fault interrupters.

3. A single, integrated operating mechanism shall fully operate each fault interrupter or load interrupter switch in a continuous movement so that additional operations are not required to establish open or grounded positions.
4. Operating mechanisms shall be equipped with an operation selector to prevent inadvertent operation from the closed position directly to the grounded position, or from the grounded position directly to the closed position. The operation selector shall require physical movement to the proper position to permit the next operation.
5. Operating shafts shall be padlockable in any position to prevent operation.
6. The operation selector shall be padlockable to prevent operation to the ground position.
7. The operating mechanism shall indicate switch position, which shall be clearly visible from the normal operating position.

D. Provisions for Grounding

1. One ground-connection pad shall be provided on the gas-tight tank of the switchgear.
2. The ground-connection pad shall be constructed of stainless steel and welded to the gas tight tank, and it shall have a short-circuit rating equal to that of the switchgear.
3. When an enclosure is provided, no less than one enclosure ground pad shall be provided.
4. One ground-connection pad per way shall be provided.

E. Overcurrent Control

1. A microprocessor-based overcurrent control shall be provided to initiate fault interruption.
2. For dry-vault-mounted style and pad-mounted style switchgear, the control shall be mounted in a watertight enclosure. For UnderCover style and wet-vault-mounted style switchgear, the control shall be mounted in a submersible enclosure. The control shall be removable in the field without taking the gear out of service.
3. Control settings shall be field-programmable using a personal computer connected via a USB port to the control. The USB port shall be accessible from the exterior of the enclosure. All programming software is resident on the control and can be accessed via personal computer using the Internet Explorer or Firefox web browser. Energization of the gear shall not be required to set or alter control settings.
4. Power and sensing for the control shall be supplied by integral current transformers.
5. The control shall feature time-current characteristic (TCC) curves including standard speed, K-speed, T-speed, coordinating-speed tap, coordinating-speed main, and related curves per IEEE C37.112-1996. Coordinating-speed tap curves shall optimize coordination with load-side weak-link/backup current-limiting fuse combinations, and coordinating-speed main curves shall optimize coordination with tap-interrupter curves and upstream feeder breakers.

6. The standard E-speed curve shall have phase-overcurrent settings ranging from 7E through 400E. The standard K-speed curve shall have phase-overcurrent settings ranging from 8K through 200K. The standard T-speed curve shall have phase-overcurrent settings ranging from 8T through 200T. The coordinating-tap curve shall have phase-overcurrent and independent ground-overcurrent settings ranging from 15 Amperes through 400 Amperes. The coordinating-main curve shall have phase-overcurrent and independent ground-overcurrent settings ranging from 25 Amperes through 800 Amperes.
7. Time-current characteristic curves shall conform to the following IEEE C37.112-199 IEEE Standard Inverse-Time Characteristic Equations for Overcurrent Relays:
 - a. U.S. Moderately Inverse Curve U1, U.S. Inverse Curve U2, U.S. Very Inverse Curve U3, U.S. Extremely Inverse Curve U4, U.S. Short-Time Inverse Curve U5, I.E.C. Class A Curve (Standard Inverse) C1, I.E.C. Class B Curve (Very Inverse) C2, I.E.C. Class C Curve (Extremely Inverse) C3, I.E.C. Long-Time Inverse Curve C4, and
 - b. I.E.C. Short-Time Inverse Curve C5.
8. The control shall have two independently settable and field-adjustable definite-time delay settings. (A definite-time delay setting can be configured to be an instantaneous- trip setting if the definite-time delay is set to 0 milliseconds.)
9. The minimum trip current shall be 14 Amperes for Vista switchgear with 660:1 ratio current transformers, and 28 Amperes for models with 1320:1 ratio current transformer.
10. Event records shall be easily viewable from the control using a personal computer connected to the USB port. The event log shall capture the last 64 events recorded by the overcurrent control.
11. The control shall store sufficient energy to operate the fault interrupters without affecting the accuracy or coordination under fault conditions.

F. Pad-Mounted Style

1. The gas-tight tank shall be made of 7-gauge mild-steel.
2. To guard against corrosion caused by extremely harsh environmental conditions, the gas-tight tank shall be made of Type 304L stainless steel.
3. For gear rated 12.5 kA short circuit, the switchgear shall conform to or exceed the requirements of applicable portions of IEC 298, Appendix AA, covering arc resistant through 12.5 kA for 15 cycles.
4. Enclosure
 - a. The switchgear shall be provided with a pad-mounted enclosure suitable for installation of the gear on a concrete pad.
 - b. The pad-mounted enclosure shall be separable from the switchgear to allow clear access to the bushings and bushing wells for cable termination.
 - c. The basic material shall be a 14-gauge hot-rolled, pickled, and oiled steel sheet.
 - d. The enclosure shall be provided with removable front and back panels and hinged lift-up roof sections for access to the operating and termination compartments. Each roof section shall have a retainer to

- hold it in the open position.
 - e. Lift-up roof sections shall overlap the panels and shall have provisions for pad-locking that incorporate a means to protect the padlock shackle from tampering.
 - f. The base shall consist of continuous 90-degree flanges, turned inward and welded at the corners, for bolting to the concrete pad.
 - g. Panel openings shall have 90-degree flanges, facing outward, that shall provide strength and rigidity as well as deep overlapping between panels and panel openings to guard against water entry.
 - h. For bushings rated 600 Amperes continuous, the termination compartment shall be of an adequate depth to accommodate encapsulated surge arresters mounted on 600 Ampere elbows having 200 Ampere interfaces.
 - i. For bushing wells rated 200 Amperes continuous, the termination compartment shall be of an adequate depth to accommodate 200 Ampere elbows mounted on feedthru inserts.
 - j. An instruction manual holder shall be provided.
 - k. Non-removable lifting tabs shall be provided.
5. Enclosure Finish
- a. All exterior welded seams shall be filled and sanded smooth for neat appearance.
 - b. To remove oils and dirt, to form a chemically and anodically neutral conversion coating to improve the finish-to-metal bond, and to retard underfilm propagation of corrosion, all surfaces shall undergo a thorough pretreatment process comprised of a fully automated system of cleaning, rinsing, phosphatizing, sealing, drying, and cooling before any protective coatings are applied. By using an automated pretreatment process, the enclosure shall receive a highly consistent thorough treatment, eliminating fluctuations in reaction time, reaction temperature, and chemical concentrations.
 - c. After pretreatment, protective coatings shall be applied that shall help resist corrosion and protect the steel enclosure. To establish the capability to resist corrosion and protect the enclosure, representative test specimens coated by the manufacturer's finishing system shall satisfactorily pass the following tests:
 - (1) 4000 hours of exposure to salt-spray testing per ASTM B 117 with:
 - (a) Underfilm corrosion not to extend more than 1/32 inch (0.79 mm) from the scribe, as evaluated per ASTM D 1645,
 - (b) Procedure A, Method 2 (scraping); and
 - (2) Loss of adhesion from bare metal not to extend more than 1/8 in. (3.2 mm) from the scribe.
 - (3) 1000 hours of humidity testing per ASTM D 4585 using the Cleveland Condensing Type Humidity Cabinet, with no blistering as evaluated per ASTM D 714.
 - (4) 500 hours of accelerated weathering testing per ASTM G 53 using lamp UVB-313, with no chalking as evaluated per ASTM D 659, and no more than 10% reduction of gloss as evaluated per ASTM D 523.

- (5) Crosshatch-adhesion testing per ASTM D 3359 Method B, with no loss of finish.
 - (6) 160-inch-pound impact, followed by adhesion testing per ASTM D 2794, with no chipping or cracking.
 - (7) 3000 cycles of abrasion testing per ASTM 4060, with no penetration to the substrate.
 - d. The finish shall be inspected for scuffs and scratches. Blemishes shall be touched up by hand to restore the protective integrity of the finish.
- 6. Labeling
 - a. Hazard-Alerting Signs
 - (1) The exterior of the pad-mounted enclosure (if furnished) shall be provided with "Warning-Keep Out-Hazardous Voltage Inside-Can Shock, Burn, or Cause Death" signs.
 - (2) Each unit of switchgear shall be provided with a "Danger-Hazardous Voltage--Failure to Follow These Instructions Will Likely Cause Shock, Burns, or Death" sign. The text shall further indicate that operating personnel must know and obey the employer's work rules, know the hazards involved, and use proper protective equipment and tools to work on this equipment.
 - (3) Each unit of switchgear shall be provided with a "Danger-Keep Away-Hazardous Voltage-Will Shock, Burn, or Cause Death" sign.
 - b. Nameplates, Ratings Labels, and Connection Diagrams
 - (1) Each unit of switchgear shall be provided with a nameplate indicating the manufacturer's name, catalog number, model number, date of manufacture, and serial number.
 - (2) Each unit of switchgear shall be provided with a ratings label indicating the following: voltage rating; main bus continuous-current rating; short-circuit rating; fault-interrupter ratings, including interrupting and duty-cycle fault-closing; and load-interrupter switch ratings, including duty-cycle fault-closing and short-time.

G. Voltage Indication

- 1. Voltage indication with provisions for low-voltage phasing
 - a. Voltage indication with provisions for low-voltage shall be provided for each load-interrupter switch and fault interrupter by means of capacitive taps on the bushings, eliminating the need for cable handling and exposure to high voltage to test the cables for voltage and phasing. This feature shall include a flashing liquid-crystal display to indicate the presence of voltage for each phase and a solar panel to supply power for testing of the complete voltage-indication circuit and phasing circuit.
 - b. The voltage-indication feature shall be mounted on the covers for the viewing windows, on the opposite side of the gear from the bushings and bushing wells, that operating personnel shall not be required to perform any routine operations in close proximity to high-voltage elbows and cables.

2.6 ACCESSORIES

- A. Current Transformer/Voltage Transformer/Sensor:
 - 1. Provide 200:5 current transformers on the incoming 600A disconnect switch for the owner to remotely monitor current. Transformer secondary shall be wired to a standard shorting terminal accessible within the low voltage compartment. CT's shall be wired in a four wire "Y" connection.
 - 2. Provide 12.47KV:120V fused potential transformers or voltage sensors to provide 120 Volts to the owner's remotely installed Power Quality Monitor (Shark 250). Low voltage shall be wired to terminals accessible within the low voltage compartment. PT's shall be wired in a four wire "Y" connection.
- B. Viewing Windows
 - 1. Each load-interrupter switch shall be provided with a large viewing window at least 6 inches by 12 inches (15 cm by 30 cm) to allow visual verification of the switch blade position (closed, open, and grounded) while shining a flashlight on the blades.
 - 2. Each fault interrupter shall be provided with a large viewing window at least 6 inches by 2 inches (15 cm by 30 cm) to allow visual verification of the disconnect-blade position (closed, open, and grounded) while shining a flashlight on the blades.
 - 3. Viewing windows shall be located on the opposite side of the gear from the bushings and bushing wells so that operating personnel shall not be required to perform any routine operations in close proximity to high-voltage elbows and cables.
 - 4. A cover shall be provided for each viewing window to prevent operating personnel from viewing the flash that may occur during switching operations.
- C. Retractable lifting tab.
- D. Pentahead bolt locking mechanism to accommodate padlock with 0.375" diameter shackle.
- E. Vista remote supervisory low voltage enclosure.
- F. Potential indication with test feature and provisions for low-voltage phasing.
- G. Vista junction box assembly.
- H. Motor operators: provide motor operated switches for the PME12 Main Incoming way and the Vista two load ways (ie, VFD feed and transformer feed).
- I. Six-way Vista electronics rack for future motor operators.

2.7 FABRICATION

- A. Construction: Outdoor.
 - 1. SF6 -Gas Insulation
 - a. The SF6 gas shall conform to ASTM D2472.

- b. The switchgear shall be filled with SF6 gas to a pressure of 7 psig at 68 deg. F (201 C).
 - c. The gas-tight tank shall be evacuated prior to filling with SF6 gas to minimize moisture in the tank.
 - d. The switchgear shall withstand system voltage at a gas pressure of 0 psig at 68 deg. F (20° C).
 - e. A gas-fill valve shall be provided.
 - f. A temperature-compensated pressure gauge shall be provided that is color coded to show the operating range. The gauge shall be mounted inside the gas-tight tank (visible through a large viewing window) to provide consistent pressure readings regardless of the temperature or altitude at the installation site.
2. Gas-Tight Tank
- a. The tank shall be submersible and able to withstand up to 10 feet water over the base.
 - b. The tank shall be of welded construction and shall be made of 7-gauge mild steel or Type 304L stainless steel, as specified in Section 4.0.
 - c. A means of lifting the tank shall be provided.
3. Gas-Tight Tank Finish (for mild steel only)
- a. To remove oils and dirt, to form a chemically and anodically neutral conversion coating to improve the finish-to-metal bond, and to retard underfilm propagation of corrosion, mild-steel surfaces shall undergo a thorough pretreatment process comprised of a fully automated system of cleaning, rinsing, phosphatizing, sealing, drying, and cooling, before any protective coatings are applied. By using an automated pretreatment process, the mild-steel surfaces of the gas-tight tank shall receive a highly consistent thorough treatment, eliminating fluctuations in reaction mild steel time, reaction temperature, and chemical concentrations.
 - b. After pretreatment, protective coatings shall be applied that shall help resist corrosion and protect the mild-steel surfaces of the gas-tight tank. To establish the capability to resist corrosion and protect the mild steel, representative test specimens coated by the manufacturer's finishing system shall satisfactorily pass the following tests:
 - (1) 1500 hours of exposure to salt-spray testing per ASTM B 117 with:
 - (a) Underfilm corrosion not to extend more than 1/32 in. (0.79 mm) from the scribe, as evaluated per ASTM D 1645, Procedure A, Method (scraping); and
 - (b) Loss of adhesion from bare metal not to extend more than 1/8 in. (3. mm) from the scribe.
 - (2) 1000 hours of humidity testing per ASTM D 4585 using the Cleveland Condensing Type Humidity Cabinet, with no blistering as evaluated per ASTM D 714
 - (3) Crosshatch-adhesion testing per ASTM D 3359 Method B, with no loss of finish.
 - (4) Certified test abstracts substantiating the above capabilities shall be furnished upon request.
 - c. The finish shall be inspected for scuffs and scratches. Blemishes shall be touched up by hand to restore the protective integrity of the finish.
 - d. The finish shall be indoor light gray, satisfying the requirements of ANSI

Standard Z55.1 for No. 61.

- B. Main Bus: Copper.

2.8 FACTORY FINISHES

- A.** Finish Color: Factory standard green.

3.1 INSTALLATION

- A. Install in accordance with IEEE C37.20.1.
- B. Provide required support and attachment in accordance with Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Install switchgear plumb and level and with each section aligned properly.
- D. Make electrical connections between equipment sections using connectors furnished by manufacturer.

3.2 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS. Section 7.1.

3.3 ADJUSTING

- A. Adjust protective devices in accordance with recommendations in the coordination study.
- B. Provide printout of the final adjustment and submit to the Owner.

3.4 CLOSEOUT ACTIVITIES

- A. Demonstrate operation of motor operated devices and switching mechanisms.

- END OF SECTION -

SECTION 26 13 10
MEDIUM-VOLTAGE PAD-MOUNTED SWITCHGEAR

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related work includes but is not limited to,
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 01 60 00 - Product Requirements
 - 3. Section 26 05 13 - Medium-Voltage Cables
 - 4. Section 26 05 26 - Grounding and Bonding for Electrical Systems
 - 5. Section 26 05 43 - Underground Ducts and Raceways for Electrical Systems
 - 6. Section 26 05 73 - Short-Circuit/Coordination Study and Arcflash Hazard Analysis
 - 7. Section 26 12 19 - Pad-Mounted, Medium Voltage Transformers
 - 8. Section 26 18 39 - Medium-Voltage VFD

1.2 SUBMITTAL

- A. Product Data: For each type of switchgear and related equipment.
 - 1. Features, accessories, characteristics, and ratings for pad-mounted gear.
 - 2. Time-current characteristic curves for overcurrent protective devices, including fusible devices.
- B. Shop Drawings: For medium voltage pad-mounted gear and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show method of field assembly and location and size of each field connection. Include the following:
 - a. Outline and general arrangement drawing shown in each assembled section.
 - b. Drawing of cable termination compartments showing preferred locations for conduits and indicating space available for cable terminations.
 - c. Plan view drawing showing locations for anchor bolts.
 - (1) Wiring Diagrams: For medium voltage pad-mounted gear and related equipment, differentiate between manufacturer-installed and field-installed wiring.
 - (a) Power, signal, and control wiring.
 - (b) Three-line diagrams of current and future secondary circuits showing device terminal numbers and internal diagrams.

- (c) Schematic control diagrams.
 - (d) Diagrams showing connections of component devices and equipment.
 - (e) Schematic diagrams showing connections to remote devices.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For pad-mounted gear include in operation and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent device.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain medium voltage pad-mounted gear and components through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of switchgear and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with IEEE C2
- E. Installing contractor shall have at least 10 years of documented experience of installation of similar equipment and work required for this project.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver gear and components properly packaged and mounted on pallets, or skids to facilitate handling of heavy items. Utilize factory-fabricated type containers or wrapping for gear and components which protect equipment from damage. Inspect equipment to ensure that no damage has occurred during shipment.
- B. Whenever possible, store gear in area where protected from physical damage. Protect switchgear from exposure to dirt, fumes, water, corrosive substances, etc.
- C. If stored in areas subjected to weather, cover gear to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside switchgear.
- D. Handle pad-mounted gear with care to prevent physical damage to equipment and

components. Remove packaging, including the opening of crates and containers, avoiding the use of excessive hammering and jarring which may damage the electrical equipment contained therein. Do not install damaged equipment; remove from site and replace damaged equipment with new.

1.5 PROJECT CONDITION

- A. Environmental Limitations: Rate equipment for continuous operation ratings for the following conditions:
 - 1. Ambient temperature not exceeding 122 degrees F.
 - 2. Altitude of 4800 feet above sea level.
- B. Installation Pathway: Remove and replace building components and site obstructions to provide pathway for moving switchgear into place.
- C. Interruption of Existing Utility Service: Do not interrupt utility service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed utility interruptions. Do not proceed with utility interruptions without Owner's written permission.

1.6 COORDINATION

- A. Coordinate layout and installation of pad-mounted gear and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
- C. Schedule delivery of pad-mounted gear equipment, which permits ready building ingress for large equipment components to their designated installation spaces. Coordinate delivery of equipment with the installation of other building components.

1.7 WARRANTY

- A. Provide manufacturer's Warranty that all goods supplied are free from non-conformities in workmanship and materials for 12 months from date of Substantial Completion.

1.8 EXTRA MATERIAL

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Six of each type and rating used. Include spares for future transformers,

- control power circuits, and fusible devices.
 - 2. Touchup Paint: Three containers of paint matching enclosure finish, each 0.5 pint.
- B. Maintenance Tools: Furnish tools and miscellaneous items required for interrupter switchgear test, inspection, maintenance, and operation. Include the following:
- 1. Fuse-handling tool.

PART 2 PRODUCTS

2.1 MANUFACTURES

- A. Subject to compliance with requirements, provide products by one of the following:
- 1. S&C Electric Company, Type PME
 - 2. Equivalent, approved by Owner.

2.2 DESCRIPTION

- A. Factory assembled and tested. The pad-mounted gear shall consist of a single self-supporting enclosure, containing interrupter switches and power fuses with the necessary accessory components, and complying with IEEE C37.20.1.
- B. Ratings: Suitable for application in 3-phase, 60-Hz, grounded wye system.
- C. System Voltage: 12.47 kV nominal; 15 kV maximum.
- D. Switch Ratings
- 1. Line Switches: 600 Amperes
 - 2. Load Switches: 200 Amperes

2.3 PAD-MOUNTED GEAR

- A. Description: Factory assembled and tested. The pad-mounted gear shall consist of a single self-supporting enclosure, containing interrupter switches and power fuses with the necessary accessory components, and complying with IEEE C37.20.3. The pad-mounted gear shall feature handle-operated Mini-Rupter Switches for three-pole switching of source circuits. Unit shall be S&C, configurations as shown on drawings.
- B. Design Level of Available-Source Fault Current: Integrated short-circuit rating consistent with value of fault current indicated.
- C. Penta-Latch Mechanism: Provides vandal-resistant three-point door latching. Closing the door releases the charged latch mechanism, automatically latching the door and securing the pentahead actuator. Only after pentahead actuator is secured can a padlock be installed. Protective hood shields the padlock shackle.
- D. Circuit Diagram shall provide instant view of circuit configuration. Label shall

indicate all gear and fuse ratings.

- E. Interphase and end barriers for all switches and fuses of fiberglass-reinforced polyester.
- F. S&C Mini-Rupter Switches furnished with operating handle. Handle folds for storage behind the switch-operating hub cover. Provide surge arrestors on Mini-Rupter Switches.
- G. Ground pads on inside at bottom door stile in each compartment, accommodate connectors for attachment of cable concentric-neutral ground leads. Ground studs for fuse terminals, switch terminals, and the ground pad in each compartment.
- H. CyPoxy, S&C's cycloaliphatic epoxy resin system, insulated all live parts from ground.
- I. Power Fuses: S&C SML-20 power fuses.
 - 1. Indicator: Integral with each fuse to indicate when it has blown.
 - 2. Mounting: Positively held in position with provision for easy removal and replacement from the front without special tools.
 - 3. Current-Limiting Fuses: Full-range, fast-replaceable, current-limiting type that will operate without explosive noise or expulsion of gas, vapor, or foreign matter from tube. Provide silencers on fuses.

2.4 FABRICATION

- A. Outdoor Enclosure: Galvanized heavy (11-gauge) sheet steel, weatherproof construction; insulated roof, integral structural-steel base frame, with lifting eyes and factory-applied asphaltic undercoating. All structural joints are welded.
 - 1. Pad-mounted gear shall have the following features:
 - a. Structural design and anchorage adequate to resist loads imposed by 125-mph wind.
 - b. Segregated circuits: full-length steel barriers separate side-by-side compartments fiberglass-reinforced polyester barriers separate front compartments from rear compartments and isolate the tie bus.
 - c. Dual-purpose front barriers of GP03 grade fiberglass-reinforced polyester for all fuses and switches guard against inadvertent contact with live parts when in the normal vertical position. Inserted into the open gap of a fuse or switch, barriers provide isolation from bus and upper contacts.
 - d. Storage racks on each fuse compartment door hold up to six SM-4 refill units or three SMU-20 fuse units per rack.
 - e. Grappler, S&C fuse handling fitting shall be provided for each fuse within the gear
 - f. Doors: Door-edge flanges shall overlap with door-opening flanges, and shall be formed to create a mechanical maze that guards against water entry and discourage tampering or insertion of foreign object, yet, allow for ventilation. Door shall have a minimum of two extruded-aluminum hinges with stainless steel pins. Mounting hardware shall be stainless

- g. steel.
 - h. Door holders store above door openings, in full view with doors open, behind door when closed.
 - i. Viewing window for visible verification of switch position.
 - j. Compartment identification and phase identification labels.
 - k. Key interlocks, C3 option, shall be provided to prevent opening fuse compartment doors unless all switches are locked open.
 - l. Base-mounted distribution class surge arresters, metal-oxide type rated 15 kV shall be provided at all source switch terminals.
- B. Finish: Manufacturer's standard factory applied enamel with factory standard green over corrosion-resistant pretreatment and compatible standard primer.

2.5 ACCESSORIES

- A. Two sets of three (3) grounding jumpers, 3 feet in length, complete with storage bag for each set.
- B. One set of three (3) fuse refills, for each fuse type, shall be provided.
- C. Provisions shall include, but not limited to, providing additional cable lengths at time of initial installation to provide future interconnecting control-wiring-base spacer, adding future voltage transformers, adding future current transformers."

2.6 IDENTIFICATION

- A. Materials: Refer to Division 16 Section "Electrical Identification". Identify units, devices, controls and wiring.
- B. Provide Hazard-Alerting Signage on exterior doors, inside of each door, interrupter switch compartments, fuse compartments, and barriers.

2.7 SOURCE QUALITY CONTROL

- A. Pad-mounted gear shall be assembled in manufacturer's plant. Before shipment of equipment, perform the following tests and prepare test reports:
 - 1. Production tests on completed pad-mounted gear assembly according to IEEE C37.20.2, Section 5.3.
- B. Prepare equipment for shipment.
 - 1. Provide suitable crating, blocking, and supports so equipment will withstand domestic shipping and handling shocks and vibration.
 - 2. Weatherproof equipment for shipment. Close connection openings to prevent entrance of foreign material during shipment and storage.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive pad-mounted gear for compliance with requirement for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Handle gear carefully to prevent internal damage, breakage, denting, and scoring of enclosure finish. Do not install damaged equipment. Protect unit from dirt, fumes, water, construction debris and traffic.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, brackets and temporary blocking of moving parts from switchgear units and components.
- C. Install on existing concrete pad. Coordinate placement with existing openings in concrete pad
- D. Install ground grid and ground rods. Ground pad-mounted gear ground bus and enclosure per manufacturer's recommended practices.
- E. Anchor pad-mounted gear per manufacturer's recommended practices.
- F. Tighten bus connections and mechanical fasteners. Do not tighten factory-made connections employing Belleville washers unless they are visibly loose. Refer to manufacturer's installation instructions for proper torque levels.
- G. Adjust S&C gear operating mechanism per manufacturer's recommendations
- H. Touch-up any areas of the exterior that are marred or damaged during construction.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide signs as specified in Division 16 Section "Electrical Identification."

3.4 CONNECTION

- A. Cable terminations at switchgear are specified in Section 26 05 13 - Medium-Voltage Cables.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.
- B. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each switchgear bus, phase-to-phase and

- phase-to-ground for one minute.
 - 2. Test continuity of each circuit.
 - 3. Test integrity of grounding.
- C. Perform the following field tests and inspections and prepare test reports:
- 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS. Certify compliance with test parameters.
 - 2. Switchgear: Perform tests and inspections stated in NETA ATS, Section 7.1.
 - 3. Surge Arresters: Perform tests and inspections stated in NETA ATS, Section 7.1
 - 4. Capacitors: Perform tests and inspections stated in NETA ATS, Section 7.20.
 - 5. Schedule tests and notify Architect at least one week advance.
 - 6. Test all electrical and mechanical interlock systems for proper operation and sequencing.
 - 7. Inspect insulators for evidence of physical damage or contaminated surfaces.
 - 8. Inspect for proper barrier and shutter installation and operation.
 - 9. Exercise manually operated and power-operated switches.

3.6 CLEANING

- A. On completion of installation, inspect interior and exterior of switchgear. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair damaged finishes.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to demonstrate switchgear and train Owner's maintenance personnel to adjust, operate, and maintain medium-voltage switch. Refer to Division 1 Section "Demonstration and Training."
 - 1. Conduct a minimum of 4 hours, training in operation and maintenance as required under Division 1 Section "Closeout Procedures." Include both classroom training and hands-on equipment operation and maintenance procedures.
 - 2. Schedule training with at least one week of advance notification.

- END OF SECTION -

SECTION 26 18 16
MEDIUM-VOLTAGE FUSES

PART 1 - GENERAL

1.1 SUMMARY

- A. The medium voltage fuses shall be general purpose type current limiting. The fuses shall be designed to operate with the fusible switch and shall be tested and rated in accordance with the current ANSI standards.
- B. Related work includes but is not limited to,
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 01 60 00 - Product Requirements
 - 3. Section 01 78 50 - Project Closeout
 - 4. Section 26 05 73 - Short-Circuit/Coordination Study and Arcflash Hazard Analysis
 - 5. Section 26 12 19 - Pad-Mounted, Medium Voltage Transformers
 - 6. Section 26 18 39 - Medium-Voltage VFD

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers (IEEE)
 - 1. ANSI/IEEE C37.40 through C37.47.

1.3 SUBMITTALS

- A. Submittals shall be in accordance with the requirements of Section 01 33 00 – Submittal Procedures.
- B. Product Data: Provide manufacturer data sheets and catalog pages for all materials and components, including component list, assembly ratings (including short-circuit rating, voltage, continuous current), dimensions, and terminal sizes.
- C. Manufacturer's Instructions: Submit instructions for storage, preparation, and installation of fuses.

1.4 PROJECT CLOSEOUT SUBMITTALS

- A. Section 01 78 50 – Project Closeout
- B. Manufacturer Operation and Maintenance Data: Submit original manufacturer manuals, installation instructions, and data sheets for products purchased.
- C. Record Documentation: Provide accurate as-built record drawings in paper and electronic format.

- D. Certificate of Compliance: Provide approval of construction and installation by government authority having jurisdiction.

1.5 QUALIFICATIONS

- A. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installation with similar equipment shall be provided demonstrating compliance with this requirement.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in manufacturer's packaging and inspect for damage.
- B. Store and protect in accordance with manufacturer's instructions and in accordance with Section 01 60 00.
- C. Protect from weather, dirt and debris. Store in a clean, dry environment. Provide adequate ventilation to prevent condensation.

1.7 SITE CONDITIONS

- A. General
 - 1. CONTRACTOR shall make all necessary field measurements to verify that equipment shall fit in allocated space in full compliance with minimum required clearances specified in National Electrical Code.

PART 2 PRODUCTS

2.1 GENERAL

- A. Product Description: Provide Fuse Type as required for the fuse holder in the individual equipment.
- B. Provide and install fuses for all services shown on the Drawings.
- C. Furnish three (3) spare fuses for each switch and store in switchgear cabinet.
- D. Ratings (1000 E Well):
 - 1. Fuse Type: 50E, 20E and 10E
 - 2. Nominal System Voltage: 12.47kV
 - 3. Maximum Design Voltage: 15.5 kV
 - 4. Interrupting Rating: 63kA RMS Sym
- E. Construction: High purity, graded silica-sand filler with pure silver (0.999 fine)

elements encased in a glass-epoxy casing. Fuses shall fit the various holders as supplied.

- F. Manufacturers:
 - 1. Eaton (Cutler-Hammer)
 - 2. Or approved equal.

2.2 FUSE HOLDERS

- A. Product Description: Fuse holders as required for fuses specified above.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install fuse holders and fuses in accordance with manufacturer's instructions.
- B. Install fuses so fuse information (manufacturer, type, rating) is readable without removing fuse.
- C. All necessary hardware required to secure the fuse assemblies in place shall be provided by the CONTRACTOR.

- END OF SECTION -

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SECTION 26 18 39
ADJUSTABLE FREQUENCY DRIVES – MEDIUM VOLTAGE

PART 1 GENERAL

1.1 SCOPE

- A. This Specification defines the requirements for Medium Voltage Adjustable Frequency Drive Systems (AFD's) for the variable speed operation of Medium Voltage AC Motors.
- B. The Bidder shall prepare the bid to be in complete compliance with this specification. Any exception shall be included in the bid with an explanation, clearly indicating the paragraph of this specification to which the exception applies, and concisely stating the reasons.
- C. Unless clearly identified as an exception, this specification shall have precedence where there is conflict between bidder's descriptive information and this specification.
- D. The contractor shall furnish all tools, equipment, material, supplies and perform all labor required to install the Medium Voltage Adjustable Frequency Drive system as indicated on the drawings and specified herein in order to install, test and place the AFDs into satisfactory operation.
- E. Current source inverter (CSI) drives are not an acceptable technology and will not be allowed.
- F. Any conflict between this specification and related codes, standards, datasheets, drawings, requisitions, etc. shall be referred to the purchaser in writing.
- G. Related work includes but is not limited to:
 - 1. Section 26 05 13 - Medium-Voltage Cables
 - 2. Section 26 13 00 - Medium-Voltage Switchgear
 - 3. Section 26 18 16 – Medium-Voltage Fuses
 - 4. Section 26 05 73 - Short-Circuit/Coordination Study/Arc Flash Hazard Analysis

1.2 REFERENCES

- A. Institute of Electrical and Electronic Engineers
 - 1. IEEE 519-2022 - Guide for Harmonic Control and Reactive Compensation of Static Power Converters
 - 2. IEEE 1100 – Powering and Grounding Sensitive Electronic Equipment
 - 3. IEEE 399 – Recommended practice for industrial and commercial power systems analysis.
 - 4. IEEE/ANSI C57 – Pad-Mounted Equipment
 - 5. IEEE 995 – Recommended Practice for Efficiency Determination
- B. National Electrical Manufacturers Association (NEMA)

1. NEMA ICS 6 – Industrial Control and Systems Enclosures
2. NEMA ICS 7 – Industrial Control Systems Adjustable Speed Drives
3. NEMA MG.1-2009 Section IV Part 31 Performance Standards for Definite Purpose Inverter Fed Polyphase Motors.

C. National Fire Protection Association (NFPA)

1. NFPA 70 – National Electrical Code® (NEC)

D. Underwriters Laboratory

1. UL 347A – Medium Voltage Control Equipment
2. UL 508C – Safety for Power Conversion Equipment

1.3 SUBMITTALS – FOR REVIEW / APPROVAL

A. The buyer shall approve final shop drawings prior to release for manufacturing. These drawings shall be provided for all the equipment included in this specification. The AFD Manufacturer shall provide digital copies of:

1. Dimensional outline and plan arrangement drawings including clearance requirements, foundation details and weights, ratings, protection, controls, diagnostics and operation.
2. Electrical schematics, wiring and interconnection drawings.
3. Heat loss data & typical air flow data for each typical unit.

B. Power Factor

1. The AFD shall maintain a minimum power factor of 100% as measured on the input side of the AFD including transformer while operating across the usable speed range.

C. The bidder shall provide computer estimated harmonic calculations to the 49th harmonic with the bid when requested. The calculations shall show total harmonic voltage and current distortion at the IEEE-designated Point of Common Coupling (PCC). PCC1 is utility transformer. To make accurate computer generated harmonic estimates, the study would require kVA and impedance of transformers, short circuit availability, and other linear and non-linear loads.

D. Warranty details.

1.4 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in Paragraph 1.3 above, and shall incorporate all changes made during the manufacturing process
2. Wiring diagrams
3. Certified production test reports

4. Installation information, including equipment anchorage provisions
5. Seismic certification as specified
6. Descriptive bulletins
7. Product sheets
8. Computer Generated Harmonic Estimation Analysis.

1.5 QUALIFICATIONS

- A. All equipment furnished under this section shall be warranted by the installing contractor and the equipment manufacturer(s) for a minimum period of 36 months after shipment. Manufacturer shall offer an extended warranty of 5 years, which includes parts and labor. This extended warranty is to be offered at time of purchase during the first 12 months of warranty period to extend the 3 year warranty to 5 years. Any warranty past 3 years requires a PM on the AFD at the end of year 3.
- B. The AFD manufacturer shall have ISO 9001 certification.
- C. The AFD manufacturer shall be able to provide start-up service, 24-hour/day emergency call service, repair work, and maintenance and troubleshooting training of customer personnel.
- D. The supplier of the AFD and assembly shall be the manufacturer of the electromechanical power components used within the assembly, such as bypass contactors when specified.
- E. The supplier of this equipment shall have produced similar electrical equipment for a minimum period of ten (10) years and installed at least one hundred (100) medium-voltage AFD's. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- F. Vendor shall have also demonstrated installed systems which are similar in design, construction, voltage rating, power rating, speed range and torque range.
- G. Adjustable Frequency Drives shall be on the basis of TMEIC Tmdrive-MVe2 for function and quality. Products that are in compliance with the specification and manufactured by others will be considered as "Approved Equal" only if pre-approved by the Engineer fourteen (14) days prior to bid date. Alternate suppliers shall submit documentation showing itemized compliance to the specifications and experience specific to the proposed AFD including a list showing details of the installation, application, location, contact name and telephone number of at least five (5) users.
- H. Provide Seismic tested equipment as follows:
 1. The medium voltage AFDs and accessories shall be designed, constructed and installed suitable for earthquake regulations in accordance with the seismic requirements of the Uniform Building Code for Zone * (* = refer to UBC Zone Map for specific job site location). The following test data must be provided for the medium voltage drive equipment being provided:
 - a. SDS: Design spectral response acceleration at short period, as

- b. determined in Section 1613.5.4 of the IBC
 - b. z/h: Height factor ratio. For nonstructural components located at grade or below, z/h= 0
 - c. Ip: Component importance factor, as set forth in Section 13.1.3 of ASCE 7
 - d. Aflx-h: Horizontal spectral acceleration calculated for flexible components
 - e. Arig-h: Horizontal spectral acceleration calculated for rigid components
 - f. Aflx-v: Vertical spectral acceleration calculated for flexible components at z/h = 0
 - g. Arig-v: Vertical spectral acceleration calculated for rigid components at z/h = 0
2. The medium voltage AFD must have "Office of Statewide Health Planning and Development" (OSHPD) seismic certification where required.

1.6 VENDOR QUALIFICATIONS

- A. Vendors shall have a minimum of two fully trained and factory authorized startup and field service engineers within 100 miles of the job site (Salt Lake City Utah). Submittal information shall include the locations of the factory-authorized field service engineers.
- B. In addition, the factory shall have a minimum of 20 factory-authorized field service engineers in the United States to provide backup support, if required.
- C. Vendor shall have 24/7/365 factory tech support.

1.7 VENDOR RESPONSIBILITY

- A. Assumptions to cover lack of information are not allowed. The vendor is obliged to obtain reliable information of the motor, driven equipment speed-torque profile and power delivery system data from the purchaser or other sources.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. TMIEC/TMdrive-MVe2
- B. Or Approved Equal

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer fourteen (14) days prior to bid date.

2.2 SYSTEM DESCRIPTION

- A. The Adjustable Frequency Drive shall consist of the following main components: fused isolation switch, isolation contactor, drive isolation/phase shifting transformers with

minimum 24-pulse rectification, DC bus pre-charge circuit, 9-level (zero to peak) Medium Voltage IGBT inverter. All above items are to be integrated in one AFD enclosure not to exceed 185" W x 64" D x 111" H, except for the fused isolation switch and isolation contactor, which shall be mounted outside in a NEMA 3R enclosure.

- B. Filters on either the input or output of the AFD, used to meet the performance requirements of this specification, will not be allowed.
- C. Regardless of technology used, all AFD proposals shall include an isolation transformer. AFD proposals not including isolation transformers will not be acceptable under this specification.
- D. The supplier of the AFD shall also supply line side fuses, switches, contactors, and circuit breakers where specified and shall take full responsibility for integration of AFD power and control circuitry with this equipment.
- E. The integrated dedicated fused contactor with isolation switch will be rated to protect the AFD from specified short-circuit levels. The input contactor controls shall be integrated with the AFD to operate as specified by the AFD manufacturer to close by AFD command and to open under conditions of AFD derangement. The AFD enclosure doors shall be key-interlocked to prevent opening when main power is available.
- F. The AFD enclosure shall be suitable for installation in an indoor, and unclassified area.
- G. DC bus capacitor charging is accomplished by use of a DC bus pre-charge circuit. The DC bus capacitors are charged before application of main power, which limits the very high damaging inrush currents to the main rectifier/converter bridge devices. When the proper DC bus voltage is attained, the pre-charge circuit is turned off.
- H. The AFD shall meet the requirements of IEEE 519-2022 with the Point of Analysis (POA) at the input terminals of the AFD. The point of common coupling shall be located at the utility. The harmonic current distortion shall not exceed the limits listed in table 10.3 of IEEE 519 - 2022 at the POA. The harmonic voltage distortion shall not exceed the limits listed in table 11.1 of IEEE 519-2022 at the POA. Total Harmonic Current Distortion of the AFT shall not exceed 5% of the rated FLA of the AFD.
- I. Drive shall operate with a +/-10 % input voltage variation.
- J. Auxiliary power 480V, 3-phase, 50/60 Hz shall be provided external to the integrated Drive to power the cooling fans. Control power 120V, 1-phase shall be provided external to the integrated Drive to provide control power for convenience receptacles. In addition, power for the motor space heaters shall be supplied to the Drive as specified. The Drive shall provide control to turn the heaters on when the Drive is not running and off when the Drive is running.
- K. The AFD shall be air cooled. The AFD blower fan motors shall be protected by an input circuit breaker located in the AFD. Metal squirrel cage ball bearing 460 VAC three-phase fan motors with 7-year design life shall be used in the Drive design. Plastic muffin fans are not acceptable.

- L. The AFD shall be provided with redundant cooling fans. Redundancy shall apply to each and every cooling fan used in the AFD. Controls in the AFD shall automatically operate redundant fans as necessary to ensure that cooling fan failure does not interrupt AFD operation.
- M. The drive shall receive 12.47 kV, 3-phase and control the motor rated 4,160V, 3-phase, 60 Hz, 700 HP.
- N. For variable torque applications the overload capacity shall be 110% of rated current for 1 minute repeated every 10 minutes. For constant torque applications the overload capacity shall be 150% of rated current for 1 minute repeated every 10 minutes.
- O. The AFD shall be suitable for use with a new or an existing standard squirrel cage motor and standard medium-voltage insulation. For new motor installations, the motor shall be designated inverter-duty (NEMA MG.1-2009 Section IV Part 31).
- P. The AFD shall be rated to operate the 700 HP motor at full load in an ambient temperature of 50 deg C.
- Q. All enclosure openings exceeding 0.25 inch (6 mm) width shall be provided with screens to prevent the entrance of snakes, rodents, etc. the maximum screen mesh opening width shall be 0-.25 inch (6 mm).

2.3 INVERTER DESIGN

- A. The AFD inverter shall be of the pulse width modulated (PWM) type.
- B. The output of the AFD inverter shall have at least 9 levels from zero to peak or 17 levels from peak to peak, at 4,160 V.
- C. The AFD frequency output accuracy shall be within plus/minus 5% of any given set point between 5-100% of the control range.
- D. If the external speed reference signal goes out of range or is lost, the AFD shall be capable of selectively defaulting to coast to stop, deceleration stop, or the operating speed prior to the loss of signal.
- E. The AFD shall have three programmable skip speeds between 0-100% and shall be provided with critical speed avoidance circuitry.
- F. The output of the inverter shall produce harmonic current of not more than 3% over a speed range of 50% to 100% regardless of load.

2.4 INTEGRATED INPUT ISOLATION TRANSFORMER AND RECTIFIER

- A. The AFD shall contain an incoming dry-type isolation transformer whose primary voltage shall be as specified. The transformer shall be a rectifier grade isolation transformer designed with the appropriate K rating for the type of drive.

- B. The transformer impedance shall be selected to limit available fault current to a value that is safe for the converter components and reducing the arc-flash exposure. Typically, a 7-1/2% impedance transformer is required.
- C. The transformer and rectifier shall be an integral part of the AFD assembly along with a primary disconnect switch, input vacuum contactor and secondary fusing eliminating the need for separate components, field installation, or wiring.

2.5 RELIABILITY

- A. Importance is given for trouble free operation, reliability and availability of the equipment.
- B. The manufacturer shall list any control or power components that require recommended maintenance or replacement before 50,000 hours of operation. Information must be available in the manufacturer's maintenance manual and available for submittal.
- C. All components of the AFD will be included in the overall calculation for Mean Time Between Failure using Failure In Time (FIT) Analysis.
- D. The published Mean Time Between Failure (MTBF) of the current carrying devices of the AFD shall be at least 16 years.
- E. Following any momentary dip of the input voltage supply, auxiliary voltage supply, or both, the drive shall be able to operate up to 300 ms and regain control once main power is established (flying restart).

2.6 INPUT POWER QUALITY

- A. The AFD shall comply with the latest edition of IEEE 519-2022.
- B. The AFD total harmonic voltage distortion (THD) contribution at each point of common coupling between the drives and other loads within the facility (Load PCC) shall not exceed the 5% THD limit recommended for General Systems as listed in Table 10.3 of IEEE 519-2022, throughout the speed range.
- C. True power factor at the input of the drive shall be unity (1.0) over 30-100% speed range without the use of any line-side filters.
- D. The AFD shall be able to inject leading VAR's back to the utility system for the remaining capacity that is not used for motoring.

2.7 OUTPUT POWER QUALITY

- A. Output waveform switching transients and harmonic content shall have a negligible contribution to motor heating, acoustical noise in the motor, torsional stress in the power train, and motor insulation.
- B. Common mode voltages on the AFD output shall be isolated from the motor.

- C. Motor cable voltage reflections and the resulting restrictions on motor cable length shall be taken into consideration and the AFD shall properly be applied to the motor.
- D. On new installations, the AFD shall be compatible with motors manufactured in accordance with NEMA MG1. Section IV Part 31 Definite Purpose Inverter Fed Polyphase Motors. For installations involving motors not in compliance with NEMA standards for Inverter Fed motors, the AFD manufacturer shall assure that the AFD protects the motor insulation from voltage excursions in excess of the insulation rating.
- E. For input voltages within the range 90 percent and 110 percent of rated voltage, the AFD shall be capable of developing the following percentage of the motor base frequency rated torque:
 - 1. 100 percent of rated motor torque continuously at any speed below base frequency
 - 2. 120 percent of rated motor torque at any speed for at least 60 seconds.
 - 3. The input transformers, filters, converter, and other components of the AFD shall be rated to supply the current requirements for the above operations without damage.
- F. The output of the AFD inverter shall have at least 9 levels (4160V) from zero to peak or 17 levels (4160V) from peak to peak.
- G. The AFD frequency output accuracy shall be within +/- 0.5 percent of any given set point between 5 - 100% of the control range.
- H. If the external speed reference signal goes out of range or is lost, the AFD shall be capable of selectively defaulting to:
 - 1. Coast to stop
 - 2. Deceleration stop
 - 3. The operating speed prior to the loss of signal

2.8 CONTROL FUNCTIONS

- A. A door-mounted drive backlit LCD keypad shall be included as standard, mounted on the AFD enclosure and used as the standard operator interface.
- B. The keypad shall include a local/remote pushbutton selection. Both start/stop source and speed reference shall be independently programmable for the keypad, remote I/O or communications interface as specified.
- C. The operator keypad shall be used to read and write parameter data, to present operational information, to produce first fault and device indication, to show alarms, to allow metering of parameters, and to provide Ethernet connectivity to the drive software programming tool on the Buyer's PC.
- D. The operator keypad shall include at least four levels of security.

- E. Digital communications shall be Modbus RTU and ethernet.
- F. The AFD shall include a comprehensive microprocessor based digital diagnostic system that monitors its own control functions and displays faults and operating conditions. Microprocessor systems must be products of the same manufacturer as the AFD.
- G. A Remote Diagnostics Module or an on-board computer shall be provided that can be accessed internally via the Owner or the AFD supplier to remote troubleshooting.
- H. A copy of the AFD software shall be provided that will give the owner full access to the drive parameters, configuration, trending, fault data, etc.
- I. A fault log shall record, store, display and print upon demand, the following for the 100 most recent events: time stamp with day and day of fault occurrence and type of fault.
- J. The following setups and adjustments, at a minimum, are to be available:
 - 1. Start/Stop command from keypad, remote or communications port
 - 2. Speed command from keypad, remote or communications port
 - 3. Motor direction selection
 - 4. Maximum and minimum speed limits
 - 5. Acceleration and deceleration times, two settable ranges
 - 6. Critical (skip) frequency avoidance
 - 7. Torque limit
 - 8. Multiple attempt restart function
 - 9. Multiple preset speeds adjustment
 - 10. Catch a spinning motor start or normal start selection
 - 11. Programmable analog output
 - 12. DC brake current magnitude and time
 - 13. PID process controller.

2.9 THE AFD SHALL HAVE THE FOLLOWING SYSTEM INTERFACES:

- A. Inputs — The AFD shall include as a minimum:
 - 1. Remote Start/Stop
 - 2. Remote fault reset
 - 3. Process control speed reference interface, 4-20mA dc
 - 4. RS232 programming and operation interface port via Serial communications port
 - 5. Interface with specified communication protocols, including ModBus RTU, BACnet, Ethernet IP, Profibus DP, LonWorks, CanOpen, DeviceNet, ModBus TCP, and Johnson Controls N2.
- B. Outputs - A minimum of two (2) programmable relay outputs, and one (1) programmable analog output shall be provided, with the following available at minimum:
 - 1. Programmable relay outputs with one (1) set of Form C contacts for each,

selectable with the following available at minimum:

- a. Fault
 - b. Run
 - c. Ready
 - d. Reversed
 - e. Jogging
 - f. At speed
 - g. Torque Limit Supervision
 - h. Motor rotation direction opposite of commanded
 - i. Over-temperature.
2. Programmable analog output signal, selectable with the following available at minimum:
- a. Motor current
 - b. Output frequency
 - c. Frequency reference
 - d. Motor speed
 - e. Motor torque
 - f. Motor power
 - g. Motor voltage
 - h. DC-bus voltage
 - i. Analog Output 1 to match Analog Input 1
 - j. Analog Output 2 to match Analog Input 2
 - k. PT100 temperature
 - l. Jog Speed.

2.10 ALARMS

- A. Comprehensive alarm and trip indications shall be provided:
1. The alarm or fault diagnostics shall have a “first out” or “sequence of events” memory function that identifies the cause of any malfunction.
 2. The alarm shall provide sufficiently detailed information to enable personnel familiar with the equipment to troubleshoot the AFD.

2.11 CONTROL POWER

- A. 480 VAC, 3-phase power for the cooling fans shall be provided by the owner.
- B. 120 VAC, single-phase control power for the AFD shall be provided by the owner.

2.12 INPUT ISOLATION SWITCHGEAR

- A. The AFD shall work in conjunction with an external fused disconnect and contactor. The AFD shall de-energize the contactor and subsequent AFD in the event of an abnormal AFD condition.
- B. The external fused disconnect and contactor shall be provided by the AFD supplier.

2.13 INTEGRATED DRIVE ISOLATION TRANSFORMER

- A. A drive isolation transformer shall be integrated in the AFD enclosure to provide power conversion from the line voltage to the required AFD voltage and to isolate the line from harmonics and common mode voltages.
- B. The transformer shall be designed to withstand a short circuit. It shall maintain electromagnetic symmetry when only one secondary winding is in short circuit in order to minimize the resulting short circuit forces. The transformer shall be capable of thermally withstanding a short circuit for 2 seconds.
- C. Transformers shall be of a high efficiency type with full load losses of no greater than 2%.
- D. Transformer design shall be open type, air-cooled, and forced ventilated.
- E. Only rectifier grade K-factor transformers shall be utilized, with K-rating for the type of the drive.
- F. A minimum of one (1) temperature detector shall be provided.
- G. Transformers shall be capable of continuously carrying current corresponding to the rated direct current of the converter while operating at a maximum design operating temperature, without exceeding the rated thermal limit of the transformer.
- H. The supplied input isolation transformer shall include distribution class surge arresters.

2.14 HARMONIC FILTERS AND POWER FACTOR CORRECTION

- A. Harmonic filters shall not be used to compensate for AFD performance not in accordance with this specification.
- B. Power factor correction shall not be required to maintain the specified 100% true power factor from 30% to 100% speed.

2.15 EFFICIENCY AND NOISE LEVEL

- A. Overall efficiency of the AFD shall include the drive isolation transformer, AFD and all AFD auxiliaries, power factor correction and harmonic filter.
- B. AFD system efficiency calculations shall be in accordance with IEEE 995.
- C. The overall efficiency shall be greater than 96% at full load, full speed.
- D. AFD noise level shall be no greater than 80dB(A) in front of the door panel. AFD's with higher than 80dB(A) will not be acceptable.

2.16 MOTOR PROTECTION RELAYS

- A. RTD Module and Display accepting up to 12 channel inputs (3 wire 100 ohm platinum RTD's (PT100)) and 3 relay outputs, and shall provide an RS485 output.

- B. The RTD Module shall be a Minco CT224 or approved equal.
- C. The ASD shall be supplied with motor protection against overload, stall, locked rotor, single-phasing, phase and ground faults, and internal motor fault.

2.17 AUXILIARY DEVICES

- A. For stand-alone AFD's, provide fixed mounted potential transformers.
- B. Provide current transformers of the quantity and current rating as required by the application.
- C. Provide an auxiliary control power transformer of the quantity and kVA rating as indicated on the contract drawings.
- D. Over-voltage protection devices shall be provided for AFD power circuits, auxiliary circuits, motor and motor cable, input transformers, DC reactors and motor.
- E. One pair of fail-safe contacts (one open and one closed) shall be provided that change state for conditions that could lead to damage of the AFD system or driven equipment, for use with external control or external trip circuits.
- F. Relays which trip the AFD for fault conditions shall have a manual-reset lockout feature. The trip information shall be memorized, and this memory will not be lost if the AFD system is isolated or de-energized.
- G. Over-speed protection shall immediately shut down the AFD if the frequency exceeds 105 percent of input set point or exceeds a preset maximum speed limit. Response time of the overspeed protection system shall prevent any damage to the motor or to the driven machine.

2.18 ENVIRONMENTAL CONDITIONS

- A. The AFD shall operate in an ambient temperature range of 0° C to 50° C (32° F to 122° F) with a relative humidity of up to 95% (non-condensing), unless specified otherwise.
- B. The equipment shall be capable of being stored in an environment with an ambient temperature range of -40° C to 70° C.
- C. The equipment shall operate at altitudes from 0 to 1000m (3,300 ft.) above sea level, without de-rating. For applications above 1000m, the maximum ambient temperature and Basic Impulse Levels (BIL) of the controllers shall be de-rated as necessary, and vacuum contactors shall be compensated for operation at the specified altitude. Derating shall not prevent the AFD from operating the motor at full load, at site elevation (Orem, Utah), at 50-Deg C.

2.19 ENCLOSURES

- A. Indoor enclosures shall be NEMA 1A with gasketing and filters.

- B. All components of the AFD shall be front accessible only.
- C. The AFD Converter enclosure doors shall include an electromechanical “kirk-key” type interlocking system including matching kirk-key on the outdoor fused switch. Access to any power section within th AFD will require opening the fused switch and removing the kirk-key.
- D. All painted surfaces shall have an exterior finish of ANSI 61 Gray.
- E. The AFD enclosure shall be as per UL 347A standards suitable for installation in an indoor, unclassified area.
- F. All enclosure openings exceeding 0.25 inch (6 mm) in width shall be provided with screens to prevent the entrance of snakes, rodents, etc. The maximum screen mesh opening width shall be 0.25 inch (6 mm).
- G. Air filters shall be of a reusable type that can be easily cleaned. All doors or front panels will be fully gasketed. Air exhaust from cooling fans will be at the top of the enclosure and direct exhaust airflow away from personnel. Provide redundant cooling fans.
 - 1. The air filters shall be a reusable type that can be easily cleaned while the drive is in operation.

2.20 COOLING

- A. A “loss of cooling” fault shutdown shall be furnished with force-cooled equipment. In the event of clogged filters or fan failure, the drive will shut down safely without electronic component failure.
- B. Fan motors shall be protected by an input circuit breaker. Metal squirrel cage ball bearing low voltage three phase fan motors with 7-year design life are to be used in the drive design. Plastic muffin fans are not acceptable. Fan power shall be provided from the primary power source through a 480V, 3-phase, 60 Hz external power supply. Convection cooling in the case of fault or main contactor opening is unacceptable as a method to insure proper cooling of the drive.
- C. The AFD shall have adequate fans internal to insure proper operation in the above referenced ambient. When specified, the AFD shall be capable of adding a redundant fan to insure operation in the event of primary fan failure.

2.21 SPACE HEATERS

- A. AFD Enclosure Space Heaters
 - 1. When specified, space heaters shall be supplied.
 - 2. The space heater circuit shall turn on automatically when the drive is not operating.
 - 3. A fused switch or circuit breaker for space heater circuit shall be provided for

- overload protection and as a disconnecting means.
4. When specified, a meter and a test circuit shall be provided on the enclosure door for indication that space heater power is available.
 5. Space heater elements shall be rated 240 Vac and operated at 120 Vac, single-phase.

2.22 NAMEPLATES, MARKING AND LABELING

- A. Nameplates shall be 2-inch high x 2-1/2 inch wide, laminated white with black lettering core.
- B. Unit nameplate and device marker lettering shall be 3/16-inch high.
- C. Warning labels shall be provided to advise the proximity of live components.
- D. Rating labels shall be installed to each main item of a AFD system, citing the equipment's rating and relationship to other equipment.
- E. Equipment labeling shall clearly identify the following according to schematic and wiring diagrams:
 1. All terminals
 2. Removable links
 3. Fuses, control and indication devices
 4. Identifiable components
 5. Internal wiring.
- F. Labels shall also be provided to indicate major parts replacements (like fans, fuses, filters) and also bolting torque standards.
- G. Meters, relays, switches and other devices within the AFD shall be permanently identified using the same name as those appearing on the schematic diagrams.
- H. All bolts shall have torque marks before drive shipment.

2.23 WIRING AND TERMINATIONS

- A. Bus bar with standard NEMA four-hole pattern shall be supplied for input and output connection of external wiring and shall be conveniently located, clearly numbered and identified.
- B. Control wire terminal blocks for external wiring terminations shall be insertion type, designed to accommodate stripped insulation bare wire ends, and shall accept only one No. 16 AWG wires.
- C. Connection points for inputs and outputs of different voltage levels shall be segregated to reduce possibility of electrical noise.
- D. Where wiring is run through sheet metal or any barrier, bushings, grommets, protection around the sheet or barrier opening shall be provided.

- E. All internal wiring shall be terminated with no more than two (2) conductors per terminal point.
- F. The AFD shall have an internal mechanical ground connection suitable for terminating a stranded copper ground conductor of the same size as the incoming phase conductors.
- G. Ground bus-bar connections shall be near the incoming and outgoing power cable termination points and control wiring connections.
- H. Enclosure shall be designed to accommodate power cable entry from either top or bottom.
- I. Minimum wire bending space shall meet or exceed the value shown in NEC Table 430-10(b) for termination of the power cable.

2.24 FINISH

- A. The finish for internal and external parts shall consist of a coat of ANSI 61 (gray) thermosetting, polyester, powder paint applied electrostatically to pre-cleaned phosphatized steel and aluminum surfaces.

2.25 ACCESSORIES

- A. If specified, provide a portable lifting device for transporting contactor outside its compartment.

PART 3 EXECUTION

3.1 FACTORY TESTING

- A. The AFD System shall undergo standard manufacturing testing.
- B. Each AFD shall be factory load tested with an induction motor on a dynamometer or M-G test stand for a minimum of 8 hours at rated ambient temperature (40-deg C standard) and rated load with AFD system at full voltage. Resistive or Inductive load-bank testing shall not be acceptable.
 - 1. Constant torque AFD's shall be tested at 100% rated load for 9 minutes, 150% rated load for 1 minute. This cycle will continue throughout the 8-hour test.
 - 2. Variable torque AFD's shall be tested at 100% rated load for 9 minutes, 110% rated load for 1 minute. This cycle will continue throughout the 8-hour test.
- C. The manufacturer shall provide three (3) certified copies of factory test reports.
- D. If required, factory tests as outlined above shall be witnessed by the owner's representative. The manufacturer shall notify the owner two (2) weeks prior to the date the tests are to be performed.

3.2 FIELD QUALITY CONTROL

- A. If required, the Supplier and User shall schedule an on-site meeting to cover the following:
 - 1. The start-up and commissioning plan
 - 2. The start-up and commissioning schedule
 - 3. The AFD's installation requirements.
- B. The AFD Manufacturer shall provide the services of a manufacturer's employed field service engineer for the start-up of the AFD after it is installed according to the manufacturer's recommendations. Functional testing, commissioning and first parameter adjusting is carried out by the manufacturer's employed field service engineer. (No third-party representatives will be permitted).
- C. Testing, final parameter adjustment and performance tests are carried out by the manufacturer's employed field service engineer with the customer present.
- D. After commissioning, the manufacturer's employed field service engineer shall review the customer's operating procedures and provide (2) two hours of basic hands-on maintenance and operation training to the customer's personnel.
- E. Typical commissioning will be at (3) consecutive eight-hour man-days per AFD. Rate schedule for commissioning, travel to the jobsite and living expenses during the period of work shall be included with the bid proposal.
- F. Microsoft Windows™ based software shall be provided for AFD commissioning, parameter setup, fault log viewing, diagnostic analysis, and monitoring and control. The software shall provide real time graphical displays of AFD performance.
- G. The Contractor shall provide three (3) copies of the manufacturer's field startup report.
- H. The AFD manufacturer shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
- I. The Contractor shall provide three (3) copies of the manufacturer's representative's certification.

3.3 TRAINING

- A. If requested, the manufacturer shall provide a training session for five (5) owner representative(s) for one normal workday at a job site location determined by the owner.
- B. The training session shall be conducted by the manufacturer (no third-party representatives will be permitted) and include instruction on assembly, starters, and other major components.

3.4 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

3.5 OPERATION AND MAINTENANCE MANUALS

- A. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

3.6 INSTALLATION

- A. The Contractor shall install all equipment per the manufacturer's recommendations and the contract drawings.
- B. All necessary hardware to secure the assembly in place shall be provided by the Contractor.
- C. Check all bolted connections to assure that they are in accordance with the manufacturer's recommended torque requirements.

3.7 FIELD ADJUSTMENTS

- A. If included with AFD, the motor protective relay will be programmed in accordance with the recommendations documented by the coordination study in Section 16011 and as directed by the owner or owner's representative. If settings are not provided by owner, the motor protection relay will be set to minimum values.
- B. AFD parameters shall be programmed to owner or owner representative provided settings.
- C. If RTD Module is included with the AFD, program Module settings as determined by owner or owner's representative.

3.8 FIELD TESTING

- A. Vendor shall provide a detailed commissioning procedure / check-list for review and approval prior to shipping the equipment to site.
- B. Field testing by a manufacturer employed and trained Engineering Services Field Service Engineer will include the following as a minimum:
 - 1. Sight Inspection
 - 2. Power-Off Checklist
 - 3. Power Up (Control Assembly only) checklist
 - 4. Full Voltage Main Power-Up No Load Testing
 - 5. Full Load Testing.

3.9 MAINTENANCE / WARRANTY SERVICE

A. Warranty to commence 24 months from the date of commissioning by manufacturer, not to exceed 30 months from the date of shipment, and include all parts, labor, and travel time.

B. Spare Parts

1. The AFD manufacturer shall provide a complete list of spare parts for the AFD.
2. The AFD manufacturer shall provide local support for renewal parts and stock spares.
3. As a minimum, the AFD manufacturer shall include these spare parts as part of the bid:
 - a. 100% spares of each type of medium voltage fuse.
 - b. 100% spares of each type of low voltage fuse.
 - c. Special tools for testing or maintaining equipment.

All spare parts shall be properly marked and packaged for long-term storage. All printed circuit boards shall be provided in separate anti-static containers.

- END OF SECTION -

SECTION 26 29 23
VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes enclosed variable frequency controllers.

1.2 RELATED WORK

- A. Related Work specified in other Sections:
1. Section 01 33 00 Submittal Procedures
 2. Section 01 75 50 Project Closeout
 3. Section 26 06 05 Electrical Equipment
 4. Section 26 05 13 Conductors and Cables

1.3 REFERENCES

- A. IEEE C62.41 (Institute of Electrical and Electronics Engineers) - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. NEMA FU 1 (National Electrical Manufacturers Association) - Fuses.
- C. NEMA ICS 3.1 (National Electrical Manufacturers Association) - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems.
- D. NEMA ICS 7 (National Electrical Manufacturers Association) - Industrial Control and Systems:
1. Adjustable Speed Drives.
- E. NEMA 250 (National Electrical Manufacturers Association) - Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. NETA ATS (International Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.
- B. Product Data: Submit catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings dimensions, and enclosure details.

- C. Test Reports: Indicate field test and inspection procedures and test results.
- D. Manufacturers Field Reports: Indicate start-up inspection findings.
- E. Five copies, plus the number of copies the CONTRACTOR wishes returned, shall be submitted to the ENGINEER for approval.
- F. Manufacturer's warranty.

1.5 SUBMITTED AT SHIPMENT

- A. Include system manuals, complete with wiring diagrams, schematics, operating, and maintenance instructions, shall be provided with the VFD and VFD systems at the time of shipment, on both hard and digital copies.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 78 50 - Project Closeout.
- B. Operation and Maintenance Data: Submit instructions complying with NEMA ICS 3.1. Include procedures for starting and operating controllers, and describe operating limits that may result in hazardous or unsafe conditions. Include routine preventive maintenance schedule.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience and service facilities within 100 miles of the project.

1.8 STANDARDS

- A. The VFD shall be UL listed and not require external fuses except where input power is supplied from multiple transformer secondaries.
- B. All VFD and VFD systems shall be designed in accordance with applicable portions of NEMA standards, and panel build ups manufactured by a UL508 listed manufacturer.
- C. The VFD shall be compatible with the installation requirements of interpretive codes such as National Electrical Code (NEC) and Occupational Safety & Health Act (OSHA).
- D. The VFD shall be capable of operating in compliance with IEEE 519-2022.
- E. The VFD shall meet IEC 612 00-2 for vibration levels.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure, and finish.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Section 26 05 00 - Electrical General Requirements.
- B. Conform to NEMA ICS 7 service conditions during and after installation of variable frequency controllers.

1.11 WARRANTY

- A. Equipment furnished under this Section shall be guaranteed against defective parts and workmanship for 1 year from date of Final Acceptance of the system and shall include labor and travel time for necessary repairs at the job site.
- B. The manufacturer shall provide the service of a factory-trained service representative to verify the correctness of the CONTRACTOR's completed installation; to check all electronic circuitry and mechanical components to assure their proper function; and to make all necessary measurements in and around the unit to ensure proper operation. A minimum of 1-day startup service shall be provided. The manufacturer shall provide through the CONTRACTOR to OWNER a written certification that the installation is complete, correct and properly calibrated.

1.12 MAINTENANCE SERVICE

- A. Provide service and maintenance of variable frequency controller for one year from Date of Final Acceptance.

1.13 MAINTENANCE MATERIALS

- A. Supply two of each air filter.
- B. Provide three of each fuse size and type.

PART 2 PRODUCTS

2.1 VARIABLE FREQUENCY CONTROLLER

- A. Manufacturers:
 - 1. Allen-Bradley
 - 2. Gault
 - 3. Mitsubishi

5. Square D, Altivar Process 630 Drive
 6. WEG
 7. No Equals
- B. Product Description: NEMA ICS 7, enclosed 6 pulse variable frequency controller suitable for operating the indicated loads. Select unspecified features and options in accordance with NEMA ICS 3.1.

2.2 RATINGS

- A. Rated Input Voltage: 480 Volts, three phase, 60 Hertz. The VFD shall be able to withstand voltage variations of -15% to +10% without tripping or affecting VFD performance.
- B. Motor Nameplate Voltage: 460 Volts, three phase 60 Hertz.
- C. Motor Nameplate Horse power: 300 horsepower design B.
- D. Displacement Power Factor: Between 1.0 and 0.95 lagging over entire range of operating speed and load.
- E. Operating Ambient: 0 degrees C to 50 degrees C.
- F. Relative Humidity: 5 to 95 percent non-condensing.
- G. Minimum Efficiency at Full Load: 96 percent.
- H. Elevation: The VFD shall be suitable for operations up to 4,700 feet.

2.3 DESIGN FEATURES

- A. Employ microprocessor-based inverter logic isolated from power circuits.
- B. Employ pulse-width-modulated inverter system.
- C. Design for ability to operate controller with motor disconnected from output.
- D. Design to attempt five automatic restarts following fault condition before locking out and requiring manual restart.
- E. The VFD shall be capable of 4 different acceleration and different deceleration rates, each rate independently adjustable from 0.01 to 3600 seconds. Selectable accel/decel patterns to include linear, S-curve, and non-linear for variable torque loads.
- F. The VFD shall have the capability of determining motor characteristics to optimize its operation with the use of pre-programmed motor data information or self-tuning operation. Self-tuning is to be available with or without the motor coupled to the load. Tuning shall also include an online mode that automatically and dynamically compensates the VFD regulator for changes in motor temperature.

2.4 INDICATORS AND MANUAL CONTROLS

- A. Input Signal: 4 - 20 mA DC.
- B. Display:
 - 1. Provide integral LCD display to indicate output voltage, output frequency, output current, fault codes and drive status.
 - 2. Upon a fault condition, the LCD shall display VFD output current, voltage, frequency, torque, DC link voltage, operating hours, I/O terminal status, and temperature at the time of fault. The last four (4) faults will be stored in memory and selectively be displayed on the LCD.
- C. Indicator Lights:
 - 1. Provide an indicator light to indicate VFD failure.
- D. The drive shall have a built-in keypad that is installed on the outside cover and shall include Forward/Reverse/Stop/Jog keys, Drive reset key and Reference increment/decrement keys.
- E. Volts Per Hertz Adjustment: Plus or minus 10 percent.
- F. Current Limit Adjustment: 60 - 110 percent of rated.
- G. Acceleration Rate Adjustment: 0.5 - 30 seconds.
- H. Deceleration Rate Adjustment: 1 - 30 seconds.
- I. HAND-OFF -AUTOMATIC selector switch and manual speed control.
- J. Control Power Source: Integral control transformer.

2.5 SAFETIES AND INTERLOCKS

- A. Includes undervoltage release.
- B. Door Interlocks: Mechanical means to prevent opening of equipment with power connected, or to disconnect power if door is opened; include means for defeating interlock by qualified persons.
- C. Safety Interlocks: Terminals for remote contact to inhibit starting under both manual and automatic mode.
- D. Control Interlocks: Furnish terminals for remote contact to allow starting in automatic mode.
- E. The VFD shall be able to automatically reset up to ten (10) times after over-current, over-voltage, overheating, and overload faults. Reset attempts and reset intervals

must be programmable.

F. Disconnecting Means: Integral circuit breaker on the line side of each controller.

2.6 VFD INPUT/OUTPUT PARAMETERS

A. The VFD shall accept and follow a selectable external frequency reference of either analog 0-5 VDC, 0-10 VDC, 4-20m A with signal inversion.

B. The VFD shall maintain the output frequency to within 0.2% of reference when the reference is analog, and to within .01% of reference when the reference is digital (Speed level inputs from keypad, contact closure, digital interface, or serial communication).

C. The VFD shall have a reference filter to reduce noise in the analog signals and a low noise control power supply system.

D. The VFD shall accept inputs from external dry contacts for the following functions:

1. Run forward command
2. Run reverse command
3. Multi-step frequency selection
4. Acceleration/Deceleration time selection
5. Stop command
6. Coast to stop command
7. Alarm reset
8. Trip command (external fault)
9. Jogging operation
10. Frequency reference selection (2)
11. DC brake command
12. Torque limits (2)
13. Switching operation between line and inverter (50 and 60 Hz)
14. Speed Increase command
15. Speed Decrease command
16. Write enable for keypad
17. PID control cancel
18. Inverse mode changeover
19. Interlock signal
20. Serial communications enable
21. Universal DI
22. Pick up start mode
23. Forced stop command
24. Forced stop command with Deceleration time

E. The frequency reference shall be from, selectively, an external speed potentiometer, external analog signals (0-5 VDC, 0-10 VDC, 4 to 20mA with signal inversion), from the built in keypad, or from serial communication.

1. The VFD shall provide five selectable digital outputs indicating the following:
 - a. Inverter running

- b. Frequency equivalence signal
- c. Frequency level detection
- d. Torque polarity
- e. Torque limiting
- f. Auto-restarting
- g. Overload early warning
- h. Keypad operation mode
- i. Inverter stopping
- j. Ready input
- k. Line/Inverter changeover
- l. Motor 2 / Motor 1
- m. Auxiliary terminal
- n. Time-up signal
- o. Cycle completion time
- p. Stage No Indication (1, 2, and 4)
- q. Alarm Indication (1, 2, 4, and 8)
- r. Fan operation signal
- s. Auto resetting
- t. Universal DO
- u. Overheat early warning
- v. Second frequency level detection
- w. Second overload early warning
- x. Terminal C1 off signal

2.7 PROTECTIVE AND DIAGNOSTIC FEATURES

- A. When a fault occurs, the VFD shall have a controlled shut down sequence. A Form C relay fault output shall be available. The reason for the fault condition shall be enunciated on the LED display, and the LCD graphic screen shall display the current, temperature, frequency, and voltage at the time of the fault as well as potential reasons for the condition. The VFD shall monitor, sense, and display the following fault conditions:
- 1. Over-current during acceleration
 - 2. Over-current during deceleration
 - 3. Over-current during constant speed operation
 - 4. Ground fault
 - 5. Input phase loss
 - 6. Fuse blown
 - 7. Over-voltage during acceleration
 - 8. Over-voltage during deceleration
 - 9. Over-voltage during constant speed operation
 - 10. Under-voltage
 - 11. Overheating of heatsink
 - 12. External thermal relay
 - 13. Over-temperature of internal air
 - 14. Overheating at Dynamic Braking circuit
 - 15. Motor 1 overload
 - 16. Motor 2 overload
 - 17. Inverter unit overload

18. Over-speed
 19. Memory Error
 20. Keypad panel communication error
 21. CPU error
 22. Option error
 23. Operational procedure error
 24. Output wiring error / Impedance imbalance
 25. Modbus-RTU error
- B. The VFD shall have a selectable Torque Limiting function for both motoring and braking that will sense an overload condition and will reduce frequency and current temporarily until the load reaches acceptable levels. If the overload condition is not settled in the proper amount of time, the Drive will trip on overload. The Torque Limiting shall be programmable from 20-150% of Drive rated motor torque (30 HP and below) and from 20-150% of Drive rated motor torque (40 HP and above), with 1% resolution.
- C. The VFD shall have a selectable electronic inverse time thermal overload function as required by NEC and UL Standard 991 for an AC Induction Motor (Refer to applicable codes for specific installation requirements). The overload shall be programmable from 20 - 135% of Drive rated current.
- D. The VFD shall have an over-voltage protection function that operates if supply voltage rises above rated value or by motor's regeneration.
- E. The VFD shall treat short circuits in either the output load or the output module as an over-current.
- F. If the VFD heat sink temperature exceeds approximately 100-degrees C, the Drive will shut down on over temperature fault.
- G. The VFD shall provide output ground fault protection.
- H. The VFD shall provide LED indication of DC bus voltage, which, when lit, will signify to maintenance people the presence of potentially dangerous voltage.

2.8 VFD CONSTRUCTION

- A. The VFD shall be a sinusoidal PWM type Drive with sensor-less vector control capability. The VFD Supplier shall provide open chassis, IP20, NEMA 1 enclosures at all ratings as required for the application. Drive shall be of modular construction for ease of access to control and power wiring, and maintenance. It shall consist of the following general components:
1. Full wave diode AC/DC rectifier, to eliminate line voltage notching of the three phase source and maintain an input displacement power factor of 0.95 or greater, regardless of speed or load. SCR front ends with gate firing electronics are unacceptable.
 2. DC link capacitors standard, DC link reactor available at all ratings, standard on systems 100HP+.

3. Input surge protection performed by internal MOV'S (metal oxide varistors) or devices providing equal protection.
4. Insulated Gate Bipolar Transistor (IGBT) power section. The power section control shall use vector dispersal pulse width modulated (PWM) control and fourth generation soft switching IGBTs to reduce noise and allow longer cable length from VFD to motor without the need for output filters.
5. The VFD shall be microprocessor based and fully transistorized with a 32 bit MCU and 33 MIPS processing speed.
6. Separate control and power terminal boards, with option plug shall be provided by the VFD to allow for remote operation.
7. The VFD shall have an RS485 serial communications port as a standard with options for communicating with recognized industry standard device level networks such as Ethernet, Modbus. A universal ethernet adapter shall be provided as an interface with the serial communications port.
8. The VFD shall have a Keypad capable of copying, uploading and downloading Drive function codes.

2.9 INPUT FILTER

- A. Harmonic Filter: Provide a Matrix Harmonic Filter to reduce the harmonic currents going back into the utility power grid and power system. The total harmonic voltage distortion factor (DF) at the main 480 volt bus for voltage shall be less than 5 percent.
- B. The filter shall include a contactor that shall de-energize the capacitors when the drive is less than 30% output.

2.10 PROCESS ALARM SWITCH

- A. Manufacturer/Model:
 1. CR Magnetics/CR3595.
 2. Or approved equal.
- B. Description - Provide a process alarm switch to monitor the VFD output Hz. When the control loop exceeds the set point the relay becomes energized and the on-board LED illuminates.
- C. Input Power: 24 VDC.
- D. Output: Form C Relay, 10A at 125 VAC.
- E. Process variable: 4-20 mA DC
- F. DIN Rail mounting.

2.11 MOTOR RTD TEMPERATURE MONITOR

- A. Manufacturer:

1. **Minco CT224**
 2. Or Approved equal.
- B. The VFD enclosure shall be supplied with an eight-channel temperature monitor. The monitor shall accept 10 0 ohm platinum RTD sensors. The motor will be supplied with 2 embedded RTD sensors in each winding and 2 for the motor bearings. The temperature monitor shall scan all eight sensors. The unit shall provide four programmable Form C relays, plus provide an audible alarm.
- C. The unit shall be provided with a display showing the highest, lowest or any other zone temperature as programmed.
- D. The alarm relays shall be programmable to react to any or all scanned input zones. The audible alarm shall sound when certain relays trip and also at its own setpoint. The unit shall be supplied with a silence pushbutton to quiet the alarm.
- E. The unit shall operate on 115 V AC, single phase 10 -percent, 50 /60 hertz.

2.12 POWER MONITOR **Delete if not required**

- A. See 26 05 05

2.13 SURGE PROTECTIVE DEVICE

- A. TVSS Manufacturer:
1. Eaton
 2. Raycap
 3. Square D
 4. Or Approved equal.
- B. This Section describes the materials and installation requirements for an integrated Transient Voltage Surge Suppressor (TVSS), also referred to as Surge Protective Device (SPD), inside VFD enclosure. These devices are used to protect AC electrical circuits from the effect of lightning induced currents, substation switching transients and internally generated transients resulting from inductive and or capacitive load switching.
- C. References
1. UL 1449 Second Edition 2005 - Transient Voltage Surge Suppressors
 2. UL 1283 - Electromagnetic Interference Filters
 3. ANSI/IEEE C62.41.1-2002 - IEEE Guide on the Surge Environment in Low Voltage (1000 V and Less) AC Power Circuits; C62.41.2-2002 - IEEE Recommended Practice on Characterization of Surge Voltages in Low Voltage AC Power Circuits; and C62.45-2002 - IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.
 4. NEC 2017 Article 285
- D. Internal TVSS

1. TVSS shall be Listed in accordance with UL 1449 Second Edition 2005 and UL 1283, Electromagnetic Interference Filters.
 2. Integrated surge protective devices (SPD) shall be Component Recognized in accordance with UL 1449 Second Edition, Revision 2/9/2005 Section 37.3 and 37.4 at the standard's highest short-circuit current rating (SCCR) of 200 kA, including intermediate level of fault current testing that will be effective 2/9/2007.
 3. TVSS shall be tested with the ANSI/IE EE Category C High exposure waveform (20kV -1.2/50s, 10kA-8/20s).
 4. TVSS shall provide suppression for all modes of protection: L-N, L-G, and N-G in WYE systems.
 5. Recommended TVSS ratings:
 - a. Minimum surge current rating shall be 90 kA per phase (80 kA per mode) for service entrance and 80 k A per phase (40 kA per mod e) for distribution applications.
 - b. UL 14 49 clamping voltage must not exceed the following: 480Y/277
 - c. Pulse life test: Capable of protecting against and surviving 5000 ANSI/IE EE Category C High transients without failure or degradation of clamping voltage by more than 10%.
 6. TVSS shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage.
 7. TVSS shall be constructed of one self-contained suppression module per phase.
 8. Visible indication of proper TVSS connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable. The status of each TVSS module shall be monitored on the front cover of the enclosure as well as on the module. A push-to-test button shall be provided to test each phase indicator. Push-to-test button shall activate a state change of dry contacts for testing purposes.
 9. TVSS shall be equipped with an audible alarm which shall activate when any one of the surge current modules has reached an end-of-life condition. An alarm on/off switch shall be provided to silence the alarm. The switches and alarm shall be located on the front cover of the enclosure.
 10. A connector shall be provided along with dry contacts (normally open or normally closed) to allow connection to a remote monitor or other system. The output of the dry contacts shall indicate an end-of-life condition for the complete TVSS or module.
 11. Terminals shall be provided for necessary power and ground connections.
 12. The TVSS shall be equipped the following optional items:
 - a. A transient voltage surge counter shall be located on the diagnostic panel on the front cover of the enclosure. The counter shall be equipped with a manual reset and battery backup to retain memory upon loss of AC power.
- E. TVSS shall have a warranty for a period of ten (10) years from date of Final Acceptance. Warranty shall be the responsibility of the electrical distribution equipment manufacturer and shall be supported by the irrespective field service division.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that building environment can be maintained within the service conditions required by the manufacturer.

3.2 INSTALLATION

- A. Install in accordance with NEMA ICS 3.1.
- B. Tighten accessible connections and mechanical fasteners after placing controller.
- C. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- D. Provide engraved plastic nameplates under the provisions of Section 26 05 00.
- E. Motor Data: Neatly type label inside controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.
- F. Ground and bond controller under the provisions of Section 26 05 26.

3.3 QUALITY ASSURANCE

- A. All VFD's shall be 100 % factory tested to ensure proper performance upon delivery.
- B. VFD's installed in panels shall be 100% factory tested as a system by the VFD supplier.

3.4 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.16 and NEMA ICS 3.1.

3.5 MANUFACTURER'S FIELD SERVICES

- A. Prepare and startup variable frequency controller.
- B. VFD operational and maintenance training and startup service shall be provided by the VFD supplier. The VFD vendor shall have factory trained personnel at field locations convenient to the installation site, available for trouble shooting and/or startup assistance 24/7.
- C. Coordinate factory startup with the VFD, motor and Motor Protector factory representatives.
- D. Coordinate VFD settings and the Backup Power Generator so that the facility operates as intended on both utility power and on backup generator power.

3.6 DEMONSTRATION AND TRAINING

- A. Provide 4 hours of instruction each for 6 persons, to be conducted at Project Site with manufacturer's representative.

3.7 WARRANTY

- A. The VFD vendor shall provide a warranty for material and workmanship, for a period of twenty-four months after Final Completion.
- B. Warranty and non-warranty service shall be available in house and in the field. There shall be authorized service centers locally available within 4 hours.

3.8 SPARE PARTS

- A. Provide a list of all spare parts to the OWNER at Substantial Completion.

3.9 RTD TEMPERATURE MONITOR

- A. Install the temperature monitor in the front of the VFD enclosure, at +50-inches above the floor, but not exceeding +60-inches (to the top of the unit).
- B. Wiring:
 - 1. Wire Relay #1 shall be wired to stop the motor on high temperature alarm.
 - 2. Wire Relay #2 to provide a high temperature warning alarm to the SCADA RTU.
 - 3. Alarm set points to be determined during startup.
- C. Nameplate
 - 1. Provide an engraved nameplate above the unit.

- END OF SECTION -

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SECTION 26 42 00
GALVANIC CATHODIC PROTECTION SYSTEM

PART 1 GENERAL

1.1 WORK INCLUDED:

- A. This section covers the work necessary to furnish and install electrical isolation, dc blocking devices, and pump column and well casing isolation, complete.
- B. CONTRACTOR to have a third party Corrosion Expert to perform CONTRACTOR required quality control testing as defined this section.

1.2 STANDARDS

- A. The following standards are included by reference:
 - 1. NACE SP-0169
 - 2. NACE SP-0177

1.3 QUALIFICATIONS

- A. All CONTRACTOR specified testing shall be performed by a third party Corrosion Expert whom holds a current NACE accreditation as a Cathodic Protection Specialist (CP-4) or Cathodic Protection Technologist (CP-3), and/or a registered professional engineer.
- B. CONTRACTOR performed quality control testing shall include the following tests, which shall be performed as defined this section.
 - 1. Insulating Joint Testing
 - 2. DC blocking devices
 - 3. Pump column and well casing isolation

1.4 DEFINITIONS

- A. Electrical Isolation: The condition of being electrically isolated from other metallic structures (including, but not limited to, piping, reinforcement, casings) and the environment as defined in NACE Recommended Practice SP0169.

1.5 SUBMITTALS

- A. Provide Submittals in accordance with Section 001 33 00 – Submittal Procedures.
- B. Shop Drawings: Catalog cuts and other information for products proposed for use.
- C. Quality Assurance Submittals:
 - 1. Manufacturers' Certificates of Compliance.
 - 2. Field Test Reports.
 - 3. Qualifications of NACE Accredited Testing Personnel.

PART 2 MATERIALS

2.1 GENERAL

- A. Like items of materials provided hereunder shall be the end product of one manufacturer to achieve standardization for appearance, maintenance, and replacement.
- B. Materials and workmanship as specified in this section shall be installed concurrently with pipe installation. Coordinate all work specified herein with related sections.

2.2 SUPPLIERS

- A. Alternate suppliers will be considered, subject to approval of ENGINEER. Address given is that of the general office; contact these offices for information regarding the location of their representative nearest the project site.
 - 1. Corpro, Inc., Chicago, IL
 - 2. Farwest Corrosion Control, Gardena, CA
 - 3. MESA Products, Tulsa, OK

2.3 INSULATING JOINTS

- A. General: Insulating joints shall be dielectric unions or flanges. The complete assembly shall have an ANSI rating equal to or higher than that of the joint and pipeline. All materials shall be resistant for the intended exposure, operating temperatures, and products in the pipeline.
- B. Insulating Flanges:
 - 1. Gaskets:
 - a. Full-face, fiberglass (G10) with O-ring seal gasket. Buried insulating flanges shall be full face gaskets only.
 - b. Complete assembly shall have an ANSI rating equal to the flanged joint.
 - c. Gasket materials shall be resistant to intended chemical exposure, operating temperatures, and pressures in the pipeline.
 - 2. Insulating Sleeves: Full-length Mylar or fiberglass reinforced epoxy (NEMA G-10 grade).
 - 3. Insulating Washers: Fiberglass reinforced epoxy (NEMA G-10 grade).
 - 4. Steel Washers: Plated, hot-rolled steel, 1/8-inch thick.
 - 5. Manufacturers:
 - a. GPT industries, Houston, TX.
 - b. Advanced Products and Systems, Scott, LA
 - c. Central Plastics Co., Shawnee, OK.
- C. Insulating Unions: O-ring sealed with molded and bonded insulating bushing to union body, as manufactured by Central Plastics Company, Shawnee, OK; or equal.

2.4 DC BLOCKING DEVICES

- A. DC isolation devices shall be solid-state electronic devices capable of passing ac current while blocking dc current.
- B. Device shall have electrical rating of 3KA fault current at 30 cycles and 40 amperes steady state ac current, minimum.
- C. Device shall have symmetrical dc blocking capabilities of -2 volts to +2 volts.
- D. DC isolation devices shall be as manufactured by Dairyland Electrical Industries, Inc., Stoughton, Wisconsin.

PART 3 WORKMANSHIP

3.1 GENERAL

- A. The installation of the facilities herein specified and described shall conform to the latest applicable NEC rules.
- B. The workmanship shall be of the highest grade and shall be in strict accordance with material manufacturer's instructions. Equipment or materials damaged in shipment or in the course of installation shall be replaced.
- C. CONTRACTOR shall examine all Drawings and coordinate his work so as to avoid conflicts, errors, delays, and unnecessary interference with the construction of the facilities and to avoid duplication of the work such as excavation, filling, etc. In the event of any conflicts in the Specifications, ENGINEER shall be consulted.

3.2 INSULATED JOINTS

- A. Install insulated joints to electrically isolate the pipeline from other pipes or structures where shown on the Drawings.
- B. Install insulated joints as shown on the Drawings.
- C. Align and install insulating joints according to the manufacturer's recommendations to avoid damaging insulating materials.
- D. CONTRACTOR shall test each insulated joint for electrical insulation as specified this section. Defective insulating joints shall be repaired by CONTRACTOR at his sole expense. All damaged or defective insulation parts shall be replaced.

3.3 DC BLOCKING DEVICES

- A. Install dc blocking devices at the following locations:
- B. In ground wire to each well pump motor, location to be determine in field.
- C. Where shown on the Contract Drawings.

- D. Support of dc blocking device shall be on either a 2-inch diameter hot-dipped galvanized steel pipe support, 4-inch hot dipped galvanized channel support, or shall be mounted to a concrete wall at CONTRACTOR's option. ENGINEER shall review and approve the applicable equipment support based on the conditions present.

3.4 QUALITY CONTROL TESTING

- A. General:
 - 1. CONTRACTOR shall correct all construction defects identified during testing.
 - 2. Provide ENGINEER with 7 days advance notice of completion for ENGINEER acceptance testing.
 - 3. CONTRACTOR required testing as defined herein shall be performed by a Corrosion Expert, with qualifications as specified this section, whom is an employee or subcontractor to CONTRACTOR.

- B. Well Isolation Test:
 - 1. CONTRACTOR shall provide a Cathodic Protection Specialist to test electrical isolation on the well at the following locations:
 - a. Between well casing and pump and pump column during installation.
 - b. Between well discharge head and well casing.
 - c. Between well discharge head and discharge pipe.
 - d. Between well discharge head and pump house grounding.
 - 2. The Cathodic Protection Specialist shall conduct additional insulating joint testing as required to insure that insulating flanges are not electrically shorted by other equipment or incidental contact with concrete reinforcement or electrical grounding.
 - 3. Testing between well pump column and well casing shall be performed as the pump and pump column is installed within well.
 - 4. CONTRACTOR to replace damaged or defective insulation parts identified during testing.
 - 5. Electrical Isolation is defined as a condition of being electrically isolated from other metallic structures (including, but not limited to, other piping, concrete reinforcement, casings, and other structures not intended to be cathodically protected) and the environment as defined in NACE Recommended Practice RP0169-83.
 - 6. CONTRACTOR shall submit a report prepared by the Cathodic Protection Specialist certifying insulating joint testing isolation and any corrective action required.

- C. General
 - 1. CONTRACTOR shall correct all construction defects identified during testing.
 - 2. Provide ENGINEER with one week advance notice before beginning tests.

- END OF SECTION -

SECTION 31 11 00
CLEARING, GRUBBING, AND STRIPPING

PART 1 GENERAL

1.1 SUMMARY

- A. This work shall consist of removing and disposing of all trees; shrubs; brush; stumps; windfalls; roots; and other vegetation, including dead and decayed matter; and debris that exist within the designated construction limits, borrow areas, and soil stockpile areas and which are not specifically designated to remain.

1.2 DEFINITIONS

- A. Clearing: Clearing operations shall consist of cutting, removing and disposing of trees, shrubs, bushes, windfalls and other vegetation within the construction limits, borrow areas, and soil stockpile areas. All brush shall be cut off within six inches of the ground surface.
- B. Grubbing: Grubbing operations shall consist of removing and disposing of stumps, roots, debris deleterious materials, and other remains (such as organic and metallic materials) which if left in place would interfere with proper performance or completion of the contemplated work, would impair its subsequent use or form obstructions therein. Organic material from clearing or grubbing operations shall not be incorporated in fill or backfill.
- C. Stripping: Stripping operations shall consist of removing all soil material containing sod, grass, or other vegetation and topsoil to a minimum depth of six (6) inches from all areas that will receive fill or over all trenches in field or yard areas.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 CLEARING

- A. All trees, stumps, shrubs, bushes, windfalls and other vegetation (except such trees and vegetation as may be indicated or directed by ENGINEER to be left standing) shall be cut off to within six inches of the ground surface and shall be removed from the construction limits. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by such means as the circumstances require.

3.2 GRUBBING

- A. All stumps, roots, debris, deleterious and other organic or metallic materials not suitable for foundations shall be removed completely from the construction limits, borrow areas and soil stockpile areas. Unless otherwise permitted by ENGINEER, stumps shall be removed completely. If any stumps are permitted to remain, they shall be cut off not more than six inches above the ground.

3.3 STRIPPING

- A. Soil material containing sod, grass, or other vegetation and topsoil shall be removed to a minimum depth of six (6) inches from all areas to receive fill from the area within lines 5

feet outside all foundation walls, over all trenches, and from beneath pavement and curb and gutter areas. The stripped material shall be deposited in such locations as are acceptable to ENGINEER. Topsoil shall be placed over designated areas to be landscaped, and over all trench areas (outside of paved areas).

- B. All areas to be sodded shall have a minimum thickness of 3 inches (or thicker if required elsewhere in these documents or on the drawings) of topsoil.

3.4 DISPOSAL

- A. No open burning of combustible materials will be allowed.
- B. All trees, timber, stumps, roots, debris, shrubs, bushes, and other vegetation removed during the clearing and grubbing operations shall be removed from the project site and disposed of by CONTRACTOR subject to specific regulations imposed by laws and ordinances and in a manner that will not create a public nuisance nor result in unsightly conditions. CONTRACTOR shall assume full responsibility for acceptable disposition of the material as well as for any damages resulting from his disposal operations.

- END OF SECTION -

SECTION 31 22 00
SITE GRADING

PART 1 GENERAL

1.1 SUMMARY

- A. This Work consists of site grading and related activities.

1.2 RELATED WORK

- A. Related Work specified in other Sections includes, but is not limited to:
1. Section 01 45 00 Quality Control and Materials Testing
 2. Section 01 50 00 Temporary Construction Utilities & Environmental Controls
 3. Section 31 23 15 Excavation and Backfill for Buried Pipelines
 4. Section 31 23 23 Excavation and Backfill for Structures
 5. Section 32 11 23 Untreated Base Course

1.3 REFERENCES

- A. The latest edition of the following publications form a part of these Specifications to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³)
 2. ASTM D 2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

PART 2 PRODUCTS

2.1 EMBANKMENT MATERIAL

- A. Embankment materials are defined as those complying with ASTM D2487, the Unified Soil Classification System (USCS) of CL, ML, SM, SC, SP, or combinations of these materials.
- B. Embankment material shall be free from frozen lumps, rocks larger than 6 inches in the larger dimension, roots, trash, lumber, or organic material. Suitability of material for embankment in accordance with these criteria will be as determined by ENGINEER.
- C. CONTRACTOR shall not borrow materials from adjacent private or public lands without providing to OWNER written verification of such approval from the appropriate landowner or agency. CONTRACTOR shall be responsible for all costs associated with providing additional quantities of embankment fill as may be required to complete the work described herein and as shown on the Contract Drawings.

PART 3 EXECUTION

3.1 GENERAL

- A. Grading shall produce uniform grades or slopes between spot elevations or contours shown.
- B. Areas of construction activity shall be left in condition of uniform grade, blending into pre-existing contours and concealing, as much as possible, evidence of construction activity by back dragging or raking to conceal tire marks. Revegetation shall not be performed until the subgrade is acceptable to OWNER.
- C. Unless otherwise directed by OWNER, all excess excavated materials shall be removed from the site and disposed of by CONTRACTOR. CONTRACTOR shall restore stockpile area to pre-existing condition.

3.2 SITE PREPARATION

- A. Prior to placement of embankment fill, loose or disturbed soil shall be removed and replaced with compacted structural fill, or disturbed soil shall be properly compacted.
- B. Prior to placement of embankment fill, the top 6-inches, or as noted on the Contract Drawings, of the subgrade shall be scarified and compacted to 95% minimum Modified Proctor density as determined by ASTM D1557.
- C. Embankment shall include the placement of materials to raise the existing grade to the established elevations indicated and the construction of driving surfaces.
- D. Embankment material shall be placed in no more than 8-inch loose lifts for heavy equipment, and 4-inch loose lifts for hand operated equipment.
- E. All embankment fill material shall be placed and compacted to 96% minimum Modified Proctor Density as determined by ASTM D1557. Embankment under roadways, to a minimum depth of four feet, shall be compacted to 96% minimum as determined by ASTM D1557.
- F. Where the moisture content is not suitable and/or sufficient compaction has not been obtained, the fill shall be reconditioned to an approved moisture content and recompacted to the minimum required compaction, unless recommended otherwise by the Soils Testing Agency, prior to placing any additional fill material.
- G. Unless otherwise specified, CONTRACTOR shall be responsible for arranging for the placing and compacting of approved fill material in accordance with these Specifications. If the Soils Testing Agency should determine that CONTRACTOR is failing to meet the minimum requirements, CONTRACTOR shall stop operations and adjust as necessary to produce a satisfactorily compacted fill at no additional cost to OWNER.

3.3 GRADING

- A. The final grade of all completed areas shall be between plus and minus one-tenth (± 0.1) of a foot from the grade designated on the Contract Drawings.

END OF SECTION

SECTION 31 22 16
FINE GRADING

PART 1 GENERAL

1.1 SUMMARY

- A. The Fine Grading Work, includes, but is not limited to:
 - 1. Perform fine grading work required to prepare site for landscape finish grading and soil preparation as described in Contract Documents.

1.2 RELATED WORK

- A. Related work specified in other sections includes, but is not limited to:
 - 1. Section 32 91 13 Finish Grading and Topsoil Preparation

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text to by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))

1.4 QUALITY ASSURANCE

- A. Pre-Installation Conference: Participate in pre-installation conference.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 PROTECTION

- A. Do not commence work of this Section until site grading tolerances are met.
- B. Surface Preparation:
 - 1. Before placing topsoil, dig out weeds from planting areas by their roots and remove from site. Remove rocks larger than 1-inch in size and foreign matter such as building rubble, wire, cans, sticks, concrete, etc
 - 2. Remove imported paving base material present in planting areas down to natural sub-grade or other material acceptable to ENGINEER.
 - 3. Limit use of heavy equipment to areas no closer than 6 feet from building or other permanent structures.

3.2 PERFORMANCE

- A. Interface with Other Work: Do not commence work of this Section until site grading tolerances are met.
- B. Site Tolerances:
 - 1. Maximum variation from required grades shall be 1/10 of one foot.
 - 2. To allow for final finish grades of planting areas, sub-grade elevations in landscape areas, before placing topsoil are:
 - a. Shrub Areas: 15 ½ inches below top of walk or curb.
 - b. Sod Areas: 5 ½ inches below top of walk or curb.
- C. Do not expose or damage existing shrub or tree roots designated to remain.
- D. Distribute approved imported topsoil as required. Remove organic material, rocks, clods greater than 1-inch in any dimension, and other objectionable materials.
- E. Slope grade away from structure for 12 feet minimum from walls at slope of 1/2 inch in 12 inches minimum unless otherwise noted. Direct surface drainage in manner indicated on Drawings by molding surface to facilitate natural run-off of water. Fill low spots and pockets with specified fill material and grade to drain properly.

- END OF SECTION -

SECTION 31 23 15
EXCAVATION AND BACKFILL FOR BURIED PIPELINES

PART 1 GENERAL

SUMMARY

- 1.1 This item shall consist of excavating all pipeline trenches to the lines and grades indicated on the drawings or as directed by ENGINEER in the field, and the backfilling of all pipeline trenches. Excavation shall include the removal of all materials of whatever nature encountered to the depths shown on the Contract Drawings, or as modified in the Field by ENGINEER.
- A.

RELATED SECTIONS

Related Work specified in other Sections includes, but is not limited to:

- 1.2
- A.
- | | | |
|----|--------------------|---|
| 1. | Section 01 33 00 | Submittal Procedures |
| 2. | Section 01 45 00 | Quality Control & Materials Testing |
| 3. | Section 01 45 23 | Testing Agency Services |
| 4. | Section 01 50 00 | Temporary Construction Utilities and Environmental Controls |
| 5. | Section 03 31 05 | Controlled Low Strength Material |
| 6. | Section 31 23 19 | Dewatering |
| 7. | Section 33 05 07.1 | Polyvinyl Chloride Pressure Pipe (ASTM D 1785, Modified) |
| 8. | Section 33 92 10 | Steel Pipe, Specials and Fittings (AWWA C-200 Modified) |

1.3 **REFERENCES**

- A. The latest edition of the following publications forms a part of this specification to the extent referred. The publications are referred to in the text by basic designation only.
- B.

1. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
- 2.
3. M 145 Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
- 4.
5. T 27 Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
6. T 88 Standard Method of Test for Particle Size Analysis of Soils
7. T 96 Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
8. T 180 Standard Method of Test for Moisture Density Relations of Soils Using a 10 lb. (4.54 kg) Rammer and an 18 in (457 mm) Drop
9. T 191 Standard Method of Test for Density of Soil-In-Place by the Sand Cone Method
10. T 205 Density of Soil In-Place by the Rubber-Balloon Method
- T 238 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- T 239 Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- T 310 Standard Specification for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- C. C 131 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- C 136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- D 422 Standard Test Method for Particle Size Analysis of Soils
- D 698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft³)
- 1. D 1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone method
- 2.
- 3. D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft³)
- 4.
- 5. D 2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity -Flow Applications
- 6. D 2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- 7.
- 8. D 6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- 9.

DEFINITIONS

- 1.4 Degree of Compaction: Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.
 - A.
 - B. Pipe Zone: That zone in an Excavation which supports, surrounds, and extends to 12 inches above the top of the pipe barrel. Specifically, 6 inches below the bottom (where rock, hard pan, boulders, etc. are encountered), 12 inches above the top of the pipe, and 1 foot laterally beyond both sides of the pipe, unless noted otherwise on the Contract Drawings.
 - C.
 - D. Trench Zone Backfill: That zone in an Excavation which begins 12 inches above the top of the pipe barrel and extends to the natural surface level or the finished grade indicated on the Plans.
 - E. Unyielding Material: Unyielding material shall consist of rock and gravelly soils with stones greater than 12 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.
 - F. Unstable Material: Unstable material shall consist of materials too wet to allow backfill compaction or to properly support the utility pipe, conduit, or appurtenant structures.
- 1.5 Rock: Solid mineral material which cannot be removed with equipment reasonably expected to be used in the Work without cutting, drilling or blasting. Minimum equipment size, in good running order, shall be similar to a Komatsu 300, Caterpillar 320 or 330, or equal.
 - A.

SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 - Submittal Procedures:

Copies of Field Density Test reports shall be submitted to ENGINEER at the beginning of each workday for the previous day's testing of subgrades, embankments and backfill Materials.

Copies of all Laboratory Test Reports shall be submitted to ENGINEER within 24 hours of the completion of the test.

Submit gradations and proctors for Pipe Zone Material and Trench Zone Backfill.

1. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property;
2. include structural calculations to support plan.

3. **SITE CONDITIONS**

4.

Unsuitable Weather Limitations: CONTRACTOR shall not place, spread, or roll any fill material during unsuitable weather conditions. CONTRACTOR shall not resume operations until moisture content of material is satisfactory.

1.6

A.

Weather Softened Subgrade: CONTRACTOR shall remove and replace at no additional cost to OWNER soft subgrade materials resulting from adverse weather conditions.

B.

Protection of Graded Areas: CONTRACTOR shall protect all graded areas from traffic and erosion and shall keep these areas free of trash and debris. Work required to repair and reestablish grades in settled, eroded, and rutted areas shall be completed to specified tolerances at CONTRACTOR's expense.

C.

D.

Reconditioning Compacted Areas: All areas compacted to required specifications that become disturbed by subsequent construction operations or weather conditions shall be scarified, moisture conditioned and re-compacted to the required density prior to further construction.

E.

Grading: the final compacted surface of base course shall not vary more than 1/4 inch above or below design grade.

2.1 PART 2 PRODUCTS

A.

MATERIALS

Stabilization Material: Stabilization material shall consist of hard, durable particles of stone or gravel, screened or crushed to the required size and gradation. The material shall be free from vegetation matter, lumps or balls of clay, or other deleterious matter and shall conform to the following gradation when tested in accordance with AASHTO T 27 or ASTM C 136.

1.

2.

Coarse material shall be crushed or washed and fine material shall be wasted to meet the grading requirements set forth below. Note that if stabilization material is required, an 8 oz. non-woven filter fabric shall be placed between the stabilization material and the pipe zone material.

Coarse aggregate, retained on the No. 4 sieve, shall have a percentage of wear not greater than 40 percent when tested by the Los Angeles Test, AASHTO T-96 or ASTM C 131.

Sieve Size (Square Opening)	Percent By Weight Passing Screen
2-inch	100
1-1/2 inch	10 - 50
3/4-inch	0 - 25
No. 4	0 - 10
No. 200	0 - 3

Pipe Zone Material: All material in the pipe zone shall be clean and free from alkali, salt, petroleum products, vegetative matter or other deleterious matter, slag, cinders, ashes and rubbish or other material that in the opinion of ENGINEER may be objectionable or deleterious. "Squeegee" or any other flowable material shall not be permitted. Pipe zone material shall conform to the following:

B.

Controlled Low Strength Material (CLSM) in accordance with Section 03 31 05 from bottom of trench to pipe spring line. Provide CLSM for entire pipe zone where noted on the Contract Drawings.

1.

From Pipe Spring Line to 12" above top of pipe – Sand per the following gradation:

2.

U.S. Standard Sieve Size (Square Opening)	Percent By Weight Passing Screen
3/8 – inch	100
No. 4	80-100
No. 10	30-50
No. 40	10-30
No. 200	0-15

C.

1.

Select Trench Backfill

Trench backfill shall consist of imported fill material or native material meeting soils classification A-1a of AASHTO M 145, with a maximum particle size no greater than 3 inches in any dimension and shall be capable of meeting the compaction requirements. Trench backfill shall be non-plastic. Trench backfill shall be free from alkali, salt, petroleum products, vegetative matter or other deleterious matter, slag, cinders, ashes and rubbish or other material that in the opinion of ENGINEER may be objectionable or deleterious.

3.1

A.

PART 3 EXECUTION

EXCAVATION

Excavation shall be performed to the lines and grades indicated. All excavated materials not intended for reuse shall be removed from the site and disposed of by CONTRACTOR.

SAFETY

3.2 Excavations shall be sloped or otherwise supported in a safe manner in accordance with applicable State safety requirements and the latest requirements of OSHA Safety and Health Standards for Construction (29 CFR 1926). CONTRACTOR is responsible for assessing safety needs to meet such requirements, arranging for proper equipment and/or construction methods, and maintaining such equipment, methods and construction practices so as to fully comply with all safety requirements.

A.

CONTRACTOR is responsible for assessing needs related to confined space entry, as defined by OSHA. CONTRACTOR shall meet all such requirements, arranging for proper equipment and/or construction methods, and maintaining such equipment, methods and construction practices so as to fully comply with all confined space safety requirements.

B.

DEWATERING

3.3 Water removal shall be in accordance with Section 31 23 19 - Dewatering.

A.

TRENCH WIDTH

3.4 The bottom of the trench shall have a minimum width equal to the outside diameter of the pipe plus 24-inches or as detailed on the Contract Drawings.

A.

B.

The width and depth of the trench shall be ample to permit the pipe to be laid and jointed properly in accordance with the specifications and the drawings, and the backfill to be placed and compacted as specified. Trenches shall be of such extra width, when required, as will permit the convenient placing of timber supports, sheeting, and bracing, and the handling of special units as necessary.

3.5

TRENCH PREPARATION

A.

Each trench shall be excavated so that the pipe can be laid to the alignment and grade as required. The trench wall shall be so braced that the workmen may work safely and efficiently. All trenches shall be drained so the pipe laying may take place in dewatered conditions.

B.

1.

Bottom Preparation

2.

Where rock, hard pan, boulders or other material which might damage the pipe are encountered, the bottom of the trench shall be over excavated 4 inches below the required grade and replaced with Stabilization Material. Otherwise, the bottom of the trench shall be over excavated 6 inches or 1/12 the outside diameter of the pipe, whichever is greater, below the required grade and replaced with Pipe Zone Backfill.

3.

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 1 inch or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

The bottom of the waterline trench shall be accurately graded to provide a minimum of 6 inches between the bottom of the pipe and the bottom of the trench for placement of CLSM.

Removal of Unstable Material

- C. Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed by ENGINEER and replaced to the proper grade with Stabilization Material. When removal of unstable material is required due to the fault or neglect of CONTRACTOR in his performance of the work, the resulting material shall be excavated and replaced by CONTRACTOR without additional cost to OWNER.

1. For pipelines other than the steel waterline, the trench bottom (at the level of the base of the pipe) shall be given a final trim using a string line, laser, or another method approved by ENGINEER for establishing grade, such that each pipe section when first laid will be continually in contact with the ground along the extreme bottom of the pipe. Bell holes shall be provided at each joint to permit the jointing to be made properly. The trench grade shall permit the pipe spigot to be accurately centered in the preceding laid pipe joint, without lifting the pipe above the grade, and without exceeding the permissible joint deflection.

D.

SHEETING AND SHORING

- 3.6 Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
- A.
- B. Support trenches excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
- C. Design sheeting and shoring to be removed at completion of excavation work.
- D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- E.
- 3.7 Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

A.

PIPELINE TRENCH BACKFILLING AND COMPACTION

1.

Pipe Zone:

2.

CLSM (Section 03 31 05) shall be placed from the bottom of the trench to the spring line of the pipe for all pipes and throughout the entire pipe zone where designated on the drawings. Sand, as defined in Subsection 2.1.B of this section shall be placed from the spring line of the pipe to the top of the pipe zone.

3.

For pipelines which include sand in pipe zones, pipe zone backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise approved or specified. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Each layer shall be compacted to at least 96 percent of the maximum Modified Proctor density (ASTM D-1557), unless otherwise specified.

Replacement of Unyielding Material: Unyielding material removed from the bottom of the trench shall be replaced with Stabilization Material placed in layers not exceeding 6 inches loose thickness.

Replacement of Unstable Material: Unstable material removed from the bottom of the trench or excavation shall be replaced with Stabilization Material placed in layers not exceeding 6 inches loose thickness.

Where the pipe grade exceeds 30%, cohesive material shall be used in lieu of pipe bedding. The cohesive material shall be moistened to within 2% of optimum moisture and compacted as noted.

4. The relative density of the compacted cohesionless material shall not be less than 60% as determined by the Bureau of Reclamation Relative Density of Cohesionless Soil Test (Designation E-12) of the "Earth Manual."
- 5.

6. Trench Backfill: Trenches shall be backfilled to the grade shown with Trench Backfill material as specified.

- B. Trench backfill in asphalted road shall consist of backfilling the trench from above the pipe zone up to underneath the noted recommended depth for untreated base course and asphalt or concrete of finished grade with Trench Backfill material compacted to 96 percent of maximum density (ASTM D-1557). Backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise approved or specified.

1. Trench backfill in unimproved or landscaped areas shall consist of backfilling the trench from above the pipe zone to 8 inches below finished grade with Trench Backfill material compacted to 96 percent of maximum density (ASTM D-1557). Backfill from 8 inches below finished grade to finished grade shall consist of topsoil replacement in addition to replacement of all landscaped materials. Trench backfill shall be placed in layers not exceeding 8 inches loose thickness.

2. It shall be the responsibility of CONTRACTOR to be assured that the Trench Backfill material is capable of being compacted to the degree specified. It shall be CONTRACTOR's responsibility to remove and dispose of all excess excavated material.
- 3.

- C. 1. Final Backfill:

Unimproved and Landscaped Areas: The top 8 inches of the trench shall be filled with topsoil. Topsoil may be native material stripped prior to excavation of the trench. Backfill shall be deposited in layers of a maximum of 12-inch loose thickness, and compacted to a minimum of 85 percent maximum density (ASTM D-1557). Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

- 3.8 A. Roadways shall be completed with the type and thickness of materials (i.e. Untreated Road Base, Asphalt, or Concrete) as indicated or shown on the drawings.

1. SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities from above the pipe zone to the natural surface level or the finished grade indicated on the Plans shall be placed and compacted as follows:

Where existing underground pipes or conduits larger than 3 inches in diameter and all sizes of sewer lines or sewer laterals cross the trench above the new work, the backfill from the bottom of the trench to 1 foot above the top of the intersecting pipe or conduit shall be pipe zone material compacted to 95 percent of maximum density (ASTM D-

1557). The pipe zone material shall extend 2 feet on either side of the intersecting pipe or conduit to ensure that the material will remain in place while other backfill is placed.

The maximum trench length open at any given time shall not exceed 200 feet unless approved by ENGINEER, and must be backfilled in a timely manner.

MAINTENANCE OF BACKFILL

- B. All backfill shall be maintained in satisfactory condition, and all places showing signs of settlement shall be filled and maintained during the life of the Contract and for a period of one year following the day of final acceptance of all work performed under the Contract.
- 3.9 When CONTRACTOR is notified by ENGINEER or OWNER that any backfill is hazardous, CONTRACTOR shall correct such hazardous condition at once. Any utility, road and/or parking surfacing damaged by such settlement shall be repaired by CONTRACTOR to the satisfaction of OWNER and ENGINEER. In addition, CONTRACTOR shall be responsible for the cost to OWNER of all claims for damage filed with the Court, actions brought against the said OWNER for, and on account of, such damage.
- A.

FINISH GRADING AND CLEANUP

- 3.10 CONTRACTOR shall grade the trench line to a smooth grade to affect a neat and workmanlike appearance of the trench line.
- A.
 - B. All tools, equipment and temporary structures shall be removed. All excess dirt and rubbish shall be removed from the site by CONTRACTOR.
 - C. CONTRACTOR shall restore the site to at least as good as original condition, including but not limited to final trench grade and restoration of affected public and private facilities whether in the public right-of-way or on private property. Any exception to this requirement must be in writing from ENGINEER for the job specific conditions.
- 3.11

COMPACTION TESTS

- A. It shall be the responsibility of CONTRACTOR to accomplish the specified compaction for backfill, fill, and other earthwork. It shall be the responsibility of CONTRACTOR to control his operations by performing any additional tests necessary to verify and confirm that CONTRACTOR has complied, and is complying at all times, with the requirements of these Specifications concerning compaction, control, and testing.
- 1.

Testing of Backfill Materials

- i) a. Characteristics of backfill materials shall be determined in accordance with the requirements of Section 01 45 00 - Quality Control & Materials Testing.
- b. The CONTRACTOR shall demonstrate the adequacy of compaction equipment and procedures before exceeding any of the following amounts of earthwork quantities:
 - 50 linear feet of trench backfill.
- c. Until the specified degree of compaction on the previously specified amounts of earthwork is achieved, no additional earthwork of the same kind shall be performed.
- d. After satisfactory conclusion of the initial compaction demonstration and at any time during construction, earthwork which does not comply with the specified degree of compaction shall not exceed the previously specified quantities.

- e. Compliance tests may be made by ENGINEER to verify that compaction is meeting the requirements previously specified at no cost to CONTRACTOR.
- f. ENGINEER may require retesting of backfill that has settled from water penetration in the trench. CONTRACTOR shall remove the overburden above the level at which ENGINEER wishes to test and shall backfill and recompact the excavation after the test is complete at no additional cost to the OWNER.
- g. If compaction fails to meet the specified requirements, CONTRACTOR shall remove and replace the backfill at proper density or shall bring the density up to specified level by other means acceptable to ENGINEER. Subsequent tests required to confirm and verify that the reconstructed backfill has been brought up to specified density shall be paid by CONTRACTOR. CONTRACTOR's confirmation tests shall be performed in a manner acceptable to ENGINEER.

Field Density Tests

- a. Field density tests shall be made in accordance with ASTM D 1557.

2.

- END OF SECTION -

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SECTION 31 23 19
DEWATERING

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section provides specifications for dewatering systems and appurtenances to be used during construction as required to keep the excavation free of water.

1.2 SUBMITTALS

- A. Before dewatering is commenced, CONTRACTOR shall provide information to ENGINEER outlining the method, installation, and details of the proposed dewatering system. CONTRACTOR shall provide ENGINEER with plans setting forth details of the proposed dewatering systems. The dewatering system plans shall be of sufficient detail to indicate sizes of pumps, piping, appurtenances, the ultimate disposal point for water and to indicate the overall completeness and effectiveness of the proposed system.
- B. CONTRACTOR shall certify to OWNER that the design and implementation of the proposed dewatering system is sufficient to complete the Work.

PART 2 PRODUCTS

2.1 MATERIALS

- A. CONTRACTOR shall be responsible for selection of dewatering means, methods and materials.

PART 3 EXECUTION

3.1 DESIGN AND IMPLEMENTATION

- A. CONTRACTOR shall be responsible for complete design and implementation of the dewatering system.
- B. CONTRACTOR shall be responsible for the design and implementation of any modifications that may be required to the initial design of the dewatering system (at no additional cost to OWNER) to provide a dewatering system that operates adequately to complete the Work.
- C. CONTRACTOR shall furnish, install, operate and maintain all machinery, appliances, and equipment to maintain all excavations free from water during construction.
- D. CONTRACTOR shall dispose of water so as to not cause damage to public or private property, or to cause a nuisance or menace to the public or violate the law.
- E. CONTRACTOR shall be responsible to obtain groundwater discharge permits, if required.

- F. CONTRACTOR shall install and operate the dewatering system so as to not cause damage or endanger adjacent structures or property.
- G. The control of groundwater shall be such that softening of the bottom of excavations, or formation of "quick" conditions or "boils," does not occur. Dewatering systems shall be designed and operated so as to prevent removal and migration of the natural soils.
- H. CONTRACTOR shall always have sufficient stand-by equipment at the project site to continuously maintain the dewatering program until Work necessitating dewatering is complete.
- I. CONTRACTOR shall have on hand equipment and machinery in good working condition for emergencies and shall have personnel available for operation of such equipment and machinery.
- J. CONTRACTOR shall control surface water to prevent entry into excavations.

- END OF SECTION -

SECTION 31 23 23
EXCAVATION AND BACKFILL FOR STRUCTURES

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers excavating, backfilling, and compacting of disturbed areas for structures and roadways as directed by ENGINEER.

1.2 RELATED WORK

- A. Related Work specified in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
 2. Section 01 45 00 Quality Control and Materials Testing
 3. Section 01 45 23 Testing Agency Services
 4. Section 01 50 00 Temporary Construction Utilities and Environmental Controls
 5. Section 31 11 00 Clearing, Grubbing and Stripping
 6. Section 31 23 15 Excavation and Backfill for Buried Pipelines
 7. Section 31 23 19 Dewatering

1.3 REFERENCES

- A. The latest editions of the following publications form a part of this Specification to the extent referred. The publications are referred to in the text by basic designation only.
- B. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
1. M 145 Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
 2. T 27 Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
 3. T 88 Standard Method of Test for Particle Size Analysis of Soils
 4. T 180 Standard Method of Test for Moisture Density Relations of Soils Using a 10 lb. (4.54 kg) Rammer and an 18 in (457 mm) Drop
 5. T 191 Standard Method of Test for Density of Soil In Place by the Sand Cone Method
 6. T 310 Standard Specification for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. D 422 Standard Test Method for Particle Size Analysis of Soils
 2. D 698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft³)
 3. D 1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone method
 4. D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft³)
 5. D 2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

6. D 6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

D. The latest Edition of the Utah Department of Transportation Standard Specification for Road and Bridge Construction.

E. The latest Edition of the American Public Works Association (APWA) and Associated General Contractors of America Standard Plans and Standard Specifications.

1.4 SUBMITTALS

A. The following shall be submitted in accordance with Section 01 33 00 Submittal Procedures:

1. Submit gradations and proctors for structural fill materials and backfill materials.
2. Submit copies of Field Density Test reports.

PART 2 PRODUCTS

2.1 WALL BACKFILL MATERIAL

A. Wall backfill material shall consist of import fill material meeting the AASHTO A-1-A soils classifications of AASHTO M 145, with a maximum particle size no greater than 3 inches in any dimension and shall be capable of meeting the compaction requirements.

1. Wall backfill material shall be free from frozen lumps, rocks larger than 3 inches in the largest dimension, roots, trash, lumber and organic material.

2.2 STRUCTURAL FILL

A. Structural fill material, if required, shall meet the following requirements.

1. Material shall be non-expansive granular soil with less than 35 percent passing the No. 200 sieve, with a liquid limit less than 30%, and free from rocks larger than 3 inches in the largest dimension, frozen lumps, roots, trash, lumber and organic material. Structural fill shall be imported.

PART 3 EXECUTION

3.1 EXCAVATION

A. Excavation shall be performed to the lines and grades indicated. Excavated material not required or not satisfactory for backfill shall be removed from the site.

B. Excavations shall be braced and supported as needed to prevent the ground adjacent to the excavation from sliding or settling. Slides shall be promptly removed and corrected by CONTRACTOR.

3.2 PREPARATION

A. Compact subgrade to density requirements for subsequent backfill materials.

- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with granular fill and compact to density equal to or greater than requirements for subsequent fill material.
- C. Scarify subgrade surface to depth of 6 inches.

3.3 DEWATERING

- A. Water removal shall be in accordance with Section 31 23 19 - Dewatering.

3.4 BACKFILL

- A. Backfill material shall not be placed against concrete structures that have not been properly cured. No backfill material shall be placed until concrete has cured for a minimum of 7 days or until the compressible strength is 3,400 psi, whichever is greater.
- B. Backfill material shall be placed in no more than 6-inch loose lifts for compaction by hand operated machine compactors, and 8 inches loose lifts for other than hand operated machines.
- C. Structural fill placed beneath foundations, footings or the floor slab shall be placed and compacted to at least 96% of maximum dry density at a moisture content within 2 percent of optimum moisture content in accordance with ASTM D 1557.
- D. Backfill material shall be placed and compacted to at least 96 percent of maximum dry density at a moisture content within 2 percent of optimum moisture content in accordance with ASTM D-1557.
- E. Where the moisture content is not suitable and/or sufficient compaction has not been obtained, the fill shall be reconditioned to an approved moisture content and re-compacted to the minimum required compaction prior to placing any additional fill material.
- F. CONTRACTOR shall be responsible for arranging for the placing and compacting of approved fill material in accordance with these Specifications. If it is determined that CONTRACTOR is failing to meet the minimum requirements, CONTRACTOR shall stop operations and make adjustments as necessary to produce a satisfactorily compacted fill at no additional cost to OWNER.
- G. Sufficient personnel, equipment, sumps or other means should be provided to maintain the site in an acceptable dry condition for the duration of this contract.
- H. Excavations shall be so braced and supported as needed to prevent the ground, adjacent to the excavation, from sliding or settling. Localized slides or settlements shall be promptly removed and corrected by CONTRACTOR.
- I. Final Backfill:
 - 1. Unimproved and Landscaped Areas: The top 8 inches of the trench shall be filled with topsoil and landscaped materials. Topsoil may be native material stripped prior to excavation of the trench. Backfill material shall be placed and compacted as specified above.
 - 2. Roadways shall be completed with the type and thickness of materials as indicated or shown on the drawings.

3.5 FINISHED GRADE

- A. The finished subgrade and grade of the fill shall not vary more than 0.05 feet from the established grades and cross sections shown on the Drawings.

3.6 COMPACTION TESTS

- A. Compaction testing shall be the provided and paid for in accordance with Section 01 45 00 – Quality Control and Materials Testing.

- B. It shall be the responsibility of CONTRACTOR to accomplish the specified compaction for backfill, structural fill, Untreated Base Course and other earthwork. It shall be the responsibility of CONTRACTOR to control his operations by performing any additional tests necessary to verify and confirm that CONTRACTOR has complied, and is complying at all times, with the requirements of these Specifications concerning compaction, control, and testing.

1. Testing of Backfill Materials

- a. Characteristics of backfill materials shall be determined in accordance with the requirements of Section 01 45 00.
 - b. Contractor shall demonstrate the adequacy of compaction equipment and procedures before exceeding any of the following amounts of earthwork quantities:
 - 1) One (1) test per 1.0 feet of backfill thickness placed per structure.
 - c. Until the specified degree of compaction on the previously specified amounts of earthwork is achieved, no additional earthwork of the same kind shall be performed.
 - d. After satisfactory conclusion of the initial compaction demonstration and at any time during construction, earthwork which does not comply with the specified degree of compaction shall not exceed the previously specified quantities.
 - e. Quality Control tests may be made by ENGINEER to verify that compaction is meeting the requirements previously specified at no cost to Contractor. If ENGINEER requires retesting of backfill, CONTRACTOR shall remove the overburden above the level at which ENGINEER wishes to test and shall backfill and recompact the excavation after the test is complete at no additional cost to OWNER.
 - f. If compaction fails to meet the specified requirements, Contractor shall remove and replace the backfill at proper density or shall bring the density up to specified level by other means acceptable to Engineer. Subsequent tests required to confirm and verify that the reconstructed backfill has been brought up to specified density shall be paid in accordance with Section 01 45 23 – Testing Agency Services. The confirmation tests shall be performed in a manner acceptable to ENGINEER. Frequency of confirmation tests for remedial work shall be double that amount specified for initial confirmation tests.
- #### **2. Field Density Tests**
- a. Tests shall be performed in sufficient numbers to meet the requirements of Section 01 45 00 and to ensure that the specified density is obtained.

- C. Field density tests shall be made in accordance with ASTM D-1557 and ASTM D-6938.

- END OF SECTION -

SECTION 31 25 00
EROSION CONTROL BLANKET

1.1 SUMMARY

- A. The erosion control blanket contains excelsior wood fiber for the purpose of erosion control and revegetation as described herein.
- B. This work shall consist of furnishing and installing the erosion control blanket; including fine grading, blanketing, stapling, and miscellaneous related work, in accordance with these standard specifications and at the locations identified on drawings or designated by the owner's representative. This work shall include all necessary materials, labor, supervision, and equipment for installation of a complete system.
- C. All work of this section shall be performed in accordance with the conditions and requirements of the contract documents.
- D. The erosion control blanket shall be used to prevent surface erosion and enhance revegetation.
The blanket shall be suitable for the following applications:
 - 1. Slope protection
 - 2. Channel and ditch linings
 - 3. Reservoir embankments and spillways
 - 4. Culvert inlets and outfalls
 - 5. Dikes, levees, and riverbanks

1.2 PERFORMANCE REQUIREMENTS

- A. Erosion control blanket shall provide a temporary, biodegradable cover material to reduce slope and/or channel erosion and enhance revegetation. Erosion control blanket performance capabilities shall be determined by ASTM D 6459, "Determination of Erosion Control Blanket (ECB) Performance in Protecting Hillslopes from Rainfall-Induced Erosion", and ASTM D 6460, "Determination of Erosion Control Blanket (ECB) Performance in Protecting Earthen Channels from Stormwater-Induced Erosion."
- B. Blanket performance requirements:
 - Slopes: $\leq 2H:1V$
 - C factor: .018
 - Shear Stress: 1.75 lb/ft² (84 Pa)
 - Velocity: 7.0 ft/sec (2.1 m/sec)
 - Functional Longevity^a : ≤ 18 months
 - ^a Functional Longevity varies from region to region because of differences in climatic conditions.

1.3 SUBMITTALS

- A. Submittals shall include complete design data, Product Data Sheets, Product Netting Information, SDS, Staple Pattern Guides, Installation Guidelines, Manufacturing Material Specifications, Manufacturing Certifications, CAD details, and a Manufacturing Quality Control Program. In addition, the Manufacturer shall provide a

test report providing data showing the performance capabilities of the erosion control blanket, along with reference installations similar in size and scope to that specified for the project.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Erosion control blanket shall be furnished in rolls and wrapped with suitable material to protect against moisture intrusion and extended ultraviolet exposure prior to placement. Each roll shall be labeled with a date code identification, which allows for sufficient tracking of the product back to date of manufacturing and for quality control purposes.
- B. Erosion control blanket shall be of consistent thickness with fibers distributed evenly over the entire area of the blanket.
- C. Erosion control blanket shall be free of defects and voids that would interfere with proper installation or impair performance.
- D. Erosion control blanket shall be stored by the Contractor in a manner that protects them from damage by construction activities.

PART 1 - PRODUCTS

1.1 EROSION CONTROL BLANKET

- A. Erosion control blanket shall be Curlex I, as manufactured by American Excelsior Company, Arlington, TX (1-866-9FIBERS).
- B. Curlex I erosion control blanket (ECB) consists of a specific cut of naturally seed free Great Lakes Aspen curled wood excelsior with 80% of the fibers ≥ 6 inches in length. It is of consistent thickness with fibers evenly distributed throughout the entire area of the blanket. The top of each blanket is covered with green polypropylene netting containing oxo-biodegrader and UV additives. Curlex I shall be manufactured in the U.S.A.
- C. Erosion control blanket shall have the following material characteristics:

Width	4.0 ft (1.2 m)	8.0 ft (2.4 m)	16.0 ft (4.9 m)
Length	112.5 ft (34.29 m)	112.5 ft (34.29 m)	112.5 ft (34.29 m)
Area	50.0 yd ² (41.8 m ²)	100.0 yd ² (83.6 m ²)	200.0 yd ² (167.2 m ²)
Weight ^b	36.5 lb (16.6 kg)	73.0 lb (33.1 kg)	146.0 lb (66.2 kg)
Fiber Count	$\approx 7,000$ per yd ² ($\approx 8,400$ per m ²)	$\approx 7,000$ per yd ² ($\approx 8,400$ per m ²)	$\approx 7,000$ per yd ² ($\approx 8,400$ per m ²)
Fiber Length (80% min.)	≥ 6.0 in (≥ 15.2 cm)	≥ 6.0 in (≥ 15.2 cm)	≥ 6.0 in (≥ 15.2 cm)
Mass per Unit Area ($\pm 10\%$)	0.73 lb/yd ² (0.40 kg/m ²)	0.73 lb/yd ² (0.40 kg/m ²)	0.73 lb/yd ² (0.40 kg/m ²)
Net Openings	1.0 in x 2.0 in (25.4 mm x 50.8 mm)	1.0 in x 2.0 in (25.4 mm x 50.8 mm)	1.0 in x 2.0 in (25.4 mm x 50.8 mm)

TYPICAL INDEX VALUES

<u>Index Property</u>	<u>Test Method</u>	<u>Value</u>
Thickness	ASTM D 6525	0.274 in (6.96 mm) Light
Penetration	ASTM D 6567	29.5%
Resiliency	ASTM D 1777/ECTC	59%
Mass per Unit Area	ASTM D 6475	0.623 lb/yd ² (0.338 kg/m ²)
MD-Tensile Strength Max.	ASTM D 6818	93.6 lb/ft (1.37 kN/m)
TD-Tensile Strength Max.	ASTM D 6818	25.2 lb/ft (0.37 kN/m)
MD-Elongation	ASTM D 6818	26.3%
TD-Elongation	ASTM D 6818	24.5% Swell ECTC
Procedure 49% Water Absorption	ASTM D 1117/ECTC	236%
Bench-Scale Rain Splash	ASTM D 7101	SLR = 4.12 @ 2 in/hr ^{c,d}
Bench-Scale Rain Splash	ASTM D 7101	SLR = 4.43 @ 4 in/hr ^{c,d}
Bench-Scale Rain Splash	ASTM D 7101	SLR = 4.79 @ 6 in/hr ^{c,d}
Bench-Scale Shear	ASTM D 7207	2.32 lb/ft ² @ 0.5 in soil loss ^d
Germination Improvement	ASTM D 7322	572%

^b Weight is based on a dry fiber weight basis at time of manufacture. Baseline moisture content of Great Lakes Aspen excelsior is 22%.

^c SLR is the Soil Loss Ratio, as reported by NTPEP/AASHTO.

^d Bench-scale index values should not be used for design purposes.

1.2 STAPLES

- A. Staples shall be a minimum 6 in biodegradable E-Staple®, as provided by American Excelsior Company. All staples shall have a U-shaped top.

PART 2 - EXECUTION

2.1 BLANKET SUPPLIER REPRESENTATION

- A. Contractor shall coordinate with the blanket supplier for a qualified representative to be present at the job site at the start of installation to provide technical assistance as needed. Contractor shall remain solely responsible for the quality of installation.

2.2 SITE PREPARATION

- A. Before placing erosion control blanket, the Contractor shall certify that topsoil has been placed and the subgrade has been properly compacted, graded smooth, has no depressions, voids, soft or uncompacted areas, is free from obstructions such as tree roots, protruding stones or other foreign matter, and is seeded and fertilized according to project specifications. The Contractor shall not proceed until all unsatisfactory conditions have been remedied. By beginning construction, the Contractor signifies that the preceding work is in conformance with this specification.
- B. Contractor shall fine grade the subgrade by hand dressing where necessary to remove local deviations.
- C. No vehicular traffic shall be permitted directly on the erosion control blanket.

NOTE: Topsoiling, seeding, and fertilizing is not included in this specification.

2.3 SLOPE INSTALLATION

- A. Erosion control blanket shall be installed as directed by the owner's representative in accordance with manufacturer's Installation Guidelines, Staple Pattern Guides, and

CAD details. The extent of erosion control blanket shall be as shown on the project drawings.

- B. Erosion control blanket shall be orientated in vertical strips and anchored with staples, as identified in the Staple Pattern Guide. Adjacent strips shall be abutted or overlapped to allow for installation of a common row of staples that anchor through the nettings of both blankets. Horizontal joints between erosion control blankets shall be sufficiently overlapped with the uphill end on top for a common row of staples so that the staples anchor through the nettings of both blankets.
- C. Where exposed to overland sheet flow, a trench shall be located at the uphill termination. Erosion control blanket shall be stapled to the bottom of the trench. The trench shall be backfilled and compacted. Where feasible, the uphill end of the blanket shall be extended three feet over the crest of the slope.

2.4 QUALITY ASSURANCE

- A. Erosion control blanket shall not be defective or damaged. Damaged or defective materials shall be replaced at no additional cost to the owner.
- B. Product shall be manufactured in accordance to a documented Quality Control Program. At a minimum, the following procedures and documentation shall be provided upon request:
 - 1. Manufacturing Quality Control Program Manual
 - 2. First piece inspection and documentation of products produced to assure component materials and finished product tolerances are within manufacturer specifications.
 - 3. Additional inspections for product conformance shall be conducted during the run after the first piece inspection.
 - 4. Moisture content readings recorded for each manufacturing day.
 - 5. Recorded weight of every erosion control blanket manufactured.
 - 6. Each individual erosion control blanket shall be inspected, weighed, and documented prior to packaging for conformance to manufacturing specifications.
 - 7. Documentation and record retention for at least two years.

2.5 CLEAN-UP

- A. At the completion of this scope of work, Contractor shall remove from the job site and properly dispose of all remaining debris, waste materials, excess materials, and equipment required of or created by Contractor. Disposal of waste materials shall be solely the responsibility of Contractor and shall be done in accordance with applicable waste disposal regulations.

END OF SECTION

SECTION 32 01 01
PLANT MAINTENANCE

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Provide maintenance for new landscaping as described in Contract Documents.
- B. Related Sections:
 - 1. Section 32 90 01: Common Planting Requirements.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 PERFORMANCE

- A. General:
 - 1. Before beginning maintenance period, plants shall be in at least as sound, healthy, vigorous, and in approved condition as when delivered to site, unless accepted by Architect in writing at final landscape inspection
 - 2. Maintain landscaping from completion of landscape installation to 30 days after Substantial Completion Meeting.
 - 3. Replace landscaping that is dead or appears unhealthy or non-vigorous as directed by Architect during and at end of maintenance period. Make replacements within 10 days of notification.
- B. Trees, Shrubs, And Plants:
 - 1. Maintain by pruning, cultivating, and weeding as required for healthy growth.
 - 2. Restore planting basins.
 - 3. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical positions as required.
 - 4. Spray as required to keep trees and shrubs free of insects and disease.
 - 5. Provide supplemental water by hand as needed in addition to water from irrigation system.

END OF SECTION

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SECTION 32 11 23
ROAD BASE - UNTREATED BASE COURSE

PART 1 GENERAL

1.1 DESCRIPTION

- A. This work consists of the placement of Sub-Base and Untreated Base Course (UBC) material at designated areas and roadways and all driving surfaces as indicated on the Contract Drawings.

1.2 RELATED SECTIONS

- A. Related Work specified in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
 2. Section 01 45 00 Quality Control and Materials Testing

1.3 REFERENCES

- A. The latest edition of the following publication forms a part of this Specification to the extent referenced. The publication is referred to in the text by basic designation only.
- B. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
1. AASHTO T 88 Standard Method of Test for Particle Size Analysis of Soils
 2. AASHTO T 180 Standard Method of Test for Moisture Density Relations of Soils Using a 10 lb. (4.54 kg) Rammer and an 18 in (457 mm) Drop
 3. AASHTO T 191 Standard Method of Test for Density of Soil In-Place by the Sand Cone Method
 4. AASHTO T 310 Standard Specification for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods. (Shallow Depth)
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM D 422 Standard Method for Particle Size Analysis of Soils
 2. ASTM D 698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³)
 3. ASTM D 1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone method
 4. ASTM D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³)
 5. ASTM D 2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
 6. ASTM D 6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- D. The latest edition of the Utah Department of Transportation Standard Specification for Road and Bridge Construction (UDOT).

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Untreated Base Course (APWA Grade 1 or Grade 3/4).

PART 2 PRODUCTS

2.1 MATERIALS

- A. Untreated Base Course: Untreated Base Course Materials shall meet the Specifications for Grade 3/4 or 1 as shown in Table 1.

TABLE 1

MASTER GRADING BANDS			
SIEVE SIZE	GRADE 1-1/2 GRADATION (PERCENT PASSING)	GRADE 1 GRADATION (PERCENT PASSING)	GRADE 3/4 GRADATION (PERCENT PASSING)
1 1/2 inch	100	-	-
1 inch	-	100	-
3/4 inch	81-91	-	100
1/2 inch	67-77	79 - 91	-
3/8 inch	-	-	78 -92
No. 4	43-53	49 - 61	55 - 67
No. 16	23-28	27 - 35	28 - 38
No. 200	6-10	7 - 11	7 - 11

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

- A. Prior to placement of untreated base course materials, the foundation area to receive untreated base course materials shall be scarified to a minimum depth of 8-inches and recompact to 96% minimum laboratory density as determined by ASTM D-1557.

3.2 UNTREATED BASE COURSE MATERIAL PLACEMENT

- A. No Untreated Base Course material shall be placed on sub-grade materials until the sub-grade has been checked and accepted by ENGINEER.
- B. Road base material placed on driving surfaces shall be compacted to a minimum density of 96% in accordance with ASTM D-1557 to provide a uniform graded smooth surface.
- C. Untreated Base Course material shall be placed to a minimum thickness eight (8) inches or as shown on the drawings.

3.3 FIELD QUALITY CONTROL

- A. CONTRACTOR shall be responsible for directing proper placement of all road base materials. CONTRACTOR shall be responsible for the stability of the road base materials during placement and shall replace any portions which have become displaced due to careless or negligent work on the part of CONTRACTOR, or to damage resulting from natural causes, such as storms.

- B. Whenever the work areas to receive Sub-Base and/or Untreated Base Course material are covered with snow, the snow must be removed prior to placing the road base and/or Untreated Base Course, and deposited outside the immediate construction areas at CONTRACTOR's expense.

- END OF SECTION -

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SECTION 32 12 16
HOT-MIX ASPHALT CONCRETE PAVING

PART 1 GENERAL

1.1 SUMMARY

- A. This section addresses the requirements for installing hot-mix asphalt concrete, as outlined in Section 33 05 25 – Pavement Restoration of the APWA Specifications, and as modified herein.
- B. CONTRACTOR shall comply with City Standards for the asphalt concrete paving in the City in which the construction is performed. If there is a conflict between the specifications of this Section and the City Standard specifications, City Standards shall govern.

1.2 RELATED SECTIONS

- A. Related Work specified in other Sections includes, but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 01 45 00 Quality Control and Materials Testing
 - 3. Section 01 50 00 Temporary Facilities and Environmental Controls
 - 4. Section 32 11 23 Road Base - Untreated Base Course
 - 5. Section 32 12 14 Tack Coat (APWA)
 - 6. Section 32 12 16 Plant-Mix – Asphalt Paving (APWA)
 - 7. Section 32 17 23 Pavement Marking (APWA)
 - 8. Section 33 05 25 Pavement Restoration (APWA)

1.3 REFERENCES

- A. The American Public Works Association General Conditions and Standard Specifications for Construction, latest edition
- B. The latest edition of the following publication forms a part of this Specification to the extent referenced. The publication is referred to in the text by basic designation only.
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM D 2041 Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
 - 2. ASTM D 2950 Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Method
 - 3. ASTM D 3665 Standard Practice for Random Sampling of Construction Materials

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Laboratory mix design for proposed hot-mix asphalt concrete paving.
- C. Means and methods for removal, reprocessing, and placement of existing asphalt surfaces as base course material.

- D. Laboratory mix design for proposed tack coat application.
- E. Quality assurance tests for asphalt and aggregate material sources.
- F. Copies of batch delivery tickets shall be submitted during progress of the work, and shall show the following information:
 - 1. Name of production facility
 - 2. Serial number of ticket
 - 3. Date and truck number
 - 4. Name of CONTRACTOR
 - 5. Job name and location
 - 6. Weight of asphalt concrete
 - 7. Loading temperature
 - 8. Signature or initial of plant representative
 - 9. Type and grade of asphalt cement
 - 10. Type and grade of aggregate
 - 11. Applicable mix design method
 - 12. Separate weights of aggregate and asphalt
- G. Submit type and number of rollers required for compacting asphalt concrete

1.5 SITE CONDITIONS

- A. Pave only when air and roadbed temperatures in the shade are greater than 40 deg. F and rising. The temperature restrictions may be waived only upon written authorization from ENGINEER.
- B. Do not pave during rain or unsuitable weather or when the surface is wet.

1.6 ACCEPTANCE

- A. Acceptance of hot-mix asphalt concrete paving is based upon minimum density, minimum thickness, smoothness, and surface appearance. Smoothness and surface appearance shall be as defined by Section 32 12 16.13 of the APWA Specifications.

PART 2 PRODUCTS

2.1 BITUMINOUS MATERIAL

- A. The bituminous material shall be PG64-22, DM-1/2, 50 blow per APWA Section 32 12 05 unless noted otherwise. The maximum allowable reclaimed asphalt pavement (RAP) is 15% and shall be free from detrimental quantities of deleterious materials.
- B. Sampling and testing shall be the responsibility of CONTRACTOR and shall be performed as required in Section 01 45 00 - Quality Control and Materials Testing.

2.2 TACK COAT

- A. Tack coat material shall conform to all requirements of Section 32 12 13.13 - Tack Coat (APWA).

PART 3 EXECUTION

3.1 PREPARATION

- A. Preparation shall conform to all requirements of Section 32 12 16.13 and Section 33 05 25 of the APWA specifications.
- B. CONTRACTOR shall map and mark all existing surface utilities within the line of work and shall lower fixtures if pavement machine is not capable of passing over structure.
- C. All asphalt and concrete surfaces within the line of work are to be removed and disposed of properly by CONTRACTOR. CONTRACTOR may, upon written authorization of OWNER, use processed asphalt materials as base course material. Excess materials shall be removed and disposed of by CONTRACTOR.
- D. Existing asphalt pavements and drive approach extensions to be removed shall be cut by a wheel cutter or other device capable of making a neat, reasonably straight and smooth cut without damaging adjacent pavement and/or concrete that is not to be removed. The cutting device operation shall be subject to the approval of ENGINEER.
- E. Any existing base, surfacing, or pavement shall be thoroughly cleaned immediately prior to receiving the plant-mixed surfacing. Where existing pavement is being widened or extended, it shall be cut to a straight vertical face prior to the paving operations and treated with asphalt paint binder.

3.2 BASE COURSE

- A. Base course material shall be placed in accordance with Section 32 11 23 of these specifications.
- B. Base course surfaces shall be maintained in an acceptable condition for both moisture and density, as defined by Section 32 11 23 - Road Base – Untreated Base Course, until the overlying hot-mix asphalt cement materials have been placed, at no additional expense to OWNER.
- C. Processed asphalt materials may be used as base course provided that the resulting gradation for the 1" or 3/4" and -200 sieves comply with the requirements of Section 32 11 23 - Road Base. Processed asphalt materials may also be used if they meet the requirements of APWA Section 32 11 24 – Pulverized Pavement Base Course with the addition of stabilizers and if approved by the OWNER. Processed asphalt which has been contaminated with clay or silt materials will not be accepted.

3.3 PLACEMENT OF TACK COAT

- A. Apply tack coat to all existing asphalt concrete surfaces preparatory to placing asphalt concrete pavement in accordance with Section 32 12 14 – Tack Coat of the APWA specifications.

3.4 PLACEMENT OF HOT-MIX ASPHALT CONCRETE

- A. For all excavations within twenty-four (24) inches of any structure, concrete, or edge of existing pavement surface; CONTRACTOR shall remove and replace existing pavement surface to the concrete, structure, or edge of existing pavement surface.

- B. Where a longitudinal trench is partly in pavement, the pavement shall be replaced to the original pavement edge, on a straight line, parallel to the center line of the roadway.
- C. Where no part of a longitudinal trench is in the pavement, surfacing replacement will only be required where existing surfacing materials have been removed.
- D. Spreading shall be as nearly continuous as possible.
- E. Placement shall also allow for line, grade, elevations, and thickness specified herein and as shown on the drawings.
- F. When asphalt concrete is laid against vertical surfaces such as gutters, the face of the vertical surface shall be roughened for proper bonding, cleaned, and then painted with a light coating of asphalt cement or emulsified asphalt.
- G. At terminations of new surface course, the asphalt concrete shall be feathered into the existing surface over such a distance as may be required to produce a smooth riding transition. Base course and single course construction shall be joined by vertical butt joints finished and rolled to a smooth surface.
- H. Asphaltic concrete shall not be placed when frozen materials are present in the base or sub-base.
- I. Asphaltic concrete shall not be placed during adverse conditions, i.e., rain or when a roadway surface is wet.
- J. Asphaltic concrete shall be placed between April 15 and October 15. Asphalt concrete shall not be placed after October 15 and before April 15 of the following year unless roadway surface temperatures are 40° F and rising in the shade. Approval to place the asphalt concrete after October 15 and before April 15 of the following year requires written approval from OWNER.
- K. Roadways not completed prior to October 15, and not meeting the requirements of this section, shall be repaired by placing a temporary 2-inch-thick asphalt (or other ENGINEER approved surface) course over all exposed, earthen surfaces. These temporary surfaces shall be completely removed and repaired in accordance with these specifications at no additional expense to OWNER.
- L. Asphalt rolling shall be in accordance with Section 32 12 16.13 of the APWA specifications. CONTRACTOR shall establish and document a rolling pattern for obtaining densities. The test strip shall be no shorter than 300 feet. Establishment of rolling patterns are for the purpose of establishing minimum rolling patterns and shall not release CONTRACTOR of meeting all requirements of these specifications and drawings.
- M. The target density for asphalt placement shall be 94 percent of laboratory density plus or minus two (2) percent. If an individual test result falls below 92 percent of maximum density, the material represented by that test will be considered defective and shall be removed and replaced by CONTRACTOR at no additional cost to OWNER.
- N. The minimum acceptable thickness of asphalt for completed roadways shall be 2 inches, as verified by core samples. Areas found to contain less than the minimum thickness shall be removed and replaced at no additional expense to OWNER.

- O. The completed finish shall be as specified in Section 32 12 16.13 of the APWA specifications.
- P. CONTRACTOR shall adjust the height of all street fixtures to match final grade. If required, concrete collars shall be placed around all surface street fixtures (i.e. manholes, valve boxes, monuments, etc.).
- Q. CONTRACTOR shall complete all concrete collars within 2 weeks of completion of paving each roadway section.
- R. CONTRACTOR shall restripe streets, as required, in accordance with Section 32 17 23 - Pavement Markings of the APWA specifications.

3.5 REPAIR

- A. Remove bumps and depressions exceeding 1/4 inch vertical deviation in 10 feet.
- B. Repair options include mill and inlay or grinding. Feather edges on bituminous concrete repairs are not allowed. Apply a cationic or anionic tack emulsion to make miller surfaces water resistant.

3.6 SITE SAFETY AND TRAFFIC CONTROL

- A. Site safety and traffic control shall be the responsibility of CONTRACTOR.
- B. CONTRACTOR shall verify full compliance with all applicable local, county, state and/or federal regulations.

- END OF SECTION -

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SECTION 32 31 15
PVC COATED CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SUMMARY

- A. This section covers the furnishing of labor, materials, and appurtenances necessary for installation of the PVC coated chain link fence system defined herein. The manufacturer shall provide a total fence system including all components, panels, posts, gates, and hardware required.

1.2 RELATED WORK

- A. Related Work specified in other Sections includes, but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 03 30 00 Cast-in-Place Concrete

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this Specifications to the extent referenced. The publications are referred to in the text to by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM A 780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
 - 2. ASTM F 552 Standard Terminology Relating to Chain Link Fencing
 - 3. ASTM F 567 Standard Practice for Installation of Chain Link Fence
 - 4. ASTM F 626 Standard Specification for Fence Fittings
 - 5. ASTM F 668 Standard Specification for Polyvinyl (PVC), Polyolefin and Other Polymer-Coated Steel Chain Link Fence Fabric
 - 6. ASTM F 900 Standard Specification for Industrial and Commercial Swing Gates
 - 7. ASTM F 934 Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials
 - 8. ASTM F1083 Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
 - 9. ASTM F1664 Standard Specification for Poly (Vinyl Chloride) (PVC) and Other Conforming Organic Polymer-Coated Steel Tension Wire Used with Chain-Link Fence
 - 10. ASTM F1665 Standard Specification for Poly (Vinyl Chloride) (PVC) and Other Conforming Organic Polymer-Coated Steel Barbed Wire Used with Chain-Link Fence

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Shop drawings: Site plan showing layout of fence location with dimensions, location of gates and opening size, cleared area, elevation of fence, gates, footings, and details of attachments.

- C. Certifications: Manufacturers material certifications in compliance with the current ASTM specifications.
- D. Domestic certifications: Material certifications, made in U.S.A., Buy American Act or Buy America when required.
- E. Material samples: When required, provide representative samples of chain link fabric, framework, and fittings.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism, and theft.

1.6 QUALITY ASSURANCE

- A. Manufacturer: Company headquartered in the United States having U.S. manufacturing facility/facilities specializing in manufacturing chain link fence products with at least 5 years' experience.
- B. Fence contractor: Company with demonstrated successful experience installing similar projects and products in accordance with ASTM F567 and have at least 5 years' experience.
- C. Tolerances: Current published edition of ASTM specifications tolerances apply. ASTM specification tolerances supersede any conflicting tolerance.

1.7 WARRANTY

- A. All structural fence components (i.e., rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. The warranty shall cover any defects in the material finish, including cracking, peeling, chipping, blistering, or corroding.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Wheatland Tube Co.,
- B. Master Halco, Inc.,
- C. Southwestern Wire, Inc.,
- D. Or approved equal

2.2 GENERAL

- A. Dimensions indicated herein for roll-formed pipe and H-sections are outside dimensions, excluding coatings.

- B. Fence fabric height shall be 6 feet unless otherwise indicated.
- C. Fencing materials shall be galvanized and PVC coated after fabrication.
- D. The color of the fencing fabric, poles, and fittings shall be **black**.

2.3 STEEL FABRIC

- A. Fence fabric shall be 9-gauge steel wire, 2-inch mesh, with top selvages knuckled and bottom selvages twisted and barbed.
- B. Fabric shall be hot-dip galvanized and PVC coated according to ASTM F668, Class 2a or Class 2b. The weight of the zinc shall meet the requirements of STM F 668, Table 4.

2.4 FRAMING AND ACCESSORIES

- A. **Round steel pipe and rail:** Schedule 40 standard weight pipe, in accordance with ASTM F1083, 1.8 oz/ ft² hot dip galvanized zinc exterior and 1.8 oz/ft² hot dip galvanized zinc interior coating. Intermediate Strength Grade: Minimum yield strength 50,000 psi.
 - 1. Line post shall be 2-3/8" outside diameter, 1.8 oz/ft² zinc coating.
 - 2. End, Corner, Pull post 2-7/8" outside diameter, 1.8 oz/ft² zinc coating.
 - 3. Top, brace, bottom, and intermediate rails, 1.660" outside diameter, 1.8 oz/ft² zinc coating.
- B. **Polymer Coated Pipe:** Polymer coated pipe shall have a PVC coating fused and adhered to the exterior zinc coating of the galvanized pipe in accordance with ASTM F1043. The minimum thickness of the PVC coating shall be 10-mils (0.254 mm). The color shall match fabric **black** per ASTM F934.
- C. **Tension Wire:** Tension wire shall be located at the bottom of the fabric and shall consist of 7-gauge wire complying with ASTM F 1664. Wire gauge specified is the core wire gauge. The color shall match the coating of the chain link fabric and shall be Class 2a or Class 2b. Tension wire shall be interlaced with the fabric or attached to the fabric with wire ties at a spacing of no more than 18 inches apart.
- D. **Barbed Wire Support Arms:** Support arms shall be manufacturer's standard fabrication with finish to match fence framework. Support arms shall be single 45-degree arm type and shall be capable of withstanding 250 pounds of downward pull.
- E. **Barbed Wire:** Polymer coated steel barbed wire shall comply with ASTM F 1665, double 14 gauge twisted strand wire, with 4-point 14-gauge round barbs spaced 5 inches on center. Match coating of the chain link fabric.
- F. **Tension and Brace Bands:** Galvanized pressed steel complying with ASTM F626, minimum steel thickness of 12 gauge (0.105 in.), minimum width of 3/4 inch and minimum zinc coating of 1.20 oz/ft². Secure bands with 5/16-inch galvanized steel carriage bolts.
- G. **Terminal Post Caps, Line Post Loop Tops, Rail and Brace Ends, Boulevard Clamps, Rail Sleeves:** In compliance to ASTM F626, pressed steel galvanized after fabrication having a minimum zinc coating of 1.20 oz/ft².

- H. **Truss Rod Assembly:** In compliance with ASTM F626, 3/8-inch diameter steel truss rod with a pressed steel tightener, minimum zinc coating of 1.2 oz/ft², assembly capable of withstanding a tension of 2,000 lbs.
- I. **Tension Bars:** Tension bars shall be in accordance with ASTM F626 and shall be galvanized steel one-piece length 2-inch less than the fabric height. Minimum zinc coating 1.2 oz. /ft². Bars for 2-inch mesh shall have a minimum cross section of 3/16 inch by 3/4-inch.
- J. **Polymer Coated Color Fittings:** In compliance with ASTM F626, PVC coating minimum thickness 0.006-inch fused and adhered to the zinc coated fittings. Match color to fence system.
- K. **Tie Wire and Hog Rings:** Galvanized minimum zinc coating 1.20 oz/ft², 9-gauge (0.148-inch) steel wire in compliance with ASTM F626. Tie wire and hog rings shall be polymer coated and match the color of the fence system.

2.5 SWING GATES

- A. **Swing Gates:** Galvanized steel pipe welded fabrication in compliance with ASTM F900. Gate frame members 1.9-inch outside diameter, ASTM F 1083 schedule 40 galvanized steel pipe. Frame members spaced no greater than 8 feet apart vertically and horizontally. Welded joints protected by applying zinc-rich paint in accordance with ASTM Practice A 780. Positive locking gate latch, pressed steel galvanized after fabrication. Galvanized malleable iron or heavy gauge pressed steel post and frame hinges. Provide lockable drop bar and gate holdbacks with double gates. Match gate fabric to that of the fence system. Gateposts per ASTM F1083 schedule 40 galvanized steel pipe. The gatepost diameter from table 2.5.B. Gate frames and gate posts shall be PVC coated and match the color of the fence system.
- B. Gateposts: Schedule 40 pipe in compliance with ASTM F1083.

Gate fabric height up to and including 6 ft.		
Gate leaf width	Post Outside Diameter	Weight
up to 4 ft.	2.375 in.	3.65 lb/ft
over 4 ft. to 10 ft.	2.875 in.	5.79 lb/ft
over 10 ft. to 18 ft.	4.000 in.	9.11 lb/ft
Gate fabric height over 6 ft. to 12 ft.		
Gate leaf width		
up to 6 ft.	2.875 in.	5.79 lb/ft
over 6 ft. to 12 ft.	4.000 in.	9.11 lb/ft
over 12 ft. to 18 ft.	6.625 in.	18.97 lb/ft
over 18 ft. to 24 ft.	8.625 in.	28.58 lb/ft

2.6 CONCRETE

- A. Concrete for post footings shall have a 28-day compressive strength of 2,500 psi in accordance with Section 03 30 00 – Cast-in-Place Concrete.

PART 3 EXECUTION

3.1 FRAMEWORK INSTALLATION

- A. Posts: Posts shall be set plumb in concrete footings in accordance with ASTM F567. Minimum footing depth, 24 inch plus an additional 3-inch depth for each 1-foot increase in the fence height over 4 feet or as indicated on the Contract Drawings whichever is greater. The minimum footing diameter shall be four times the largest cross section of the post up to a 4.00-inch dimension and three times the largest cross section of post greater than a 4.00-inch dimension or as indicated on the contract drawings, whichever is greater. Top of concrete footing to be at grade and crowned to shed water away from the post. Line posts installed at intervals not exceeding 10 feet on center.
- B. Top rail: When specified, install 21-foot lengths of rail continuous thru the line post or barb arm loop top. Splice rail using top rail sleeves minimum 6 inches long. Rail shall be secured to the terminal post by a brace band and rail end. Bottom rail or intermediate rail shall be field cut and secured to the line posts using boulevard clamps or brace band with rail end. Fences 12 feet high or higher require mid rail.
- C. Terminal posts: End, corner, pull and gate posts shall be braced and trussed for fence 6 ft. and higher and for fences 5 ft. in height not having a top rail. The horizontal brace rail and diagonal truss rod shall be installed in accordance with ASTM F567.
- D. Tension wire: Shall be installed 4 inches up from the bottom of the fabric. Fences without top rail shall have a tension wire installed 4 inches down from the top of the fabric. Tension wire to be stretched taut, independently and prior to the fabric, between the terminal posts and secured to the terminal post using a brace band. Secure the tension wire to each line post with a tie wire. Install the top tension wire through the barb arm loop for fences having barbed wire and no top rail.

3.2 CHAIN LINK FABRIC INSTALLATION

- A. Chain Link Fabric: Install fabric to outside of the framework. Attach fabric to the terminal post by threading the tension bar through the fabric; secure the tension bar to the terminal post with tension bands and 5/16-inch carriage bolts spaced no greater than 12 inches on center. Chain link fabric shall be stretched taut free of sag. Fabric to be secured to the line post with tie wires spaced no greater than 12 inches on center and to horizontal rail spaced no greater than 18 inches on center. Secure fabric to the tension wire with hog rings spaced no greater than 18 inches on center.
 - 1. Tie wire shall be wrapped 360 degrees around the post or rail and the two ends twisted together three full turns. Excess wire shall be cut off and bent over to prevent injury. The installed fabric shall have a ground clearance on no more than 2 inches.

3.3 BARBED WIRE INSTALLATION

- A. Barbed Wire: Stretched taut between terminal posts and secured in the slots provided on the line post barb arms. Attach each strand of barbed wire to the terminal post using a brace band.

3.4 GATE INSTALLATION

- A. Swing Gates: Installation of swing gates and gateposts in compliance with ASTM F 567. Direction of swing shall be inward. Gates shall be plumb in the closed position having a bottom clearance of 3-inch, grade permitting. Hinge and latch offset opening space shall be no greater than 3 inches in the closed position. Double gate drop bar receivers shall be set in a concrete footing minimum 6-inch diameter 24 inch deep. Gate leaf holdbacks shall be installed for all double gates.

3.5 GROUNDING

- A. Fences crossed by powerlines of 600 volts or more shall be grounded at or near the point of crossing and at distances not exceeding 150-feet on each side of the crossing.
- B. Ground conductor shall consist of No. 8 AWG solid copper wire. Grounding electrodes shall be 3/4-inch by 10-foot-long copper-clad steel rod. Electrodes shall be driven into the earth so that the top of the electrode is at least 6 inches below grade. Where driving is impractical, electrodes shall be buried a minimum of 12-inches deep and radially from the fence. Top of electrode shall be not less than 2 feet or more than 8 feet from the fence.
- C. Ground conductor shall be clamped to the fence and electrodes with bronze grounding clamps so as to create electrical continuity between the fence posts, fence fabric, and ground rods. After installation, the total resistance of fence to ground shall not be less than 25 ohms. PVC coated shall be ground down prior to installing clamps. Repair coating around clamp per the manufacturer's recommendations.
- D. Fence grounding is not the responsibility of the fence installer or manufacturer. A licensed electrical contractor shall install grounding when required.

3.6 CLEAN UP

- A. Clean Up: The area of the fence line shall be left neat and free of any debris caused by the installation of the fence.

- END OF SECTION -

SECTION 32 84 23
UNDERGROUND SPRINKLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install planting irrigation system as described in Contract Documents complete with accessories necessary for proper function.

- B. Related Requirements:
 - 1. Section 31 22 16: Fine Grading.
 - 2. Section 32 90 01: Common Planting Requirements.
 - a. Pre-installation conference held jointly with other common planting related sections.
 - 3. Section 32 91 13: Finish Grading and Topsoil Preparation.
 - 4. Section 32 91 20: Topsoil Placement and Grading.
 - 5. Section 32 93 00: Plants.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conference:
 - 1. Participate in mandatory pre-installation conference:
 - a. Irrigation Subcontractor's Representative and Foreman responsible for installation of irrigation system required to be in attendance.
 - b. Schedule pre-installation conference before irrigation system installation begins.
 - c. Review required test and inspections and requirements.

- B. Sequencing:
 - 1. Install sleeves before installation of cast-in-place concrete site elements and paving.

1.3 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Manufacturer's cut sheets for each element of system.
 - b. Parts list for operating elements of system.

- B. Manufacturer Instructions:
 - 1. Manufacturer's printed literature on operation and maintenance of operating elements of system.
 - 2. Instruction Manual:
 - a. Includes complete directions for system operation and maintenance, including winterizing, controller program worksheet and annual service and scheduling calendar based on local site specific conditions.

- C. Qualification Submittals:
 - 1. Irrigation Subcontractor:
 - a. Minimum five (5) years experience in irrigation sprinkler installations.

- b. Minimum five (5) satisfactorily completed irrigation sprinkler installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
 - c. Produce certifiable list of reputable landscape suppliers from whom it will be purchasing materials to be used on this project.
 - d. Produce evidence that it employs quality employees with specified experience and in a quantity sufficient to perform work of this Section within time limits established by Contractor.
 - e. Produce evidence that all employees have legal documents to be working in the United States and that documents have been verified legitimate by the owner.
 - f. Agree to complete reporting documents, including:
 - 1. Assist Landscape Architect in completing the Watering Schedule.
2. Irrigation Installer:
- a. Irrigation sprinklers shall be performed under direction of foreman or supervisor with minimum three (3) years experience in irrigation sprinkler installations similar in size, scope, and complexity.
 - b. Foreman or supervisor required to attend pre-installation conference.
 - c. Use trained personnel familiar with required irrigation sprinkler procedures and with Contract Documents.
- D. Closeout Submittals:
- 1. Record Drawings:
 - a. As installation occurs, prepare accurate record drawing to be submitted before final inspection, including:
 - 1. Detail and dimension changes made during construction.
 - 2. Significant details and dimensions not shown in original Contract Documents.
 - 3. Field dimensioned locations of valve boxes, manual drains, quick-coupler valves, control wire runs not in mainline ditch, and both ends of sleeves.
 - 4. Take dimensions from permanent constructed surfaces or edges located at or above finish grade.
 - 5. Take and record dimensions at time of installation.
 - b. Print copy of record drawing to *11 x 17 inches*, color key circuits, and laminate both sides with 5 mil thick or heavier plastic. Drill two *1/2 inch* holes at top of board and hang on hooks in Custodial Room. Provide 2 additional, non-mounted, full size copies: 1-nonlaminated and 1-laminated.
 - 2. Operations And Maintenance Manual Data:
 - a. Include in the Maintenance Manual the following information:
 - 1. Instruction manual that contains complete directions for system operation and maintenance, including winterizing, controller program worksheet and annual service and scheduling calendar based on local site specific conditions.
 - 2. Manufacturer's cut sheets for each element of system.
 - 3. Parts lists for operating elements of system.
 - 4. Manufacturer's printed literature on operation and maintenance of operating elements of system.
 - 3. Warranty Documentation:
 - a. Manufacturer's warranty information for each operating elements of system.
 - 4. Final payment for system will not be authorized until Closeout Submittals are received and accepted by Architect and landscape consultant.
- E. Maintenance Material Submittals:
- 1. Extra Components to Owner:
 - a. Contractor to provide the following materials prior to the final inspection:

1. 1 bag for each size of bubbles specified on plans.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Work and materials shall be in accordance with latest rules and regulations, and other applicable state or local laws.
 2. Nothing in Contract Documents is to be construed to permit work not conforming to these codes.
- B. Qualifications: Requirements of Section 01 4301 applies, but not limited to the following:
 1. Installer Qualifications:
 - a. General:
 1. Perform installation under direction of foreman or supervisor with five (5) years minimum experience in sprinkling system installations.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. During delivery, installation, and storage, protect materials from damage and prolonged exposure to sunlight.

1.6 WARRANTY

- A. Standard one year guarantee stipulated in General Conditions shall include replacement of defective parts and workmanship. Guarantee shall also include the following:
 1. Repairing or replacing defective materials or workmanship.
 2. Filling and repairing depressions and replacing plantings due to settlement of irrigation system trenches.
 3. Adjusting system to supply proper coverage of areas to receive water.
 4. Ensuring system can be adequately drained.

PART 2 - PRODUCTS

2.1 SYSTEM

- A. Manufacturers:
 1. Manufacturer Contact List (for reference only):
 - a. Action Machining Inc, Bountiful, UT www.actionfilters.com.
 - b. Apollo Valves by Conbraco Industries, Matthews, NC www.apollovalves.com
 - c. 3M, Austin, TX www.3m.com/elpd.
 - d. King Innovation, St Charles, MO www.kinginovation.com.
 - e. IPS Corporation, Compton, CA www.ipscorp.com.
 - f. Netafim, Inc. www.netafimusa.com.
 - g. Northstar Industries, LLC, Methuen MA www.northstarind.com.
 - h. Paige Electric, Union, NJ www.paigewire.com.
 - i. Hunter Industries, San Marcos, CA www.hunterindustries.com
 - j. Rain Bird Sprinkler Manufacturing Corp, Glendora, CA www.rainbird.com
 - k. T. Christy Enterprises, Inc. (Christy's), Anaheim, CA www.tchristy.com.
 - l. Wilkins Backflow Prevention, Milwaukee, WI, Zurn.com

m. 3M, Austin, TX www.3m.com/elpd

B. Materials:

1. Pea Gravel:
 - a. For use around drains, valves, and quick couplers.
 - b. *1/2 inch* maximum dimension, washed rock.
2. Sand:
 - a. For use of backfill around PVC lateral pipe.
 - b. Fine granular material naturally produced by rock disintegration and free from organic material, mica, loam, clay, and other deleterious substances.
3. Native Material: Soil native to project site free of wood and other deleterious materials and rocks over *1 inch*.
4. Topsoil: Approved conditioned, stockpiled material without rocks, roots, sticks, clods, debris, and other foreign matter over *1 inch* longest dimension.
5. Pipe, Pipe Fittings, And Connections:
 - a. Pipe shall be continuously and permanently marked with Manufacturer's name, size, schedule, type, and working pressure.
 - b. Pipe sizes shown on Drawings are minimum. Larger sizes may be substituted if at no additional cost to Owner.
 - c. Pipe:
 1. Pressure Lines: Refer to irrigation schedule.
 2. Lateral Lines: Refer to irrigation schedule.
 3. Quick Coupler Piping: Refer to Irrigation Details.
 - d. Fittings: Lateral Line - Same material as pipe, except where detailed otherwise.
 - e. Sleeves:
 1. Under Parking Area And Driveway Paving: Schedule 40 PVC Pipe.
 2. All Other: Class 200 PVC Pipe.
 3. Sleeve diameter shall be two times larger than pipe installed in sleeve.
6. Automatic Irrigation Control Wiring:
 - a. Control Wiring:
 1. Traditional control wire shall be UF-UL listed, color coded PE insulated copper conductor direct burial size 14. For wire runs exceeding 3,300 feet (1 005.84 meter), use 12 AWG wire. Do not use green color coded wire.
 2. Waterproof Wire Connectors:
 - a) Control wire connections shall consist of properly-sized wire nut inserted in waterproof grease cap:
 - b) Type Two Acceptable Products:
 - (1) DBY or DBR by 3M.
 - (2) 'One Step' 20111SP by King Innovation.
 - (3) Equal as approved by Architect before installation. See Section 01 6200.
7. Drip System:
 - a. Drip Valve Assembly
 1. Refer to Irrigation Schedule.
 - b. Distribution Tubing:
 1. Refer to Irrigation Schedule and Details.
 - c. Drip Emitters
 1. Refer to Irrigation Schedule and Details.
 - d. Valve Boxes and lids:
 1. Colors:
 - a) Green: Lawn areas.
 - b) Brown: Bare soil and shrub beds.

2. Type Two Acceptable Products:
 - a) Carson Industries *12 Inch* Standard Series: Model 1419-12, Model 1419-18 – Refer to Details.
 - b) Equal as approved by Architect before use. See Section 016200.
8. Solvent Cement:
 - a. Primer:
 1. Meet ASTM F656 standard and applicable sections of latest edition of 'Uniform Plumbing Code'.
 2. Meet NSF/ANSI standard for use on potable water applications.
 3. Low VOC emissions and compliant with LEED.
 4. Product: Weld-On P-70 primer by IPS.
 - b. PVC Solvent Cement:
 1. Heavy bodied, medium setting, high strength:
 - a) Meet ASTM D2564 standard and applicable sections of latest edition of 'Uniform Plumbing Code'.
 - b) Meet NSF/ANSI standard for use on potable water applications.
 - c) Meet CSA standards for use in pressure and non-pressure potable water applications.
 - d) Low VOC emissions and compliant with LEED.
 - e) Product: Weld-On 711 Low VOC PVC Cement by IPS.
9. Other Components:
 - a. Recommended by Manufacturer and subject to Architect's review and acceptance before installation.
 - b. Provide components necessary to complete system and make operational.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Site Verification of Conditions: Perform pressure test at stub-out on main water line provided for irrigation system, or at near-by fire hydrant. Notify Architect if pressures over *70 psi* or under *55 psi* are found to determine if some re-design of system is necessary before beginning work on system.

3.2 PREPARATION

- A. Protection:
 1. Protection Of In-Place Conditions:
 - a. Repair or replace work damaged during course of the Work at no additional cost to Owner. If damaged work is new, installer of original work shall perform repair or replacement.
 - b. Do not cut existing tree roots measuring over 2 inches (50 mm) in diameter in order to install irrigation lines.
- B. Layout of Irrigation:
 1. Location of piping shown on Drawings is approximate. Actual placement may vary slightly.
 2. During layout, consult with Architect to verify proper placement and make recommendations, where revisions are advisable.
 3. Minor adjustments in system layout will be permitted to avoid existing fixed obstructions.
 4. Make certain changes from Contract Documents are shown on record drawings.

- C. Surface Preparation:
 - 1. Layout of Irrigation Components:
 - a. Location of emitters and piping shown on Drawings is approximate. Actual placement may vary slightly as is required to achieve full, even coverage.
 - b. During layout, consult with Architect to verify proper placement and make recommendations, where revisions are advisable.
 - c. Minor adjustments in system layout will be permitted to avoid existing fixed obstructions.
 - d. Make certain changes from Contract Documents are shown on record drawings.

3.3 INSTALLATION

- A. Trenching and Backfilling:
 - 1. Pulling of pipe is not permitted.
 - 2. Excavate trenches to specified depth. Remove rocks larger than *1 inch* in any direction from bottom of trench. Separate out rocks larger than *1 inch* in any direction uncovered in trenching operation from excavated material and remove from areas to receive landscaping.
 - 3. Cover pipe both top and sides with *2 inches* of sand as specified under PART 2 PRODUCTS. Top 12 inches of backfill in shrub beds shall be topsoil as specified in Section 32 91 13.
 - 4. Do not cover irrigation pipe, or fittings until Architect has inspected and approved system.
 - 5. Contractor to ensure that all pipe is properly bedded and all trenches are properly compacted. Contractor will be responsible for completely repairing settled trenches.
- B. Sleeving and Conduits:
 - 1. Sleeve water lines and control wires under walks and paving. Extend sleeves *6 inches* minimum beyond walk or pavement edge. Cover sleeve ends until pipes and wires are installed to keep sleeve clean and free of dirt and debris.
 - 2. Use one water pipe maximum per sleeve. Sleeve control wiring in separate sleeve.
 - 3. Position sleeves with respect to buildings and other obstructions so pipe can be easily removed.
 - 4. Glue all sleeve and conduit joints to keep water out.
- C. Grades And Draining:
 - 1. Grade piping so system can be completely drained or blown out with compressed air.
- D. Installation of Pipe:
 - 1. Install pipe in manner to provide for expansion and contraction as recommended by Manufacturer.
 - 2. Install pipe and wires under driveways or parking areas in specified sleeves *18 inches* below finish grade or as shown on Drawings.
 - 3. Cut plastic pipe square. Remove burrs at cut ends before installation so unobstructed flow will result.
 - 4. Make solvent weld joints as follows:
 - a. Do not make solvent weld joints if ambient temperature is below *35 deg F*.
 - b. Clean mating pipe and fitting with clean, dry cloth and apply one coat of P-70 primer to each.
 - c. Apply uniform coat of 711 solvent to outside of pipe.
 - d. Apply solvent to fitting in similar manner.
 - e. Give pipe or fitting a quarter turn to insure even distribution of solvent and make sure pipe is inserted to full depth of fitting socket.
 - f. Allow joints to set at least 24 hours before applying pressure to PVC pipe.

5. Tape threaded connections with teflon tape.
- E. Control Valves and Controller
1. Wiring:
 - a. Use waterproof wire connectors consisting of properly sized wire nut and grease cap at splices and locate all splices within valve boxes.
 - b. Use white or gray color for common wire and other colors for all other wire. Each common wire may serve only one controller.
 2. Install control wires in accordance with Manufacturer's recommendations and according to electrical code.
 3. Extend extra control wires 24 inches and leave coiled in each valve box
- F. Drip Assembly (refer to irrigation details):
1. Install pipe providing for expansion and contraction as recommended by Manufacturer.
 2. Cut tubing square and remove burrs at cut ends.
 3. Locate drip emitter on uphill side of plant within rootball zone. Where significant slope does not occur, locate emitter on backside or building side of plant.
 4. Spaghetti tubing shall be no longer than 48 inches long. Layout distribution lines as necessary to keep Spaghetti tubing lengths within specified tolerances
 5. Set emitter to be visible to maintenance personnel.
 6. Layout in-line tubing for trees as indicated on Drawings.
 7. Locate distribution tubing on top of soil but under filter fabric and bark or rock mulch.
 8. Staple in-line tubing to ground at *6 foot* maximum intervals and within *12 inches* of ends and intersections.
 9. Assembly Using 'Funny Pipe' Type Joints (refer to details).
 - a. Connect distribution tubing to lateral line using barbed ell fitting.
 - b. Connect fitting to distribution tubing using straight barbed fitting with *1/2 inch* threaded end.
- G. Backflow Preventer (refer to Irrigation Drawings, Details, and Specifications).
- H. Before installation of drip emitters, open control valves and use full head of water to flush out system.
- I. Arrange valve stations to operate in an easy-to-view progressive sequence around building. Tag valves with waterproof labels showing final sequence station assignments.
- J. Note any changes on as-builts.

3.4 FIELD QUALITY CONTROL

- A. Field Tests and Inspections:
1. Controller Testing:
 1. Verify controller is working properly.
 2. Provide controller report with all information programmed into the controller
 2. Pre-substantial Inspection:
 - a. Landscape Architect will review irrigation system before substantial completion.
 3. Substantial Completion Walkthrough:
 - a. Landscape Architect will inspect site and create list of non-conforming items to be resolved prior to Irrigation Final Acceptance. Date on this list will act as date of Landscape Substantial Completion.

- b. Installations completed after water source has been turned off for season, as determined by Landscape Architect, will be inspected following spring after system can be checked for proper operation.
 - 4. Irrigation Final Inspection:
 - a. Irrigation Final Acceptance will be awarded when all non-conforming work is brought into conformance.
- B. Non-Conforming Work: Non-conforming work as covered in the General Conditions applies, but is not limited to the following:
 - 1. Underground Sprinkler System:
 - 2. Correct any work found defective or not complying with Contract Document requirements at no additional cost to the Owner.

3.5 ADJUSTING

- A. Watering Time:
 - 1. Adjust watering time of valves to provide proper amounts of water to plants.

3.6 CLOSEOUT ACTIVITIES

- A. Instruction of Owner:
 - 1. After system is installed and approved, instruct Owner's designated personnel in complete operation and maintenance procedures.
 - a. Describe difference between plant establishment schedule and long term maintenance schedule.
 - b. Describe annual and regular filter maintenance.

END OF SECTION

**SECTION 32 90 01
COMMON PLANTING REQUIREMENTS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Common procedures and requirements for landscaping work.
- B. Related Sections:
 - 1. Section 32 84 23: Underground Sprinklers.
 - 2. Section 32 01 01: Plant Maintenance
 - 3. Section 32 93 00: Plants

1.2 SUBMITTALS

- A. Quality Assurance / Control:
 - 1. Pre-Bid Submission: Verification of plant quantities and report of discrepancies. Include with submission an itemized list of materials with quantities and units of measure of rock mulch, fertilizers, plants, herbicide, topsoil, and other landscaping materials anticipated to complete work of this Section. Purpose of submittal is to verify accuracy and consistency of interpretation of Contract Documents by each bidder.
 - 2. Pre-Bid Submission: Landscape Company's certification of specified qualifications.
 - 3. Within 30 days of contract award, provide written guaranty from plant supplier that shrubs specified will be reserved and held for this project. Include location where materials will be held.
- B. Closeout: At completion of landscape work, submit two copies of typewritten instructions recommending procedures to be established by Owner for maintenance of landscape work for one full year after contract maintenance period ends.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Landscaping Company:
 - a. Landscaping Company shall be required to produce certification of following requirements minimum 10 days bid opening:
 - 1) Have been in business for period of minimum five years while providing quality of labor and materials specified in this section.
 - 2) Provide evidence of having completed minimum ten projects of scope and quality as this project in a timely manner.

- 3) Produce certifiable list of reputable landscape suppliers from whom it will be purchasing materials to be used on this project.
 - 4) Produce evidence that it employs quality employees with specified experience and in a quantity sufficient to perform work of this Section within time limits established by Contractor.
 - 5) Produce evidence that all employees have legal documents to be working in the United States and that documents have been verified legitimate by the owner.
2. Workers:
 - a. Trained personnel familiar with required planting procedures and Contract Documents shall perform planting.
 - b. Planting shall be performed under direction of foreman or supervisor with minimum five years experience in landscape installations.
- B. Pre-Installation Conferences:
1. Participate in pre-installation conference.
 2. Schedule planting pre-installation conference after completion of Fine Grading specified in Section 31 22 16, but before beginning landscape work. In addition:
 - a. Establish responsibility for maintenance of new landscaping during all phases of construction period.
 - b. Prepare two typical landscape planting excavations and conduct percolation test to verify that water drains away within one hour. Discuss results of percolation tests with Architect and Owner's representative.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver packaged materials in containers showing weight, analysis, and name of Manufacturer. Protect materials from deterioration during delivery and while stored at site.
- B. Deliver trees, plants and shrubs in healthy and vigorous condition and store in location on site where they will not be endangered and where they can be adequately watered and kept in healthy and vigorous condition.

1.5 SEQUENCING

- A. Do not plant trees and shrubs until major construction operations are completed. Do not commence landscaping work until work of Sections 31 22 16 and 32 84 23 has been completed and approved.
- B. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Inspect site and Contract Documents to become thoroughly acquainted with locations of irrigation, ground lighting, and utilities. Repair damage to these and other items adjacent to landscaping caused by work of this Section or replace at no additional cost to Owner.

3.2 PREPARATION

- A. Before proceeding with work, verify dimensions and quantities. Report variations between Drawings and site to Architect before proceeding with landscape work.
 - 1. Plant totals are for convenience of Contractor only and are not guaranteed. Verify amounts shown on Drawings.
 - 2. All planting indicated on Drawings is required unless indicated otherwise.
- B. Protection:
 - 1. Take care in performing landscaping work to avoid conditions that will create hazards. Post signs or barriers as required.
 - 2. Provide adequate means for protection from damage through excessive erosion, flooding, heavy rains, etc. Repair or replace damaged areas.
 - 3. Keep site well drained and landscape excavations dry.

3.3 INSTALLATION

- A. Hand excavate as required.
- B. Maintain grade stakes until parties concerned mutually agree upon removal.
- C. When conditions detrimental to plant growth are encountered, such as rubble fill or adverse drainage conditions, notify Architect before planting.
- D. Interface With Other Work: Do not plant shrubs until major construction operations are completed. Do not commence landscaping work until work of Sections 31 22 16 and 32 84 23 has been completed and approved.
- E. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

3.4 FIELD QUALITY CONTROL

- A. Inspection:

- B.
 - 1. Do not place or plant trees or shrubs until after inspection by Architect to verify they are in healthy and vigorous condition. Notify Architect 48 hours minimum before placing or planting of plants and shrubs.
 - 2. Architect will inspect landscaping installation approximately two weeks before Substantial Completion. Replace landscaping that is dead or appears dead as directed by Architect within 10 days of notification and before Substantial Completion.

3.5 CLOSEOUT ACTIVITIES

- A. Replace damaged plantings at no additional cost to Owner.

3.6 CLEANING

- A. Immediately clean up soil or debris spilled onto pavement and dispose of deleterious materials.

3.7 PROTECTION

- A. Protect planted areas against traffic or other use immediately after planting is completed by placing adequate warning signs and barricades.
- B. Provide adequate protection of planted areas against trespassing, erosion, and damage of any kind. Remove this protection after Architect has accepted planted areas.

END OF SECTION

**SECTION 32 91 13
FINISH GRADING AND TOPSOIL PREPARATION**

PART 1 GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Perform finish grading and topsoil preparation work required to prepare site for installation of landscaping as described in Contract Documents.
2. Furnish and apply soil additives as described in Contract Documents.
3. Place conditioned, imported topsoil in shrub beds.

1.2 RELATED WORK

A. Related work specified in other sections:

1. Section 01 33 00 Submittal Procedures
2. Section 01 60 00 Product Requirements
3. Section 31 11 00 Clearing, Grubbing, and Stripping
4. Section 31 22 16 Fine Grading
5. Section 32 92 13 Upland Grass Seeding

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. American Society for Testing and Materials (ASTM)
1. ASTM D1557 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.'

1.4 SUBMITTALS

- A. Provide submittals and shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product Data: Product literature and chemical / nutrient analysis of soil amendments and fertilizers.

1.5 QUALITY ASSURANCE

- A. Pre-Installation Conference: Participate in pre-installation conference.

1.6 MEASUREMENT AND PAYMENT

- A. Finish grading and topsoil preparation shall not be measured or paid as a separate item but shall be included as part of the bid item to which it relates.

PART 2 PRODUCTS

2.1 MATERIALS

A. Topsoil

1. Incorporate following amendments, fertilizers into imported topsoil:
 - a. Acceptable fertilizers and application rates:
 - 1) Spread 30-10-0 fertilizer at label rate and 0-0-0-15 fertilizer at label rate.
 - 2) Equal as approved by Architect before installation. See Section 01 60 00.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not commence work of this Section until grading tolerances specified in Section 31 22 16 – Fine Grading is met.

3.2 PREPARATION

- A. Protection: Protect utilities and site elements from damage.

B. Surface Preparation:

1. Before placing topsoil, rip, disk, till, or aerate with approved agricultural aerator to min. depth of 6 inches.
2. Seven days maximum before beginning seeding and planting:
 - a. Loosen area 4 inches deep, dampen thoroughly, and cultivate to properly break up clods and lumps.
 - b. Rake area to remove clods, rocks, weeds, roots, and debris.
 - c. Grade and shape landscape area to bring surface to true uniform planes free from irregularities and to provide drainage and proper slope to catch basins.
3. Limit use of heavy equipment to areas no closer than 6 feet from building or other permanent structures. Use handheld tillers for preparation of subsoil in areas closer than 6 feet.

- C. Screen Imported Topsoil: Screen all imported topsoil to remove rock measuring 3/32". Contractor to ensure that topsoil contains no more than 2 percent by volume of rocks measuring over 3/32 inch in largest size.

3.3 PERFORMANCE

A. Site Tolerances:

1. Total Topsoil Depth:
 - a. Upland Grass Planting Areas: 3 inches minimum throughout entire seeded area.

- B. Do not expose or damage existing shrub or tree roots.

- C. Distribute approved imported topsoil stored on site in, as a result of work of Section 31 11 00 – Clearing, Grubbing, and Stripping. Remove organic material, rocks and clods greater than 1 inch in any dimension, and other objectionable materials.

- D. Slope grade away from buildings or structures for 12 feet minimum from walls at slope of 1/2 inch in 12 inches minimum unless otherwise noted. High point of finish grade at building foundation shall be 6 inches minimum below finish floor level. Direct surface drainage in manner indicated on Drawings by molding surface to facilitate natural run-off of water. Fill low spots and pockets with topsoil and grade to drain properly.
- E. After landscape areas have been prepared, take no heavy objects over them. Rake or scarify and cut or fill irregularities that develop as required until area is true and uniform, free from lumps, depressions, and irregularities.

- END OF SECTION -

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**SECTION 32 92 13
UPLAND GRASS SEEDING**

PART 1 GENERAL

1.1 SUMMARY

- A. Includes but not limited to:
 - 1. Furnish and install seeded grass as described in Contract Documents.
- B. Related Sections
 - 1. Section 32 92 13 Finish Grading and Topsoil Preparation.

1.2 QUALITY ASSURANCE

- A. Pre-Installation Meetings - Participate in pre-installation meetings specified in previous sections.
- B. Do not make substitutions. If acceptable seed landscape material is not obtainable, submit to Architect proof of non-availability and proposal for use of equivalent material. When authorized, adjustment of contract amount will be made.

1.3 SEQUENCING

- A. Do not commence work of this Section until work of Section 32 91 13 has been completed and approved.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Topsoil – Refer to Specification Section 32 91 13.
- B. Erosion Control Blanket
 - 1. Use Curlex I Erosion Control Blanket on all areas to be seeded.
- C. Seed
 - 1. Provide fresh, clean, new crop seed complying with tolerance for purity and germination established by Official Seed Analysis of North America. Provide proof of grass species, proportions and minimum percentages of purity, germination, and maximum percentage of weed seed. Seed blend shall consist of the following:

'Sodar' Sterambank Wheatgrass	20%
'Covar' Sheep Fescue	27.5%
'Pryor' Slender Wheatgrass	10%
'Nezpar' Indian Ricegrass	15%
'Canbar' Canby Bluegrass	10%
'Appar' Lewis Blue Flax	5%
'Lutana' Cicer Milkvetch	6%
Western Yarrow	0.5%
Rocky Mountain Penstemon	2%
'Californica' California Poppy	4%

2. Purchase seeds which bear this season's certification of weight, purity, and germination from a reputable seed company.

PART 3 EXECUTION

3.1 PREPARATION

- A. Protection
 1. Take care and prepare in work to avoid conditions which will create hazards. Post signs or barriers as required.
 2. Provide adequate means for protection from damage through excessive erosion, flooding, heavy rains, etc. Repair or replace damaged areas.
- B. Surface Preparation
 1. Seven days maximum prior to seeding -
 - a. Loosen area 4 inches deep, dampen thoroughly, and cultivate to properly break up clods and lumps.
 - b. Rake area to remove clods, rocks, weeds, roots, and debris.
 - c. Grade and shape area to receive seed to bring surface to true uniform planes free from irregularities and to provide drainage and proper slope to catch basins.
 - d. After areas have been prepared, take no heavy objects over them except lawn rollers.
 - e. Rake or scarify and cut or fill irregularities that develop as required until area is true and uniform, free from lumps, depressions, and irregularities.

3.2 INSTALLATION

- A. Site Tolerances - Final grade of soil after installing topsoil and hydro-seeding is complete shall be one inch below top of adjacent pavement of any kind.
- B. Install 3" depth of approved topsoil.
- C. One Step Hydro-Seeding – After topsoil is placed and areas are graded, hydro-seed with adequate equipment at time when little or no wind is blowing. Perform operation within the following dates: March 1 to June 1. Hydro-Seeding shall consist of preparing the seed mixture at a rate of 40 pounds per acre, fertilizer at a minimum rate of 50 pounds per acre, 'silva-fiber' at a rate of fourteen hundred pounds per acre of area. With water, agitate these components into a well-mixed slurry substance and spray the mixture, under pressure, onto the prepared area.
- D. After completion of One Step hydro-seeding place Curlex I erosion control blanket.
 1. Before installing Curlex I blankets, the seedbed shall be inspected by the Owner's Representative to ensure it has been properly compacted and fine graded to remove any existing rills. It shall be free of obstructions, such as tree roots, projections such as stones, and any other foreign objects. The contractor shall proceed when satisfactory conditions are present, After the area has been properly shaped, seeded, fertilized and compacted, remove the Curlex protective cover. Next, locate the start of the roll, making sure the roll is facing toward the area to be covered, and then roll out the product. The product shall

be rolled out flat, even, and smooth without stretching the material then anchored to the sub-grade.

2. Curlex I blanket to be installed vertically on the slope; however, on short slopes it may be more practical to install horizontally across the width of the application when agreed upon by the Engineer prior to installation. If more than one width is required, simply abut the edges of the vertically installed blankets together and secure them with a common row of staples. Overlapping adjacent sides of Curlex I blankets is not required when installed vertically on slopes. Curlex I blankets shall be trenched at the head of the slope if the blanket cannot be extended three feet over the slope crest or if overland flow is anticipated from upslope areas.

3.3 MAINTENANCE

- A. The contractor shall be responsible for the weeding of hydroseeded areas until accepted by the owner and Architect. The contractor shall be responsible for re-seeding, filling in low areas, repairing or replacing erosion control blanket, etc., as required.

3.4 FIELD QUALITY CONTROL

- A. Inspection
 1. Hydro-Seeded areas will be accepted at final inspection if -
 - a. Hydro-Seeded areas are properly established.
 - b. Hydro-Seeded areas are free of bare and dead spots and without weeds.

3.5 ADJUSTING

- A. Replace damaged areas at no additional cost to Owner.

3.6 CLEANING

- A. Immediately clean up any soil or debris spilled onto pavement and dispose of all deleterious materials.

3.7 PROTECTION

- A. Protect Hydro-seeded areas against traffic or other use immediately after seeding is completed by placing adequate warning signs and barricades.
- B. Provide adequate protection of hydro-seeded areas against trespassing, erosion, and damage of any kind. Remove this protection after seeded areas have been accepted by Architect.

END OF SECTION

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**SECTION 32 93 00
PLANTS**

GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install landscaping plants as described in Contract Documents.
- B. Related Sections:
 - 1. Section 32 90 01: Common Planting Requirements.

1.2 REFERENCES

- A. American Nursery & Landscape Association / American National Standards Institute:
 - 1. ANLA / ANSI Z60.1-2004, 'American Standard for Nursery Stock.'

1.3 SUBMITTALS

- A. Samples:
 - 1. Top dressing rock mulch for approval before delivery to site.
 - 2. Soil pep for approval before delivery to site.
 - 3. Certification that plant material is available in the required varieties, sizes and condition.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver healthy and vigorous shrubs.
 - 1. Do not prune before delivery, except as approved by Architect.
 - 2. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping and other handling and tying damage.
 - 3. Do not bend or bind-tie shrubs in such a manner as to destroy natural shape.
 - 4. Provide protective covering during delivery.
- B. Handle stock by root ball or container. Do not drop shrubs during delivery.
- C. Deliver shrubs and other plants after preparations for planting have been completed and install immediately.
 - 1. If planting is delayed more than six hours after delivery, set planting materials in shade and protect from weather and mechanical damage.
 - 2. Set balled stock on ground and cover ball with soil, saw dust, or other acceptable material approved by Architect. Do not place on pavement.
 - 3. Do not remove container-grown stock from containers before time of planting.
 - 4. Water root systems of shrubs stored on site with fine mist spray. Water as often as necessary to maintain root systems in moist condition.

1.5 SEQUENCING

- A. Do not commence work of this Section until work of Section 32 91 13 has been completed and approved.

1.6 WARRANTY

- A. Guarantee furnished shrubs and other plants to live and remain in strong, vigorous, and healthy condition for one year from date landscape installation is accepted as substantially complete.
- B. Warranty shall include:
 - 1. Removal of dead or damaged plant material immediately and the replacement of said dead or damaged plant material during acceptable planting periods as determined by Landscape Architect.
 - 2. Replacement of plant material that is more than 25 percent dead or in an unhealthy condition at the end of the warranty period
- C. Plant material that has been replaced during the warranty period shall be warranted an additional 1 year after replacement.

1.7 OWNER'S INSTRUCTIONS

- A. Provide written instructions covering maintenance requirements by Owner for the full guarantee period beyond Contract maintenance period specified in Section 32 01 01.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Plants:
 - 1. Conform to requirements of Plant List and Key on Drawings and to ANSI Z60.1.
 - 2. Nomenclature: Plant names used in Plant List conform to 'Standardized Plant Names' by American Joint Committee on Horticultural Nomenclature except in cases not covered. In these instances, follow custom of nursery trade. Plants shall bear a tag showing the genus, species, and variety of at least 10 percent of each species delivered to site.
 - 3. Quality:
 - a. Plants shall be sound, healthy, vigorous, free from plant disease, insect pests or their eggs, noxious weeds, and have healthy, normal root systems. Container stock shall be well established and free of excessive root-bound conditions.
 - b. Do not prune plants prior to delivery.
 - c. Plant materials shall be subject to approval by Architect as to size, health, quality, and character.
 - d. Provide plant materials from licensed nursery or grower.
 - 4. Measurements:

- a. Measure height and spread of specimen plant materials with branches in their normal position as indicated on Drawings or Plant List.
 - b. Measurement should be average of plant, not greatest diameter. For example, plant measuring 15 inches in widest direction and 9 inches in narrowest would be classified as 12 inch stock.
 - c. Plants properly trimmed and transplanted should measure same in every direction.
 - d. Where caliper or other dimensions of plant materials are omitted from Plant List, plant materials shall be normal stock for type listed.
 - e. Plant materials larger than those specified may be supplied, with prior written approval of Architect, and:
 - 1) If complying with Contract Document requirements in all other respects.
 - 2) If at no additional cost to Owner.
 - 3) If sizes of roots or balls are increased proportionately.
5. Shape and Form:
- a. Plant materials shall be symmetrical or typical for variety and species and conform to measurements specified in Plant List.
 - b. Well grown material will generally have height equal to or greater than spread. However, spread shall not be less than 2/3's of height.
- B. Planting Mix: Refer to details.
- C. Planting Tablets: 21 gram Agriform 20-10-5.
- D. Pre-Emergent Herbicide:
- 1. Category Four Approved Products.
 - a. Elanco XL.
 - b. Ronstar.
 - c. Surflan.
- E. Weed Barrier:
- 1. Acceptable Products:
 - a. DeWitt PRO-5 Weed Barrier.
 - b. Equal as approved by Architect before bidding.
- F. Rock Mulch:
- 1. Type Two Acceptable Products:
 - a. Refer to landscape plan.
 - b. Equal as approved by Architect before installation. Testing results will be required.
 - c. Required Testing - All rock mulch requested by contractor as an Equal shall have a sieve analysis (ASTM C136) with an accumulative % passing rating of 95% or greater. All material shall meet a resistance to degradation test (ASTM C131) at 500 revolutions per minute with a percent of loss of 45% or less. Contractor to provide test results to Landscape Architect before shipping rock mulch to the site.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before proceeding with work, check and verify dimensions and quantities. Report variations between Drawings and site to Architect before proceeding with work of this Section.
- B. Plant totals are for convenience only and are not guaranteed. Verify amounts shown on Drawings. All planting indicated on Drawings is required unless indicated otherwise.

3.2 PREPARATION

- A. Layout individual shrub locations and areas for multiple plantings. Stake locations and outline areas. Secure Architect's acceptance before planting. Make minor adjustments as may be requested.

3.3 INSTALLATION

- A. Excavation:
 - 1. If underground construction work or obstructions are encountered in excavation of planting holes, Architect will select alternate locations.
 - 2. Plant Excavation Size:
 - a. Diameter: Twice diameter of root ball or container minimum.
 - b. Depth – Refer to Details.
 - 3. Roughen sides and bottoms of excavations.
- B. Planting:
 - 1. Before planting, test two typical planting excavations with water and verify that water drains away within one hour. Inform Architect in writing if water does not drain properly. Do not plant shrubs in holes that do not properly drain.
 - 2. Removing Binders And Containers:
 - a. Remove top one / third of wire basket and burlap binders.
 - b. Remove plastic and twine binders from around root ball.
 - c. Remove wood boxes from around root ball. Remove box bottoms before positioning plant in hole. After plant is partially planted, remove remainder of box without injuring root ball.
 - 3. Plant immediately after removing binding material and containers. Place shrubs in holes so, after watering and settling, top of root ball shall be approximately one inch higher than finished grade.
 - 4. Properly cut off broken or frayed roots.
 - 5. Center plant in hole and backfill with specified planting mix.
 - 6. Install "PHC Tree Saver" per manufacturer's recommendations in all shrub planting mixes.
 - 7. Add planting tablets in plant pit as follows. Place tablets in relation to root ball as recommended by Manufacturer.
 - a. One Gallon Shrub: 1 tablet.

- b. 5 Gallon Shrub: 2 tablets.
 - 8. Fill landscape excavations tamped planting mix. Settle by firming and watering to ensure top of ball one inch higher than surrounding soil.
 - 9. Do not use muddy soil for backfilling.
 - 10. Make adjustments in positions of plants as directed by Architect.
 - 11. Thoroughly water shrubs immediately after planting.
- C. Post Planting Weed Control:
- 1. Apply specified pre-emergent herbicide to shrub and ground cover planting areas and grass-free areas at tree bases after completion of planting.
 - 2. Areas shall be free of existing weed growth prior to application of herbicide.
- D. Weed Barrier Fabric:
- 1. After planting and application of herbicide in shrub beds, apply covering of specified weed barrier fabric with fuzzy side down.
 - 2. Achieve 100 percent coverage over ground areas.
 - 3. Overlap seams 6 inches minimum.
 - 4. Staple at 5 feet on center each way with two at each corner.
- E. Mulching:
- 1. After application of herbicide, mulch shrub and ground cover planting areas with 3 inches deep layer of specified top dressing rock mulch.
 - 2. Place top dressing mulch to uniform depth and rake to neat, finished appearance.

END OF SECTION

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SECTION 33 05 01
PIPE ACRYLONITRILE-BUTADIENE-STYRENE (ABS) PIPE

PART 1 GENERAL

1.1 DESCRIPTION

- A. The Section includes the furnishing and installation of ABS Pipe, fittings, joint materials, and appurtenances, for a complete and operable system in accordance with the Contract Documents.

1.2 RELATED WORK

- A. Related Work specified in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittals
 2. Section 05 45 00 Mechanical Metal Supports
 3. Section 31 23 15 Excavation and Backfill for Buried Pipelines

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publication is referred to in the text by basic designation only.

B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM D 2235 Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
2. ASTM D 2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
3. ASTM D 2412 Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
4. ASTM D 2661 Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings
5. ASTM D 2680 Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping.
6. ASTM D 2774 Standard Practice for Underground Installation of Thermoplastic Pressure Piping
7. ASTM D 3311 Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
8. ASTM D 3965 Standard Classification System and Basis for Specifications for Rigid Acrylonitrile-Butadiene-Styrene (ABS) Materials for Pipe and Fittings
9. ASTM F 477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
10. ASTM F 628 Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe With a Cellular Core
11. ASTM F 1498 Standard Specification for Taper Pipe Threads 60° for Thermoplastic Pipe and Fittings
12. ASTM F 1668 Standard Guide for Construction Procedures for Buried Plastic Pipe

13. ASTM F 2969 Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) IPS Dimensioned Pressure Pipe

C. NATIONAL SANITATION FOUNDATION (NSF)

1. NSF 14 Plastics Piping System Components and Related Materials

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit catalog information on all fittings shown on the Contract Drawings. Information shall indicate manufacture specification compliance and dimensional data.

1.5 QUALITY ASSURANCE

- A. Reject any pipe which does not conform to Contract Documents or is damaged or otherwise unacceptable.

PART 2 PRODUCTS

2.1 ABS SOLID WALL PIPE (NON-PRESSURE SYSTEM)

- A. Pipe shall be plain end, Schedule 40, and shall conform to ASTM D 2661 for diameters 1-1/2 inch to 6 inches. Fittings shall conform to ASTM D 2661. Pipe and fittings shall conform to NSF International Standard 14.
- B. Joints shall be bell and spigot with solvent cement which complies with ASTM D 2235 or threaded joint which complies with ASTM F 1498.
- C. Material shall be rigid ABS plastic conforming to cell class 4-2-2-2 for pipe and cell class 3-2-2-2 for fittings as defined in ASTM D 3965.
- D. Manufacturer, or approved equal:
 - 1. Plastic Services & Products, LLC
 - 2. JM Eagle

2.2 ABS SCHEDULE 40 CELLULAR CORE PIPE (NON-PRESSURE SYSTEM)

- A. ABS cellular core pipe shall conform to ASTM F 628 for diameters 1-1/2 inch to 6 inches. Fittings shall conform to ASTM D 2661. Pipe and fittings shall conform to NSF International Standard 14.
- B. Joints shall be bell and spigot with solvent cement which complies with ASTM D 2235 or threaded joint which complies with ASTM F 1498.
- C. Material: Rigid ABS plastic conforming to cell class 4-2-2-2 for pipe and cell class 3-2-2-2 for fittings as defined in ASTM D 3965.
- D. Manufacturer, or approved equal:
 - 1. JM Eagle

2. Plastic Services & Products, LLC
3. Charlotte Pipe and Foundry Company

PART 3 EXECUTION

3.1 INSTALLATION

- A. Excavation and backfill of trenches and for appurtenances shall be in accordance with Section 31 23 15 - Excavation and Backfill for Buried Pipelines.
- B. Installation shall comply with the manufacturer's latest installation instructions and shall conform to all applicable plumbing, fire, and building code requirements.
- C. Buried pipe shall be installed in accordance with ASTM D 2321 and ASTM F 1668.
- D. Solvent joints shall be made with solvent cement conforming to ASTM D 2335.
- E. Provide pipe supports every 4 feet, if required by code, or per Section 05 45 00 – Mechanical Metal Supports.
- F. The non-pressure system shall be hydrostatically tested after installation per local codes or the following procedure, whichever is more stringent:
 1. Fill the system with water at the highest point and allow any air trapped in the system to escape.
 2. Test the system with a hydrostatic pressure of 10 feet.
 3. If any leaks are found, repair the leak and then repeat the test procedure.
 4. Do not use compressed air or gas to test the system.

- END OF SECTION -

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SECTION 33 05 02
REINFORCED CONCRETE PIPE

PART 1 GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall construct the reinforced concrete storm drain pipeline complete and in place, including connections to new and existing structures, all in accordance with the Contract Documents.

1.2 RELATED WORK

- A. Related Work specified in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
 2. Section 31 23 15 Excavation and Backfill of Buried Pipelines
 3. Section 33 08 30 Gravity Pipeline Testing

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)
1. ASTM C 76 Standard Specifications for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
 2. ASTM C 443 Standard Specifications for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
 3. ASTM C 596 Standard Test Method for Drying Shrinkage of Mortar Containing Hydraulic Cement
 4. ASTM D 3212 Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
 5. ASTM F 477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit manufacturer's data sheets on reinforced concrete pipe showing pipe dimensions, rubber gaskets, pipe connectors, and other appurtenances.
- C. Submit manufacturer's information on grout.
- D. CONTRACTOR shall furnish certificates to ENGINEER guaranteeing that the pipe is in compliance with the requirements of these Specifications.

1.5 QUALITY ASSURANCE

- A. Pipe shall be subject to inspection at the place of manufacture. Notify ENGINEER not less than 14 days prior to the start of any phase of the pipe manufacture. During

manufacture ENGINEER shall be given access to all areas of the process and shall be permitted to make inspections necessary to confirm compliance with the Specifications.

- B. Materials used in the manufacture of the pipe shall be tested in accordance with this Section and the referenced standards. CONTRACTOR shall perform said material tests. ENGINEER shall have the right to witness testing provided that CONTRACTOR's schedule is not delayed for convenience of ENGINEER.

PART 2 PRODUCTS

2.1 PIPE MATERIALS

- A. Reinforced Concrete Pipe: Reinforced concrete pipe shall conform to the requirements of ASTM C 76 for Class III, Wall B, and Type II modified or V cement; provided, that pipe shall have tongue and groove joint designed to be self-centering. Pipe shall be designed for an internal pressure of 7 feet of water, and an external design loading meeting AASHTO HS-20-44, soil weight of 120 pcf, and minimum cover depth of 1 foot. Pipe manufacturer shall be **Geneva Pipe and Precast, Inc., Oldcastle Precast, Inc.**, or approved equal.
- B. Bell and spigot joints, including rubber gaskets, shall conform to the requirements of the latest revision of ASTM C443. Pipe joints shall be so designated as to provide for self-centering and when assembled, to compress the gasket to form a watertight seal. The gasket shall be confined in a groove on the spigot so that pipe movement or hydrostatic pressure cannot displace the gasket. Each pipe section shall be identified by a stamp indicating:
 - 1. Name of Manufacturer
 - 2. Date of Manufacture
 - 3. Pipe Classification
 - 4. Top of pipe
- C. Quick Setting Grout: Grout shall be a high strength, non-staining grout approved by ENGINEER prior to use. It shall reach an initial set within 90 minutes at 70° F and shall reach minimum compressive strength of 2,500 psi within 24 hours. Shrinkage shall be less than 0.1 percent when tested, using the test procedures of ASTM C 596. The grout shall be mixed, handled, and placed in accordance with the manufacturer's written instructions.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILL

- A. Excavation and backfill of trenches and for appurtenances and backfilling for reinforced concrete pipe shall be in accordance with Section 31 23 15 Excavation and Backfill for Buried Pipelines.

3.2 INSTALLATION

- A. All pipes shall be installed accurately to the defined line and grade. Variance from established line and grade shall not be greater than one thirty-second (1/32) of an inch per inch of pipe diameter and not to exceed one-half (1/2) inch, provided that such

variation does not result in a level or reverse sloping invert; provided also that variation in the invert elevation between adjoin ends of pipe due to non-concentricity of joining surface and pipe interior surfaces does not exceed one sixty-fourth (1/64) inch per inch of pipe diameter, or one-half inch maximum.

- B. All concrete pipe installation shall proceed upgrade on a stable foundation with joints closely and accurately fitted. Rubber gaskets shall be fitted properly in place and care shall be taken in joining the pipe units to avoid twisting gaskets. Joints shall be clean and dry before a joint lubricant, as recommended by the pipe supplier, shall be applied uniformly to the mating joint surface to facilitate easy positive joint closure.
- C. Pipe shall be installed with uniform bearing under the full length of the barrel, with suitable excavations being made to receive pipe bells.
- D. Select material shall be compacted around the pipe to firmly bed the pipe in position. If adjustment of position of a pipe length is required after being laid, it shall be removed and re-jointed as for a new pipe. When laying is not in progress, the ends of the pipe shall be closed with a tight-fitting stopper to prevent the entrance of foreign material.
- E. In addition to the above-mentioned requirements, all pipe installation shall comply to the specific requirements of the pipe manufacturer.
- F. During the pipe installation, the trench shall be sufficiently dewatered that the joints will be free of water when jointed.

3.3 PRELIMINARY CLEANING

- A. CONTRACTOR shall clean the pipeline as the work progresses by a means in accordance with good practice to ensure that sand, rocks, or other foreign material are not left in any of the pipeline.
- B. Do not flush sand, gravel, concrete, debris, or other materials into existing piping.

3.4 TESTING OF PIPELINE

- A. Testing for the reinforced concrete pipe shall be in accordance with Section 33 08 30 – Gravity Pipeline Testing.

- END OF SECTION -

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SECTION 33 05 05
DUCTILE IRON PIPE

PART 1 GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall furnish and install all pipe, fittings, closure pieces, supports, bolts, nuts, gaskets, jointing material, polyethylene wrap, marker tape, tracer wire, and appurtenances as shown and specified, and as required for a complete and workable piping system.

1.2 RELATED WORK

- A. Related Work specified in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
 2. Section 01 50 30 Protection of Existing Utilities
 3. Section 09 91 00 Painting and Finishes
 4. Section 31 23 15 Excavation and Backfill for Pipelines
 5. Section 33 12 00 Mechanical Appurtenances
 6. Section 33 13 00 Pipeline Testing and Disinfection

1.3 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
- B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
1. ASTM D 2041 Cast-Iron Pipe Flanges and Flanged Fittings Class 25, 125, and 250
- C. AMERICAN STANDARDS FOR TESTING AND MATERIAL (ASTM)
1. ASTM A 193 Standard Specification for Alloy-Steel and Stainless-Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
 2. ASTM A 194 Standard Specification for Carbon Steel, Alloy Steel, and Stainless-Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
 3. ASTM A 283 Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
 4. ASTM A 536 Standard Specification for Ductile Iron Castings
- D. American Society of Mechanical Engineers (ASME)
1. ASME B1.1 Unified Inch Screw Threads, (UN And UNR Thread Form)
 2. ASME B18.2.1 Square, Hex, Heavy Hex, And Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, And Lag Screws (Inch Series)
 3. ASME B18.2.2 Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, And Coupling Nuts (Inch Series)

E. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. AWWA C 104 Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
2. AWWA C 105 Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
3. AWWA C 110 Standards for Ductile-Iron and Gray-Iron Fittings, 3-inch Through 48-inch, for Water
4. AWWA C 111 Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
5. AWWA C 115 Standard for Flanged Ductile-Iron Pipe with Ductile Iron or Gray-Iron Threaded Flanges
6. AWWA C 150 Standard for the Thickness Design of Ductile-Iron Pipe
7. AWWA C 151 Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water
8. AWWA C 153 Standard for Ductile-Iron Compact Fittings, 3-inch Through 64-inch for Water
9. AWWA C 219 Standard for Bolted, Sleeve-Type Couplings for Plain-End Pipe
10. AWWA C 600 Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances
11. AWWA C 606 Standard for Grooved and Shouldered Joints
12. AWWA C 651 Standard for Disinfecting Water Mains
13. AWWA M 11 Steel Pipe – A Guide for Design and Installation

1.4 SUBMITTALS

- A. Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit catalog information on all pipe, fittings, valves, couplings, gaskets, tapes, bolts and nuts, wraps, safety tapes, and tracer wires as shown on the Drawings. Information shall indicate manufacture specification compliance and dimensional data.
- C. Submit shop drawings on all fabricated piping and pipe supports.
- D. Submit bolting patterns, procedures, and bolting equipment data, and calculations for target torque calculations.
- E. Certified affidavit of compliance for pipe and fittings or other materials furnished under this Section and as specified in the referenced standards.

1.5 QUALITY ASSURANCE

- A. Except as modified herein, materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.

PART 2 PRODUCTS

2.1 DUCTILE IRON PIPE

- A. Ductile iron pipe shall conform to the requirements of the AWWA C151 and AWWA C150 and pipe must be certified for potable water use by the National Sanitation Foundation (NSF/ANSI 61) and must bear the logo "NSF-pw" or "NSF-61" indicating such certification. Pipe thickness rating shall be Pressure Class 350, unless otherwise noted on the

drawings. The pipe shall be provided with rubber gaskets, specials, and fittings as required. Nominal pipe laying lengths shall be 20-feet.

- B. Buried Ductile Iron Pipe shall be encased with 8 mil (minimum), Group 2, Class C [black] polyethylene, conforming to the requirements of AWWA C105. All seams in the polyethylene encasement shall be taped with a minimum 12 mil adhesive tape, **Polyken #900, 3M Scotchrap 51**, or approved equal, to completely seal the seam.

2.2 FITTINGS

- A. MJ and Push-on fittings shall conform to the (AWWA C110 or C153), be NSF certified to ANSI/NSF 61 and shall be for a minimum rated working pressure of 250 psi.
- B. Flanges shall conform to AWWA C110 AWWA C111, and ANSI B16.1, Class 125 and shall have either raised or plain faces and shall have a minimum working pressure rating of 250 psi. For pipe sizes 24-inch and smaller, flanged joints may be rated for a maximum of 350 psi with the use of specially designed gaskets.

2.3 DUCTILE IRON PIPE JOINTS

- A. Ductile iron pipe and fittings shall be furnished with mechanical joints, push-on joints, flanged joints, or restrained joints as required.
 1. Mechanical and push-on joints shall conform to the requirements of AWWA C111.
 2. Flanged joints shall conform to the requirements of AWWA C115.
 3. Restrained joints shall conform to the requirements of AWWA C151. Restrained joints shall be **Flex-Ring, Field Flex-Ring, or Lok-Ring by American Ductile Iron Pipe, Field Lok, TR-Flex by U.S. Pipe**, or approved equal.
 4. Joint restraining devices that impart point loads and/or wedging action on the pipe wall as a means of joint restraint shall not be allowed unless there are no other options available. CONTRACTOR may propose such devices by providing a formal substitution request indicating the locations the devices are to be used with an accompanying thrust block and that the devices is rated at least for the class of pipe being supplied. The devices shall be **MegaLug Model 1100 by EBAA Iron**, or approved equal.

2.4 SOLID SLEEVE-TYPE COUPLINGS

- A. Solid sleeve-type couplings shall be provided where shown on the Drawings. Coupling shall be of ductile iron and shall be of the size to fit the pipe and fittings shown. Coupling shall be pressure rated 250 psi and comply with AWWA C110. Restraints shall be provided where indicated on the Drawings.

2.5 BOLTED SLEEVE-TYPE COUPLINGS

- A. Sleeve-type couplings shall be provided where shown on the Drawings. Couplings shall be of ductile iron, without pipe stop, and shall be of sizes to fit the pipe and fittings shown. Coating shall be fusion bonded epoxy. Couplings shall be pressure rated for 250 psi and comply with AWWA C219. Couplings shall be **Style 501 or FC1 by EJ Prescott, Style 501 by Romac**, or approved equal.

2.6 RESTRAINED BOLTED SLEEVE-TYPE COUPLINGS

- A. Restrained bolted sleeve-type couplings shall be provided where shown on the Drawings. Couplings shall be of ductile iron or ASTM A283 Grade C steel, without pipe stop, and shall be of sizes to fit the pipe and fittings shown. Coating shall be fusion bond epoxy. Couplings shall be rated for 250 psi and comply with AWWA C219. Sleeve length shall be 7 inches for pipe diameters 4-inch through 12-inch and 10 inches for pipe diameters 14-inch and larger. Restraint gland shall be ductile iron meeting the requirements of ASTM A 536. Couplings shall be **Series 470 by Smith-Blair, Style 400RG by Romac, Series 3800 by EBAA Iron, Inc.**, or approved equal.

2.7 GASKETS

- A. Except as otherwise provided, gaskets for flanged joints shall be 1/8-inch-thick rubber fabric. Class 250 or less flange gaskets shall be **Flange-Tyte by U.S. Pipe**, higher pressure joint gaskets shall be **Garlock BLUE-GARD Style 3000**, or approved equal. Wherever blind flanges are shown, the gaskets shall consist of 1/8-inch-thick cloth-inserted rubber sheet which shall cover the entire inside surface of the blind flange and shall be cemented to the surface of the blind flange.
- B. All buried fittings using steel bolts shall be coated with no-oxide wax and wrapped with polyethylene or as otherwise approved by ENGINEER.

2.8 BOLTS AND NUTS

- A. Bolts and nuts shall be rated for the system working pressure with a minimum safety factor of three. Bolts and nuts inside vaults shall be zinc coated steel. Bolts and nuts above grade, exposed or inside structures, shall be zinc coated steel. Bolts and nuts buried or in corrosive environments shall be Type 304 stainless steel.
- B. All flange bolt lengths shall be selected by CONTRACTOR such that three full threads, as a minimum, protrude from the hex nut and washer after assembly.
- C. Flange bolts shall have ASME B1.1, Class 2A threads, and be manufactured of ASTM A 193, Grade B7 steel. Bolts shall conform to ASME B18.2.1.
- D. Flange nuts shall have Class 2A fit, and be manufactured of ASTM A 194, Grade 2H steel, having square or hex heavy dimensions in accordance with ASME B18.2.2.
- E. Connection T-bolts for mechanical joint (MJ) fittings shall be Cor-Ten high strength, low alloy steel conforming to AWWA C111.

2.9 CEMENT MORTAR LINING

- A. Ductile iron pipe and fittings shall be lined with cement mortar in accordance with the requirements of the AWWA C104 except that the lining thickness shall be not less than 1/8 of an inch. The pipe interior surfaces shall be smooth and free from fractures, excessive crazing, and roughness.

2.10 THRUST BLOCKS/ RESTRAINTS

- A. All fittings for pipe 20-inch diameter and larger shall not have thrust blocks, but joint restraints for the adjacent pipe shall be provided for the distances indicated on the

drawings. All fittings for pipes smaller than 20-inch diameter shall have proper thrust blocks and restraints as noted for the type of installation required. Joint restraint shall be provided for all bends, fittings, and valves regardless of pipe size or location. Thrust blocks shall be concrete as per Drawings.

- B. Joint restraints shall be as defined in Subsection 2.3.A.3 of this Section.
- C. Restrained joints shall be suitable for 250 psi test pressures.

2.11 SAFETY TAPE

- A. Safety tape shall be a minimum of 3-inch wide by 5.0 mil overall thickness, with no less than a 0.35-gauge solid aluminum foil core. It shall be Safety Blue in color per American Public Works Association (APWA) National Color Code and shall be clearly labeled with the words "CAUTION WATER LINE BELOW" or similar wording approved by ENGINEER. Safety tape shall be **MagnaTec by Empire Level Mfg Corp**, or approved equal.

2.12 TRACER WIRE

- A. All piping (including service lines) shall be installed with 12-gauge solid copper THHN direct bury blue tracer wire for pipeline location purposes by means of an electronic line tracer.
 - 1. The wires must be installed along the entire length of the pipe on the bottom of the pipe and be held in place with poly tape at all pipe joints and at 5-foot intervals.
 - 2. Sections of wire shall be spliced together using approved splice caps and waterproof seals. Twisting the wires together is not acceptable.

2.13 PIPE COATINGS

- A. All exposed piping, valves, and fittings including inside vaults and buildings shall be painted as specified in Section 09 91 00 – Painting and Finishes. Exposed piping, valves and fittings to be painted shall be primed by the manufacturer in preparation for painting. CONTRACTOR shall provide verification from the finish coating supplier that the field applied coatings are compatible with the manufacturer's prime coat. Pipe to be painted shall not have asphalt emulsion coating. The exterior of buried pipe and fittings shall be an asphaltic coating approximately one-mil thick.

2.14 COLD-APPLIED WAX TAPE COATING

- A. Apply wax tape coating over all flanges, valves, actuators, joints, nuts, bolts, and all metallic appurtenances which are buried.
- B. Primer: Primer shall be a blend of petrolatums, plasticizers, and corrosion inhibitors having a paste-like consistency. The primer shall have the following properties:
 - 1. Color Brown
 - 2. Pour Point 100°F to 110°F
 - 3. Flash Point 350°F
 - 4. Coverage 1 gallon/100 square feet
 - 5. Manufacturer **Trenton Wax Tape Primer, Denso Paste Primer**, or approved equal.

- C. Wax Tape: Wax tape shall consist of a synthetic fiber felt, saturated with a blend of microcrystalline wax, petrolatums, plasticizers, and corrosion inhibitors, forming a tape coating that is easily formable over irregular surfaces. The tape shall have the following properties:

- | | |
|------------------------|---|
| 1. Color | Brown |
| 2. Saturant Pour Point | 115°F to 120°F |
| 3. Thickness | 50 to 70 mils |
| 4. Tape Width | 6 inches |
| 5. Dielectric Strength | 100 volts/mil |
| 6. Manufacturer | Trenton No. 1 Wax Tape, Denso "Densyl Tape" , or approved equal. |

- D. Plastic Wrapper: Wrapper shall be a polyvinylidene chloride plastic with three 50-gauge plies wound together as a single sheet. The wrapper shall have the following properties:

- | | |
|-----------------|--|
| 1. Color | Clear |
| 2. Thickness | 1.5 mils |
| 3. Tape Width | 6 inches |
| 4. Manufacturer | Trenton Poly-Ply, Denso Tape PVC Self-Adhesive , or approved equal. |

PART 3 EXECUTION

3.1 INSTALLATION

- A. Excavation and backfill of trenches and for appurtenances shall be in accordance with Section 31 23 15 - Excavation and Backfill for Buried Pipelines.
- B. Ductile iron fittings shall be installed in accordance with the ANSI/AWWA C600. Inspect each pipe and fitting prior to installation to verify there is no damage and clean each pipe and fitting prior to installation.
- C. Pipe shall be laid directly on the bedding material. Bell holes shall be formed at the ends of the pipe to prevent point loading.
- D. No pipe shall be installed on a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation before backfilling occurs.
- E. Immediately before joining the pipe, the bell end of the pipe shall be thoroughly cleaned. The spigot end of the pipe and the inside surface of the gasket shall be cleaned and lubricated. The lubricant shall be non-toxic, shall not support bacteria growth, shall not be harmful to the gasket material, and shall be compliant with NSF/ANSI 61 requirements. The lubricant shall not impart a taste or odor to the water in the pipe. Tilting of the pipe to insert the spigot into the bell will not be permitted.
- F. Buried Ductile Iron pipe shall be polyethylene encased in accordance with the requirements of AWWA C105 Method A. Remove all lumps of clay, mud, cinders, etc. on the pipe surface before installation of the encasement. During installation, soil or embedment material shall not be trapped between the pipe and the polyethylene. Cut polyethylene tube to a length at least 2 feet longer than the pipe section. Wrap shall

overlap the adjacent pipe joint at least 1 foot. After assembling the pipe joint, overlap the joint with the polyethylene tube and secure to the pipe with adhesive tape completely around the seam. Overlap the joint on the previous pipe with the polyethylene tube and secure to the existing wrap with adhesive tape and completely seal the seam. Take up the slack width at the top of the pipe to make a snug but not tight fit along the barrel of the pipe and secure with poly tape at 5-foot intervals. For installations below the water table or wet areas, circumferential wraps of tape should be placed at 2-foot intervals along the barrel of the pipe prior to lowering the pipe into the trench.

- G. Repair punctures to the polyethylene wrap with adhesive tape. Repair cuts, tears, or damage to the polyethylene wrap with a tube cut open, wrapped around the pipe to cover the damaged area, and secure in place with **Polyken #900, 3M Scotchrap 51**, adhesive tape, or approved equal, to completely seal the seam.
- H. Provide openings for branches, service taps, blowoffs, air valves, and similar appurtenances by cutting an "X" in the polyethylene and temporarily folding back the film. After the appurtenance is installed, tape the slack securely to the appurtenance, and repair the cut and any other damaged areas.
- I. To make a direct tap, apply two or three wraps of adhesive tape completely around the polyethylene encased pipe to cover the area where the tapping machine and chain will be mounted. Install the corporation stop directly through the tape and polyethylene encasement. After the direct tap is completed, inspect for damage and repair if needed.
- J. Where polyethylene wrapped pipe joins an adjacent pipe that is not wrapped, extend the polyethylene wrap to cover the adjacent pipe for a distance of 3 feet. Secure the end with adhesive tape completely around the seam. Service lines with dissimilar metals shall be wrapped with polyethylene or approved dielectric tape for a minimum clear distance of 3 feet away from the ductile iron pipe.
- K. Valves shall be handled in a manner to prevent damage to any part of the valve. CONTRACTOR shall adjust stem packing and operate each valve prior to installation to insure proper operation. Valves shall be installed so that the valve stems are plumb and, in the location, indicated on the drawings.
- L. The pipe shall be plugged at the end of each work day or period of suspension.
- M. Safety tracer tape shall be installed 18 inches above the pipe along the entire length of pipeline.
- N. Tracer wire shall be brought up at valve boxes and fire hydrants as shown on the Drawings. Tracer wire does not need to be brought up at shut-off valves for fire hydrants. When splicing a wire use a greased filled or approved connector. All splices should occur within a valve box. Wire is to be continuous underground. Underground splices may only be used with specific permission of the OWNER and must be inspected before backfill.

3.2 THRUST BLOCKS

- A. Thrust blocks shall be installed at points where the pipe changes direction such as: at all tees, elbows, wyes, caps, valves, hydrants, reducers, etc.

- B. Thrust blocks shall be constructed so that the bearing surface is in direct line with the major force created by the pipe or fitting.
- C. Thrust blocks shall bear against solid undisturbed earth at the side and bottom of the trench excavation and shall be shaped so as not to obstruct access to the joints or the pipe or fitting.
- D. Thrust blocks shall be sized and constructed per OWNER's Standards or the drawings, whichever is greater.

3.3 PRELIMINARY CLEANING AND FLUSHING

- A. CONTRACTOR shall flush the pipeline as the work progresses by a means in accordance with good practice to ensure that sand, rocks, or other foreign material do not remain in any of the pipeline. If possible, the flushing shall be made with an open pipe end.
- B. CONTRACTOR shall provide to ENGINEER a proposed schedule and method of flushing for review before the flushing starts.

3.4 BOLTING PROCEDURES FOR FLANGED JOINTS

- A. Flange joints shall be assembled per the gasket manufacturer's instructions and as specified herein. Utilize calibrated bolting equipment capable of applying a measured torque to flange bolts during joining. Bolting patterns, procedures, and bolting equipment data shall be submitted prior to pipe fitting and bolting.
- B. Gaskets, bolts, and anti-seize lubricant used in the bolting procedure shall be selected from those specified herein. Submit target torque calculations for each application. Calculations shall identify specific gasket (manufacturer, model, size, configuration, material), bolts (size and material), and anti-seize lubricant. The calculations shall document and take into consideration the pipe service, working and test pressures, pipe diameter, gasket data sheet, bolt material, gasket supplier-recommended assembly stress, and gasket-supplier recommended bolt stress. Calculations shall be stamped by a professional engineer. Target torque calculations shall be used in the assembly of bolted joints.
- C. Flange bolts, nuts, and washers shall be visually inspected and cleaned prior to bolting. Lubricate bolts and nuts; if hardened washers are not used, lubricate the flange surface around the bolt holes. This lubricant must be removed by cleaning solvent prior to applying a coating system. Hand-tighten all nuts and bolts then tighten them to 10 to 20 percent of the target torque. The initial torque shall not exceed 20 percent of the target torque. The bolts shall be tightened according to the pattern included in AWWA Manual M11, Figure 12-3.
- D. For flanges having 4 to 8 bolts there shall be three rounds of tightening, after hand tightening, to 30 percent, 60 percent and then 100 percent of the target torque. For flanges having 12 or more bolts there shall be four rounds of tightening, after hand tightening, to 20 percent, 40 percent, 80 percent and 100 percent of the target torque. At 100 percent of target torque the flange gap shall be measured at every other bolt to confirm uniformity. The bolts shall be re-tightened to the target torque 24 hours after completion of the initial bolting sequence.

3.5 TRACER WIRE TESTING

- A. Tracer wire shall be installed where indicated above or shown on the Contract Drawings on the pipe along the entire length of pipeline.
- B. Upon completion of the pipe installation, CONTRACTOR shall demonstrate that the wire is continuous and unbroken through the entire run of the pipe.
 - 1. Demonstration shall include full signal conductivity (including splices) when energizing for the entire run in the presence of OWNER and/or ENGINEER.
 - 2. If the wire is broken, CONTRACTOR shall repair or replace it. Pipeline installation will not be accepted until the wire passes a continuity test.

3.6 TESTING OF PIPELINE

- A. CONTRACTOR shall provide additional temporary blow-off valves and fittings as required to flush and disinfect new pipelines as required in Section 33 13 00 – Pipeline Testing and Disinfection. Temporary blow-off valves and fittings shall be removed prior to placing pipeline into service.
- B. Source of Water
 - 1. CONTRACTOR shall assume all responsibility to obtain the necessary water supplies for pressure testing of the pipeline.
- C. Testing Procedure
 - 1. Pipe shall be tested at a static pressure of 200 psi for 2 hours and in accordance with the AWWA C600 standards. For projects with long pipeline segments, pipe shall be tested in segments such that the test pressure at the low point of the segment shall not be greater than 210 psi, and the pressure at the high point in the segment shall not be less than 180 psi.
 - 2. Hydrostatic testing shall be in accordance with the requirements of AWWA C 600 and Section 33 13 00 - Pipeline Testing and Disinfection. In case of a conflict between these two references, the more stringent requirement shall be followed.
 - 3. In the case of pipelines that fail to pass the leakage test, CONTRACTOR shall determine the cause of the excessive leakage, shall take corrective measures necessary to repair the leaks, and shall repeat the pipeline test, all at no additional cost to OWNER.
 - 4. ENGINEER shall be notified at least 48 hours before the pipeline is to be tested so that ENGINEER may be present during the test
 - 5. Air pressure testing will not be allowed.

3.7 DISINFECTING

- A. Disinfection shall be in accordance with Section 33 13 00 – Pipeline Testing and Disinfection.

3.8 PAINTING

- A. All exposed piping including inside vaults shall be painted as specified in Section 09 91 00 – Painting and Finishes.

- END OF SECTION -

SECTION 33 05 07.1
POLYVINYL CHLORIDE (PVC) PRESSURE PIPE
(ASTM D 1785, modified)

PART 1 GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall furnish and install all PVC pressure pipe and appurtenances as shown and specified, and as required for a complete and workable piping system.
- B. This Section includes PVC pressure pipe with solvent-welded, flanged, or threaded joints in accordance with ASTM D 1785 as modified herein. PVC pipe with bell and spigot joints is included in Section 33 05 07 - PVC Pressure Pipe, Rubber Joints (AWWA C900 and C905).

1.2 RELATED WORK

- A. Related Work specified in other Sections includes, but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 05 45 00 Mechanical Metal Supports
 - 3. Section 31 23 15 Excavation and Backfill for Pipelines
 - 4. Section 33 12 00 Mechanical Appurtenances
 - 5. Section 33 13 00 Pipeline Testing and Disinfection

1.3 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
- B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
 - 1. ANSI B 16.5 Pipe Flanges and Flanged Fittings Class 150
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM D 1785 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
 - 2. ASTM D 2467 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
 - 3. ASTM F 1498 Standard Specification for Taper Pipe Threads 60 Degrees for Thermoplastic Pipe and Fittings
- D. AMERICAN WATER WORKS ASSOCIATION (AWWA)
 - 1. AWWA C 605 Standard for Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
 - 2. AWWA C 651 Standard for Disinfecting Water Mains
 - 3. AWWA C 900 Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-Inch through 12-Inch for Water Transmission and Distribution

- 4. AWWA C 905 Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings 14-Inch through 48-inch
- 5. AWWA M 23 Manual of Water Supply Practices - PVC Pipe - Design and Installation

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit manufacturer's affidavit certifying product was manufactured, tested and supplied in accordance with applicable references in this section together with a report of the test results and the date each test was completed.
- C. Submit shop drawings of pipe, fittings, and appurtenances showing compliance with this Section; and manufacturer's literature on tracer wire and accessories.
- D. Submit plan for commissioning the waterline, including but not limited to cleaning, pressure testing, and disinfection.

PART 2 PRODUCTS

2.1 POLYVINYL CHLORIDE PIPE

- A. PVC pipe shall be made from new rigid unplasticized polyvinyl chloride and shall be normal impact Type 1, Grade 1, class 12454, listed as compliant with NSF Standard 61, unless otherwise indicated, in accordance with ASTM D 1785.
- B. Pipe sections shall be clearly marked to:
 - 1. Identify manufacturer's name or trademark
 - 2. Nominal pipe size and OD base
 - 3. ASTM material code designation
 - 4. Schedule
 - 5. Pressure class
 - 6. ASTM specification designation
 - 7. Product record code
- C. **PVC pipe shall be schedule 80 unless otherwise noted.**

2.2 PIPE JOINTS

- A. Pipe joints shall be solvent-welded type with solvent cement and primer as recommended by the pipe manufacturer for the chemical in the pipe.
- B. Threaded joints that are necessary to match up to threaded valves or fittings shall be made up with appropriate thread sealant, either paste or tape.
- C. Flanged joints shall be made with solvent-welded PVC flanges, drilled to ASME B 16.5 - Pipe Flanges and Flanged Fittings, Class 150, unless otherwise indicated. Gaskets shall be ANSI 150 lb. full face, 1/8-inch-thick Neoprene for water or wastewater service. Gasket material for chemicals shall be suitable for the chemical service.

2.3 FITTINGS

- A. Solvent-welded and threaded fittings shall be Schedule 80 PVC fittings in accordance with ASTM D 2467 - Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- B. Flanged fittings shall be Schedule 80 fabricated PVC fittings with 150 lb. flanges to ASME B 16.5.

2.4 TRACER WIRE

- A. All buried piping (including service lines) shall be installed with 12-gauge solid copper THHN tracer wire for pipeline location purposes by means of an electronic line tracer.
 - 1. The wires must be installed along the entire length of the pipe on the top of the pipe and be held in place with ties or hitches spaced not more than 12-feet apart.
 - 2. Sections of wire shall be spliced together using approved splice caps and waterproof seals or solder. Twisting the wires together is not acceptable.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Excavation and backfill of trenches and for appurtenances shall be in accordance with Section 31 23 15 - Excavation and Backfill for Buried Pipelines.
- B. PVC pipe shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary, piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points.
- C. Piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with Section 05 45 00 – Mechanical Metal Supports (Pipe Supports). Where necessary to avoid stress on equipment or structural members, the pipe shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature changes.
- D. Unless otherwise indicated, connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection. Valves and flanges attached to PVC pipe shall be provided with adequate supports.

3.2 PIPE PREPARATION

- A. Prior to installation, each pipe length shall be carefully inspected, flushed clean of any debris or dust, and be straightened, if not true. Ends of threaded pipes shall be reamed and filed smooth. Pipe fittings shall be equally cleaned before assembly.

3.3 PIPE JOINTS

- A. Pipe threads shall conform to ASTM F 1498 and shall be full and cleanly cut with sharp dies or molded. Joints shall be made with Teflon tape or thread sealant.
- B. Solvent-welded joints shall be made with fresh primer and solvent cement on clean, dry pipe ends. The primer and cement cans shall be kept closed at all times and the joints shall be made up at the recommended ambient temperatures, according to the pipe or cement manufacturer's written recommendations. Pipe ends shall be inserted to the full depth of the socket. Solvents used on potable water pipes shall be ANSI/NSF 61 certified.
- C. Flanged joints shall be made with gaskets and Type 316 stainless steel bolts and nuts, unless noted otherwise. Care shall be taken not to over-torque the bolts, in accordance with the manufacturer's written recommendations.

3.4 PRELIMINARY CLEANING AND FLUSHING

- A. CONTRACTOR shall flush the pipeline as the work progresses by a means in accordance with good practice to ensure that sand, rocks, or other foreign material are not left in any of the pipeline. If possible, the flushing shall be made with an open pipe end.
- B. CONTRACTOR shall provide to ENGINEER a proposed schedule and method of flushing for review before the flushing starts.

3.5 TRACER WIRE TESTING

- A. Upon completion of the pipe installation, CONTRACTOR shall demonstrate that the wire is continuous and unbroken through the entire run of the pipe.
 - 1. Demonstration shall include full signal conductivity (including splices) when energizing for the entire run in the presence of OWNER or ENGINEER.
 - 2. If the wire is broken, CONTRACTOR shall repair or replace it. Pipeline installation will not be accepted until the wire passes a continuity test.

3.6 INSPECTION AND TESTING OF PIPELINE

- A. CONTRACTOR shall provide temporary blow-off valves and fittings as required to flush and disinfect new pipelines. Temporary blow-off valves and fittings shall be removed prior to placing pipeline into service.
- B. Source of Water
 - 1. CONTRACTOR shall assume all responsibility to obtain the necessary water supplies for disinfection and/or pressure testing of the pipeline.
- C. Testing Procedure
 - 1. CONTRACTOR shall allow adequate time for the solvent cement joints to cure. Curing time shall be per the solvent cement manufacturer's recommendation. Prior to enclosure or burying, piping systems shall be pressure tested at 200 psi for a period of not less than one hour, without exceeding the tolerances listed on the Contract Drawings. Caution - Do not use air or gas for testing PVC pipe. CONTRACTOR shall furnish test equipment, labor, materials, and devices.

2. Leakage shall be determined by loss of pressure. Fixtures, devices, or other accessories that would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines shall be plugged or capped as appropriate during the testing procedures.
3. Leaks shall be repaired, and the piping shall be re-tested until no leaks are found.
4. ENGINEER shall be notified at least 48 hours before the pipeline is to be tested so that ENGINEER may be present during the test.

3.7 DISINFECTING

- A. Disinfection shall be in accordance with Section 33 13 00 – Pipeline Testing and Disinfection for water bearing piping.

- END OF SECTION –

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SECTION 33 05 11
HDPE PRESSURE PIPE (AWWA C906)

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers furnishing and installation of the high-density polyethylene (HDPE) pipeline as shown on the Contract Drawings and specified herein.

1.2 RELATED WORK

- A. Related Work specified in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
 2. Section 31 23 15 Excavation and Backfill of Buried Pipelines
 3. Section 33 13 00 Pipeline Testing and Disinfection

1.3 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
1. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - a. ASTM D 1248 Standard Specifications for Polyethylene Plastics, Molding & Extrusion Materials.
 - b. ASTM D 2321 Underground Installation of Flexible Thermoplastic Sewer Pipe.
 - c. ASTM D 2361 Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
 - d. ASTM D 2837 Standard Method for Obtaining Design Basis for Thermoplastic Pipe Materials.
 - e. ASTM D 3350 Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.
 2. AMERICAN WATER WORKS ASSOCIATION
 - a. AWWA C 901 Polyethylene (PE) Pressure Pipe and Tubing, 1/2"-inch through 3-inch, for Water Service.
 - b. AWWA C 906 Polyethylene (PE) Pressure Pipe and Fittings, 4 In. through 63 In., for Water Distribution.
 - c. AWWA M 55 PE Pipe – Design and Installation

1.4 CONTRACTOR SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. The following shall be submitted:
1. Product data sheets, brochures, and other information demonstrating conformance to applicable pipe specifications before pipe is installed.
 2. Certified dimensional as-built drawings/profile of all installed pipe, specials, and fittings.

3. Details of fittings and specials such as elbows, tees, outlets, connections, test bulkheads, nozzles or other special items where shown in the Contract Drawings. All connections to jointed gasketed pipe materials, valves or fire hydrants must be restrained and supported independently to withstand the pressure transients, soil settlement, and external loading conditions.
4. The Supplier of the material shall submit, through CONTRACTOR, a Certificate of Compliance that the HDPE pipe and fittings furnished for this project meet or exceed the standards set forth in this Specification. CONTRACTOR shall submit these certificates to ENGINEER prior to installation of the pipe materials.
5. A plan for pipe joining and installation. The plan must be reviewed and approved by ENGINEER prior to pipe installation.
6. Provide a certification that personnel responsible for fusing the pipe have been trained and qualified per ASTM F 3190.
7. Information on manufacturer and model of machine to be used for fusion of HDPE pipe.

1.5 QUALITY ASSURANCE

- A. Pipe shall be subject to inspection at the place of manufacture. Notify ENGINEER not less than 14 days prior to the start of any phase of the pipe manufacture. During manufacture ENGINEER shall be given access to all areas of the process and shall be permitted to make inspections necessary to confirm compliance with the Specifications.
- B. Materials used in the manufacture of the pipe shall be tested in accordance with this Section and the referenced standards. CONTRACTOR shall perform said material tests. ENGINEER shall have the right to witness testing if CONTRACTOR's schedule is not delayed for convenience of ENGINEER.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

- A. Pipe up to 3-inch nominal diameter shall meet the requirements of AWWA C901. Pipe 4-inch through 63-inch nominal diameter shall meet the requirements of AWWA C906.
- B. The high-density polyethylene pipe shall be manufactured by **JM Eagle, WL Plastics Corp.**, or approved equal, and shall have a minimum pressure rating as noted on the Contract Drawings. The HDPE pipe shall have designation of PE 4710 (IPS size), made from prime virgin resin with a minimum cell classification of PE 445574C or higher in accordance with ASTM F 714 and D 3350. The resin shall be listed by the Plastic Pipe Institute (PPI) in its pipe-grade registry Technical Report (TR) 4, "Listing of HDB/HDS/SDB/PDB/MRS for Thermoplastic Piping Materials or Pipe".
- C. The manufacturer shall comply with NSF Standard 14 by certifying in writing to the design engineer and making the pipe with the NSF logo in the print line. The manufacturer shall comply with AWWA Standard C901 or C906 by certifying to the design engineer and marking the pipe with the appropriate AWWA standard in the print line.
- D. Fittings shall be pressure rated to match the system piping to which they are joined. At the point of fusion, the outside diameter and minimum wall thickness of the fitting shall meet the outside diameter and minimum wall thickness specifications of AWWA C901 or AWWA C906 for the same size of pipe.

2.2 TRACER WIRE

- A. All HDPE piping shall be installed with continuous tracer wire, Copperhead Extra High Strength (EHS), #1245B with 45 mil HDPE jacket with minimum 1150# break load or approved equal.

2.3 FUSION UNIT REQUIREMENTS

- A. All Fusion Equipment, whether new or used, rented, or owned, shall comply with the requirements of ISO 12176-1 "Equipment for Fusion Jointing Polyethylene Systems".
- B. The butt fusion equipment must be in satisfactory working order and the hydraulic system must be leak free. Heater plates shall be free from scrapes, gouges, and have a consistent clean coated surface. The pressure gauge and thermometer should be properly calibrated. When requested by ENGINEER, records showing a maintenance service/inspection within 3 months prior to use for this project shall be provided.
- C. Rental Butt Fusion Equipment must be maintained by an Authorized Service and Repair Center with at least one Certified Master Mechanic on staff. When requested by ENGINEER, an inspection report detailing the components inspected within 3 months prior to arrival at the jobsite will be provided.
- D. For 16-inch diameter and larger pipe sizes, the butt fusion machine shall be capable of autonomously calculating the drag pressure and perform the shift sequence autonomously.
- E. Electrofusion Processors shall be maintained and calibrated per manufacturer's requirements and recommendations.

PART 3 EXECUTION

3.1 STORAGE AND HANDLING

- A. Pipe shall be stored on clean level ground to prevent undue scratching or gouging. Sections of pipe with deep cuts or gouges shall be removed and ends of pipes rejoined. Handling of the joined pipe shall be in such a manner that the pipe is not damaged by dragging over sharp or cutting objects.
- B. Lifting of joined pipe sections shall preclude concentration of bending stresses at joints and shall be done in a manner which evenly distributes lifting stresses along the full length of the pipe.
- C. Pipe shall be stored in a shaded area or covered to avoid temperature extremes which may cause the pipe to bow or warp.

3.2 EXCAVATION AND BACKFILL

- A. Excavation and backfill of trenches and for appurtenances and backfilling for high density polyethylene pipe shall be in accordance with Section 31 23 15 Excavation and Backfill for Buried Pipelines.

3.3 INSTALLATION

- A. High density polyethylene pipe shall be installed according to the requirements of ASTM D 2321, AWWA M 55, and the manufacturer's requirements. Wherever these requirements are in conflict, the more stringent requirement shall apply.
- B. Pipe embedment - Embedment material should be Class I, Class II, or Class III materials as defined by ASTM D 2321 Section 6. The use of Class IV or Class V materials is not recommended; however, they may be used only with the evaluation and approval of ENGINEER at a demonstrated achievable compaction.
- C. Bedding: Pipe bedding shall be in conformance with ASTM D 2321 Section 8. Compaction rates should be as specified in ASTM D 2321. Deviations shall be approved by ENGINEER.
- D. Haunching and backfill shall be as specified in ASTM D 2321 Section 9 with Class I, II, or III materials. Compaction shall be in excess of 85% Proctor, providing a minimum modulus of 1,000 psi or greater.
- E. Sections of pipe shall be joined into continuous lengths by the butt fusion method and shall be performed in strict conformance with the pipe manufacturer's recommendations using approved equipment. Sections of pipe shall be as long as practical to minimize the number of joints.
- F. High density polyethylene pipe shall be installed, backfilled, and allowed to acclimatize to the typical soil temperatures prior to connection to other piping systems.

3.4 PULL-IN INSTALLATION

- A. Pull-In Installation
 - 1. Per ASTM F 1804, CONTRACTOR shall determine and document the maximum proposed pull-in length and pull-in force for the pressure class and pipe diameter to be pulled into an open trench. Pull-in lengths will not exceed the maximum lengths for the class and diameter pipe. A commercially available load limiter (weak link) approved by ENGINEER shall be used between the puller and the pipe.
 - 2. Prior to pulling the pipeline, CONTRACTOR shall place rollers or other approved devices beneath the pipe to avoid unnecessary damage and to reduce pipe drag.
- B. Trenchless installations:
 - 1. For slip lining, refer to ASTM F 585, PPI PE Handbook (Chapter 11).
 - 2. For pipe bursting, refer to PPI PE Handbook (Chapter 16).

3.5 FUSION AND JOINING

- A. Fusion Joining Requirements:
 - 1. All HDPE pipes shall be joined to by the heat fusion process which produces homogeneous, sealed, leak-tight joints. Tie-ins between sections of HDPE pipe shall be made by butt fusion whenever possible.
 - 2. Butt Fusion: The pipe shall be joined by the butt fusion procedure outlined in ASTM F2620 or PPI TR 33. All fusion joints shall be made in compliance with the pipe or

- fitting manufacturer's recommendations. Fusion joints shall be made by qualified fusion technicians per ASTM F 3190. A record or certificate of training for the fusion operator must be provided which documents training to the fundamentals of ASTM F2620. Considerations should be given to, and provisions made, for adverse weather conditions, such as temperatures below freezing, precipitation, or wind, which is accepted by OWNER and ENGINEER. The use of a controlled cooling cycle procedure to reduce cooling time is acceptable only as part of a controlled cooling cycle procedure where testing demonstrates that acceptable joints are produced using the controlled cooling cycle procedure.
3. Electrofusion: Electrofusion for joints and appurtenances must be approved by OWNER and ENGINEER prior to beginning the project. Electrofusion joining shall be done in accordance with the manufacturer's recommended procedure. Other sources of electrofusion joining information are PPI MAB-01 and PPI MAB-02. The process of electrofusion requires an electric source, commonly called an electrofusion processor that has wire leads. The electrofusion processor must be capable of reading and storing the input parameters and the fusion results for later download to a record file. The qualification of the fusion technician shall be demonstrated by evidence electrofusion training within the past year on the equipment to be utilized for this project.

B. Fusion Operators:

1. The employer of the fusion machine operator is responsible for the fusion joint quality of the fusion weld made by that individual. The employer is responsible for documenting all training and qualification records for that individual, including compliance with any code requirements for fusion/bonder operators.
2. All HDPE fusion equipment operators shall be qualified in the procedure used to perform pipe joining. Fusion equipment operators shall have current, formal training on all fusion equipment employed on the project. Training received more than two years prior to operation with no evidence of activity within the past 6 months shall not be considered current.
3. For Projects with at least 5,000 feet or with pipe larger than 24-inches diameter, operators or their supervisor must have a current training certificate for the equipment to be used on the project.
4. When the fusion machine operator is employed by the HDPE pipe and fusion machine supplier, the supplier shall maintain an ISO 9001 Certified Quality Management System.

C. Butt Fusion Equipment:

1. For 6-inch and larger pipe sizes, the pipe butt fusion machine shall be a self-contained hydraulic fusion machine capable of butt fusing HDPE pipe. The carriage must be removable from the chassis for in-ditch use. The machine must be compatible with an electronic data recording device. Accessories will include all butt fusion inserts for the specified range of pipe sizes, a pyrometer kit for checking the surface temperature of the heater, extension cord of appropriate gauge (25 feet minimum), and hydraulic extension hoses (minimum of four). The butt fusion machine will be **McElroy**, or approved equivalent.
2. For 16-inch diameter and larger pipe sizes, the butt fusion machine shall be capable of autonomously calculating the drag pressure and perform the shift sequence autonomously.

3. In areas where there may be insufficient space for layout of the entire length of fused pipe to be pulled-back, CONTRACTOR shall utilize a continuous HDPE pipe fusion equipment such as a PolyHorse by McElroy or other means to fuse the length of pipe necessary for the installation.

D. Fusion Data Recording:

1. For 6-inch and larger pipe sizes, McElroy DataLogger or equivalent fusion data recorder shall be used to record all fusion welds on hydraulically operated fusion machines. The device shall be capable of meeting the requirements of ASTM F3124. The device, or combination of devices, shall record the following variables of each fused joint:
 - a. Heater surface temperature- immediately before inserting the heater plate, measure with a pyrometer and manually enter into the weld record.
 - b. Gauge pressure during the initial heat cycle.
 - c. Gauge pressure and elapsed time during the heat-soak cycle.
 - d. Heater removal (dwell) time.
 - e. Gauge pressure and elapsed time during the fusing/cool cycle.
 - f. Drag pressure.
 - g. Pipe diameter and wall thickness.
 - h. Type of HDPE material (Specification and Classification) and manufacturer.
 - i. Fusion Machine Identification.
2. The device shall record the operator's name and a unique operator ID number, along with the date and time of each weld.
3. Records showing the device is up to date on all required calibration should be available for presentation when requested.
4. All fusion welds should be traceable to the report (via operator and weld ID) with an indentation weld stamp or by permanent paint marker/pen next to fusion weld.
5. A weld location map may be requested, prior to commencement of work, by the OWNER or OWNER's representative.

E. Butt Fusion Examination and Testing:

1. Examinations
 - a. Visual: For pipe sections, examine the full exterior circumference for bead uniformity before cutting. After cutting the pipe section, review the interior bead. All beads should have visually acceptable bead formation as shown in Fig 4 and Appendix X2 of ASTM F 2620. In addition, the following characteristics are expected:
 - 1) There shall be no evidence of cracks or incomplete fusing.
 - 2) There shall be no evidence of captured objects (e.g., pipe shavings, facer ribbons) between bonded surfaces.
 - 3) Variations in upset bead heights on opposite sides of the cleavage and around the circumference of fused pipe joints are acceptable.
 - 4) The apex of the cleavage between the upset beads of the fused joint shall remain above the base material surface.
 - 5) Fused joints shall not display visible angular misalignment, and outside diameter mismatch shall be less than 10% of the nominal wall thickness.
 - 6) Fusion data record review that meets criteria of section 3.04.D.1 can be used as additional verification of visual indicators.

- b. Fusion Data Record Review: The fusion data record for each fused joint shall be compared to the approved fusion procedure. The reviewer shall verify the following:
 - 1) That all data required by section 3.04.D.1 was recorded
 - 2) Interfacial pressure was within the acceptable range.
 - 3) The heater surface temperature was within the acceptable range.
 - 4) The butt fusion pressure applied during the fusing/cool cycle was correctly calculated to include drag pressure, fell within the acceptable range for the applicable size and agrees with the recorded hydraulic fusing pressure.
 - 5) The butt fusing pressure was reduced to a value less than or equal to drag pressure at the beginning of the heat soak cycle.
 - 6) The fusing machine was opened at the end of the heat soak cycle, the heater was removed, and the ends were brought together at the fusion pressure with the acceptable time range.
 - 7) Cooling time at butt fusing pressure met the minimum time specified.
 - c. If the recorded data in section 3.4.D.1 is outside the limits of the acceptable range, the joint is unacceptable, and must be removed and replaced.
 - d. Frequency. Records for test fusion joints should be reviewed immediately after the joint is completed. Fusion joints for jobsite fusions should be reviewed daily or before being covered with backfill.
2. Mechanical Tests
- a. CONTRACTOR shall mechanically test the first fusion of each operator and each machine used on the project. Installation shall not continue until a fusion test has passed the test. Additional mechanical tests are not required as long as long as the fusion is reviewed with the frequency specified in section 3.4.E.1.d. Testing of fusion joints with no fusion data record review shall be at a frequency specified by OWNER or ENGINEER.
 - b. The fusion shall be allowed to cool completely, then fusion test straps shall be cut out.
 - c. All samples shall be labeled with operator information. Testing must be done at 73 degrees F plus or minus 5 degrees. The test temperature and sample size are critical to testing. Testing performed at cold or elevated temperatures may not give similar results to tests performed at ambient temperatures.
 - d. Each pipe sample weld shall be subjected to testing at two locations 180 degrees apart from each other in the joint weld. All specimens shall be tested by one of the following methods:
 - 1) Reverse Bend Test are allowed for pipe sizes 4-inch diameter IPS or smaller. The specimens shall be prepared and tested in accordance with ASTM F 2620, Appendix X4.
 - 2) Guided Side Bend Test is allowed for all wall thicknesses of 1-inch or greater. The specimens shall be removed and tested in accordance with ASTM F 3183.
 - 3) Hydrostatic Burst Test is allowed for pipe sizes 2- to 24-inch. The specimen length should measure 6 times pipe diameter with the butt fusion joint in the center of the specimen. The specimen should be tested in a tank filled with water, and testing conditions monitored and recorded with computerized equipment. The specimen will be tested at 4 times pipe rated pressure for 5 minutes with no failure of joint allowed.
 - e. Results of any mechanical test should be documented. Information on the weld and operator should be transferred from the sample to the testing record.

3.6 TRACER WIRE TESTING

- A. Safety tracer tape shall be installed above pipe as required by the Drawings. Tracer wire shall also be installed as required by the Drawings.
- B. Upon completion of the pipe installation, CONTRACTOR shall demonstrate that the wire is continuous and unbroken through the entire run of the pipe.
 - 1. Demonstration shall include full signal conductivity (including splices) when energizing for the entire run in the presence of OWNER or ENGINEER.
 - 2. If the wire is broken, CONTRACTOR shall repair or replace it. Pipeline installation will not be accepted until the wire passes a continuity test.

3.7 PRELIMINARY CLEANING AND FLUSHING

- A. CONTRACTOR shall flush the pipeline as the work progresses by a means in accordance with good practice to ensure that sand, rocks, or other foreign material are not left in any of the pipeline. If possible, the flushing shall be made with an open pipe end.
- B. CONTRACTOR shall provide to ENGINEER a proposed schedule and method of flushing for review before the flushing starts.

3.8 PRESSURE AND LEAK TEST

- A. The system test pressure shall be 200 psi for the new DR-11 pipelines and 250 psi for the new DR-9 pipelines.
- B. Testing prior to pipe installation outside of the trench.
 - 1. CONTRACTOR shall test all piping either in sections or as a unit. The test shall be made by placing temporary bulkheads as needed in the pipe and filling the line slowly with water. Care shall be taken to see that all air vents are open during the filling. After the piping or section thereof has been filled, subject the pipe to a hydrostatic test pressure as specified in 3.6.A for a maximum of three hours. During this time, add water periodically to maintain the test pressure; this compensates for the initial stretching of the pipe. The line-pressure tightness is determined by visual observation; therefore, it is not necessary to measure the make-up water. Examine every fused joint; any leakage must be repaired and then retested.
 - 2. CONTRACTOR shall be responsible to ensure that appropriate safety precautions are observed during the hydrostatic testing above ground.
- C. Testing in the trench. Fill the pipeline with water after it has been laid, and bleed off any trapped air. Subject the lowest element in the system to a test pressure that is 1.5 times the design pressure and check for any leakage. When, in the opinion of the engineer, local conditions require that the trenches be backfilled immediately after the pipe has been laid, apply the pressure test after backfilling has been completed but not sooner than a time which will allow sufficient curing of any concrete that may have been used.
 - 1. The test procedures consist of two steps: the initial expansion and the test phase. When test pressure is applied to a water-filled pipe, the pipe expands. During the initial expansion of the pipe under test, sufficient make-up water must be added to the

- system at hourly intervals for three hours to maintain the test pressure. After about four hours, initial expansion should be complete, and the actual test can start.
2. When the test is to begin, the pipe is full of water and is subjected to a constant test pressure of 1.5 times the system design pressure. The test phase should not exceed three hours, after which time any water deficiency must be replaced and measured. Add and measure the amount of make-up water required to return the test pressure and compare this to the maximum allowance in Table 1 below.

TABLE 1 ALLOWANCE FOR EXPANSION UNDER TEST PRESSURE							
Nominal Pipe Size	U.S. Gal/100 ft of Pipe			Nominal Pipe Size	U.S. Gal/100 ft of Pipe		
	1-Hour	2-Hour	3-Hour		1-Hour	2-Hour	3-Hour
2	0.08	0.12	0.15	20	2.80	5.50	8.00
3	0.10	0.15	0.25	22	3.50	7.00	10.50
4	0.13	0.25	0.40	24	4.50	8.90	13.30
5	0.21	0.41	0.63	28	5.50	11.10	16.80
6	0.30	0.60	0.90	30	6.20	12.60	19.10
8	0.50	1.00	1.50	32	7.00	14.30	21.50
10	0.75	1.30	2.10	36	9.00	18.00	27.00
12	1.10	2.30	3.40	42	12.00	24.00	36.00
14	1.40	2.80	4.20	48	15.00	27.00	43.00
16	1.70	3.30	5.00	54	18.00	30.00	50.00
18	2.20	4.30	6.50				

From PPI Technical Report TR-31 by the Plastic Pipe Institute.

- D. An alternate leakage test consists of maintaining the test pressure over a period of four hours, and then dropping the pressure by 10 psi. If the pressure then remains within 5% of the target value for one hour, this indicates there is no leakage in the system.
- E. Under no circumstances shall the total time under test exceed eight hours at 1.5 times the system pressure rating. If the test is not complete within this time limit (due to leakage, equipment failure, etc.), the test section shall be permitted to “relax” for eight-hours prior to the next test sequence.

DISINFECTING

- F. Disinfection shall be in accordance with Section 33 13 00- Pipeline Testing and Disinfection.

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SECTION 33 05 13
PRECAST CONCRETE MANHOLES AND STRUCTURES

PART 1 GENERAL

1.1 SUMMARY

- A. CONTRACTOR shall provide precast concrete manholes and vaults, complete and in place, in accordance with the Contract Documents.

1.2 RELATED WORK

- A. Related work specified in other sections:
1. Section 01 33 00 Submittals
 2. Section 01 45 00 Quality Control and Materials Testing
 3. Section 31 23 15 Excavation and Backfill for Buried Pipelines
 4. Section 31 23 23 Excavation and Backfill for Structures
 5. Section 33 05 05 Ductile Iron Pipe

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)
1. ASTM A 48 Standard Specification for Gray Iron Castings
 2. ASTM A 536 Standard Specification for Ductile Iron Castings
 3. ASTM A 615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 4. ASTM C 150 Standard Specification for Portland Cement
 5. ASTM C 478 Standard Specification for Precast Reinforced Concrete Manhole Sections
 6. ASTM C 497 Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile
 7. ASTM C 857 Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
 8. ASTM C 858 Standard Specification for Underground Precast Concrete Utility Structures
 9. ASTM C 913 Standard Specification for Precast Concrete Water and Wastewater Structures
 10. ASTM C 923 Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
 11. ASTM C 990 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. Shop Drawings: Indicate manhole and concrete structure locations, elevations, and piping sizes, material, and elevations of penetrations.
- C. Product Data: Submit cover and frame construction, features, configuration and dimensions. Submit pipe connector materials and dimensions. Submit manhole step materials and dimensions. Submit manhole and structure joint sealant materials.

1.5 QUALITY ASSURANCE

- A. CONTRACTOR shall demonstrate that manholes and structures have been properly installed, level, with tight joints, at correct elevations and orientations, and have been backfilled and compacted in accordance with the specifications.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Comply with precast concrete manufacturer's instructions for unloading, storing and moving precast manholes and structures.
- B. Store precast concrete manholes and structures to prevent damage to Owner's property or other public or private property. Repair property damaged from materials storage.
- C. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Drawings to indicate its intended use.

PART 2 PRODUCTS

2.1 MANHOLES

- A. Reinforced precast concrete manholes in accordance with ASTM C 478 with HS-20 loading. Axial length of barrel sections shall be selected to provide the correct total height with the fewest joints. Conical sections shall be designed to support cast iron frames and covers under H-20 loading, unless noted otherwise. Design criteria shall be as shown on the drawings. Manholes shall be manufactured by **Oldcastle Precast, Geneva Pipe and Precast**, or approved equal.
- B. Joints shall be sealed with butyl-rubber sealants, **ConSeal CS-102, Ram-Nek RN101**, or approved equal, conformation to ASTM C 990
- C. Barrel section to pipe connections shall be sealed with resilient connectors, **Kor-N-Seal by Trelleborg**, or approved equal, complying with ASTM C 923. Mechanical devices shall be stainless steel.

2.2 STRUCTURES

- A. Provide reinforced concrete structures and vaults designed for the applications and sizes as shown on the drawings. Structures shall conform to the requirements of ASTM C 857, ASTM C 858, or ASTM C 913 as required. Minimum wall thickness shall be 5-inches. Cement shall be Type V Portland cement conforming to the requirements of ASTM C 150. The minimum 28-day concrete compressive strength shall be 4,000 psi. Reinforcing steel shall be embedded in the concrete with a minimum rebar clear cover as recommended by ACI 318. Structure and vaults shall be manufactured by **Oldcastle Precast, Geneva Pipe and Precast**, or approved equal

- B. Structures in areas subject to traffic shall be designed for H-20 traffic loading. Vaults in other areas shall be designed for a vertical live load of 300 psf.
- C. Where joints are required, joints shall be interlocking to secure proper alignment between members and shall prevent migration of soil through the joint. Joints shall be sealed with butyl-rubber sealants, **ConSeal CS-102**, **Ram-Nek RN101**, or approved equal, conformation to ASTM C 990.
- D. Openings, where required, shall be of the size and location indicated on the drawings and shall be provided without obstructions from brackets and supports. Unless noted otherwise, frames and covers shall be fabricated from steel and galvanized after fabrication. Frames shall be integrally cast into the structure concrete sections. Covers shall be tight fitting to prevent dirt and debris entering the structure.
- E. Where penetrations are required for piping, conduits, or ducts, such penetrations shall be through precast openings or core drilled through unreinforced thin-wall knock-out sections. Penetrations shall be smooth and exposed reinforcing steel will not be allowed. Unless noted otherwise, structures do not need to be designed to resist thrust from piping passing through the structure.

2.3 FRAMES AND COVERS

- A. Manufacturers:
 - 1. D & L Foundry and Supply, East Jordan Iron Works, Neenah Foundry Co., or approved equal. Model Number as shown on the Drawings.
- B. Product Description: Casting frames and covers shall be non-rocking and shall conform to the requirements of ASTM A 48, Class 35B for Gray Iron and ASTM A 536 for ductile iron. Unless noted otherwise, cast iron covers and frames shall be 30-inches in diameter, machined flat bearing surface, removable lid; HS-20 load rating; with embossed lettering saying (“IRRIGATION”, “WATER”, “SEWER”, “STORM DRAIN”) cast into cover.

2.4 COMPONENTS

- A. Manhole and Structure Steps shall have a 1/2-inch ASTM A 615 grade 60 steel reinforcement rod encased in polypropylene copolymer plastic. Steps shall have a tread width of 14-inches nominal. Steps shall be manufactured by **American Step Company, Inc.**, **M.A. Industries**, or approved equal.

2.5 CONFIGURATION

- A. Shaft Construction: Square or rectangular with flat lid top section; lipped male/female joints; shaped to receive pipe sections.
- B. Clear Inside Dimensions: As indicated on Drawings.
- C. Design Depth: As indicated on Drawings.
- D. Clear Cover Opening: As indicated on Drawings.

2.6 BEDDING AND COVER MATERIALS

- A. Bedding: 3/4" Washed Rock as specified in Section 31 23 23.
- B. Soil Backfill to Finish Grade: Trench Backfill Material as specified in Section 31 23 15.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify built-in items are in proper location, and ready for roughing into Work.
- C. Verify correct size of manhole and structure excavation.

3.2 PREPARATION

- A. Do not install structures where site conditions induce loads exceeding structural capacity of structures.
- B. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage. Remove and replace damaged units.

3.3 PRECAST CONCRETE MANHOLE AND STRUCTURE INSTALLATION

- A. Lift precast components at lifting points designated by manufacturer.
- B. When lowering manholes and structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and structure remains clean.
- C. Set precast structures bearing firmly and fully on crushed stone bedding, compacted in accordance with provisions of Section 31 23 23.
- D. Assemble multi-section structures by lowering each section into excavation. Lower, set level, and firmly position base section before placing additional sections.
- E. Remove foreign materials from joint surfaces and verify sealing materials are placed properly. Maintain alignment between sections by using guide devices affixed to lower section.
- F. Joint sealing materials may be installed on site or at manufacturer's plant.
- G. Verify manholes and structures installed satisfy required alignment and grade.
- H. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe.
- I. Steps shall be installed 12-inches on centers vertically not more than 1/2-inch out of plumb. The top step shall not be more than 12-inches below the manhole cover.

- J. Prior to backfilling, fill all cracks and voids in the manholes or vaults with non-shrink grout, polyurethane sealant, or both.

3.4 FRAME AND COVER INSTALLATION

- A. Set frame and cover 2-inches above finished grade for manholes and structures with covers located within unpaved areas to allow area to be graded away from cover beginning 1-inch below top surface of frame.

3.5 FIELD QUALITY CONTROL

- A. Section 01 45 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Vertical Adjustment of Existing Manholes and Structures
 - 1. Where required, adjust top elevation of manholes and structures to finished grades shown on Drawings.
 - 2. Reset existing frames, grates and covers, carefully removed, cleaned of mortar fragments, to required elevation in accordance with requirements specified for installation of castings.

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SECTION 33 12 00
MECHANICAL APPURTENANCES

PART 1 GENERAL

1.1 SUMMARY

- A.CONTRACTOR shall furnish and install all valves, and equipment, complete and operable in accordance with the Specifications.
- B.Where two or more valves or equipment of the same type and size are required, the valves shall be furnished by the same manufacturer.
- C.CONTRACTOR shall verify that flanges on pipe match the bolt hole pattern of the flanges on the mechanical appurtenances.
- D.All appurtenances shall be NSF 61 certified if used in potable water systems.
- E.Unless noted otherwise below or in the Contract Drawings, all system components shall be rated for the maximum system pressure or higher.

1.2 RELATED WORK

A.Related Work specified in other Sections includes, but is not limited to:

- 1. Section 01 33 00 Submittal Procedures
- 2. Section 01 45 00 Quality Control & Materials Testing
- 3. Section 01 50 00 Temporary Construction Utilities and Environmental Controls
- 4. Section 33 05 05 Ductile Iron Pipe
- 5. Section 33 05 07.1 Polyvinyl Chloride (PVC) Pressure Pipe (Modified)
- 6. Section 33 13 00 Pipeline Testing and Disinfection
- 7. Section 33 92 10 Steel Pipe, Specials, and Fittings (AWWA C200, modified)

1.3 REFERENCES

A.The latest editions of the following publications form a part of these Specifications to the extent referenced. The publications are referred to in the text to by basic designation only.

B.AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- 1. A 126 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
- 2. A 216 Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
- 3. B 584 Standard Specification for Copper Alloy Sand Castings for General Applications
- 4. D-1763 Standard Specification for Epoxy Resins

C.AMERICAN WATER WORKS ASSOCIATION (AWWA)

- 1. C-504 Rubber-Seated Butterfly Valves, 3-inch through 72-inch
- 2. C-509 Resilient-Seated Gate Valves for Water Supply Service

3. C-512 Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service
4. C-515 Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
5. C-540 Standard for Power-Actuating Devices for Valves and Sluice Gates
6. C 550 Protective Interior Coatings for Valves and Hydrants

D.AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

1. B 16.1 Gray Iron Pipe Flanges and Flanged Fittings
2. B 16.34 Valves – Flanged, Threaded, and Welding End

E.NSF INTERNATIONAL (NSF)

1. NSF/ANSI 61 Drinking Water System Components - Health Effects

1.4 SUBMITTALS

A.Provide submittals in accordance with Section 01 33 00 – Submittals.

B.Submit catalog cut sheets on all mechanical appurtenances including fittings, valves, or other items shown on the Drawings referencing each item by mark number. Information shall indicate manufacturer specification compliance, Cv factor, pressure rating, and dimensional data.

C.Submittals for the electric motor operators for the butterfly valves shall include calculations verifying the selected actuator output torque and computed valve opening and closure times under the conditions specified herein.

PART 2 PRODUCTS

2.1 GATE VALVES

A.Gate valves shall conform to the requirements of AWWA C-509 or C-515. Valves shall be of the resilient-seat type with non-rising stem (NRS), opening to the left, and provided with a 2-inch square operating nut for buried valves or hand wheel for valves located in structures. Buried valves shall be of flange or mechanical joint design to match pipe joint system.

B.Valves, valve-operating units, stem extensions and other accessories shall be installed by CONTRACTOR where shown, or where required in the opinion of ENGINEER, to provide for convenience in operation. Where buried valves are indicated, CONTRACTOR shall furnish and install valve boxes to 3-inches above grade in unimproved areas or at grade with concrete collar in improved areas. All valves and gates shall be new and of current manufacture.

C.The valve shall have a two-part thermosetting or fusion bonded epoxy protective coating (10 mil minimum inside and out) system that is non-toxic and imparts no taste to water. The epoxy shall be applied in accordance with AWWA C550 and be ANSI/NSF 61 certified.

D.The flanges of valves may be raised or plain faced. Flanges of valves shall be faced and drilled to 125-lb American Standard template. Provide ASME Class 250 flanges for valves located on the high-pressure discharge side piping.

E.All valves shall be furnished with pressure classes equal to or better than the pressure class of the pipe with which the valves are to be used. Unless otherwise specified, each valve body shall be tested under a test pressure equal to twice its design water-working pressure.

F.Valves shall be manufactured by **Mueller Co., Clow Valve Co.**, or approved equal.

2.2 BUTTERFLY VALVES

A.Butterfly valves shall be High Performance: High Performance Butterfly valves shall meet MSS SP-68, for high pressure butterfly valves with a double offset seat, disc and stem design. The valve must meet the latest ASTM, ANSI and API standards for material, design and testing specifications. Stem bearings must be constructed of PTFE and stainless-steel material. The valve stem is to be a one-piece design. Packing must have an adjustable, two-bolt pull down design. Lugged valves must be capable of fully rated double dead-end service. Valves shall be NSF 61 certified and have a Flange by Flange, Flange by Mechanical Joint, Mechanical Joint, or wafer body style, as indicated on the drawings, rated for 250 psi working pressure. The valves shall have a heavy-duty ductile iron body with flanges fully faced and drilled per ANSI B16.1 Class 150B. Shells shall be tested at a minimum of 400 psi. Maximum flow velocity shall be less than 16 fps for cold water service. The valve shall have a hand wheel operator, 2-inch Standard AWWA nut operator, or traveling nut actuators rated at 450 ft. lbs. torque and extensions as indicated on the Drawings. The valve shall have an FDA, EPA, AWWA C550 and ASTM D1763 approved two-part thermosetting epoxy protective coating (10 mil minimum inside and out) system that is non-toxic and imparts no taste to water. The epoxy shall be applied in accordance with AWWA C550 and be ANSI/NSF 61 certified. Valves shall be manufactured by **VAG, Av-Tek DEX** or approved equal.

2.3 BALL VALVES

A.Valves shall be rated for the working pressure of the system. Valves for use in potable water systems shall be NSF 61 certified and NSF 372 lead free.

B.**Stainless Steel Ball Valves** shall be full port opening stainless steel and have adjustable stem packing gland. Body and ball shall be stainless steel in accordance with ASTM A351. Seats shall be reinforced PTFE and packing stem shall be PTFE. The handle shall be Type 304 stainless steel with vinyl insulator. The valves shall conform to MSS-SP-110. The valves shall be manufactured by **Apollo 76F-100-A, NIBCO T-585-S6-R-66-LL, Watts Series S-FBV-1**, or approved equal.

C.**Bronze Ball Valves** shall be full port opening bronze body, hard chrome plated brass ball and have adjustable stem packing gland. Seat and seals shall be PTFE. Handle shall be heavy, duty, zinc-plated steel with vinyl insulator. The valves shall conform to MSS-SP-110. They shall be **Watts Series LFB6080G2, NIBCO T685-80-LF, Apollo 70CLF-100 Series**, or approved equal.

D.**Brass Ball Valves** shall be full port opening brass, blow out proof stem design, adjustable stem packing, secondary O-ring stem seal, zinc plated steel handle with vinyl insulator. The valves shall conform to MSS-SP-110. Provide **Apollo Series 77F-100, Watts Series LFB6801, NIBCO FP600A-LF, FNW X410C**, or approved equal.

E.**PVC Ball Valves** shall be full port opening with all wetted materials composed of Schedule

80 PVC. Valve shall have true union ends or flanged ends to mate with ANSI B16.5 Class 150 flanges. PVC ball valves shall be **NIBCO Chemtrol Series, Spears Manufacturing TU-2000**, or approved equal. PVC ball valves shall have PTFE ball seats, EPDM o-rings, and high impact handle. Valves shall be full port rated for water to 235 psi.

2.4 SEGMENTED BALL VALVES

A. Segmented ball valves shall be **Neles R-Series Segment Valve**, flanged RE, with low flow Q trim for cavitation/noise abatement, flanged rated at ASME 150 as manufactured by Metso Automation. Valves shall be connected to a 3-phase, 480/277 volt, electric motor operator.

2.5 PUMP CONTROL VALVES AND ELECTRIC MOTOR OPERATORS

A. Pump Control Valves

1. The pump control valves shall be electrically operated segmented ball valves in the pump to waste lines and butterfly valves in-line designed to eliminate pipe surges caused by the starting and stopping of deep-well pumps.
2. At the well sites, the pumps shall start and stop with the segmented ball control valve in the predetermined partially open position, and the in-line butterfly valve in the closed position. After pumping to waste, the in-line valve will open. While the in-line butterfly valve opens, the segmented ball valve closes, gradually transferring the pumped water from the pump-to-waste line to the transmission line. Before the pump stops, the segmented ball control valve shall gradually open. Simultaneously, the in-line butterfly valve shall close, allowing the check valves to seat and directing flow to pump-to-waste. When the ball valve reaches the predetermined set point, the pump shall be shut-off. The pressure class shall be 150. The butterfly valves shall conform to Section 2.2 above.
3. The segmented ball valve shall conform to Section 2.4 above.

B. Electric Motor Operators (EMO)

1. EMOs shall be furnished and installed to operate the high-performance butterfly and segmented ball control valves. The EMOs or valve actuator shall be fully compatible with the valves specified in this Section. CONTRACTOR shall be responsible for assuring that valve stem diameter, threading, key and keyway adaptation, and other dimensional information is as required to make the valve actuator and valve function as an integrated package.
2. EMOs shall mount directly to the butterfly or segmented ball valve. The motor operator shall include the motor, gearing, limit and torque switches, selector switch, push button station, position indicator, control voltage transformer, integral reversing controller, indicator lights, handwheel, lubricants, heating elements, wiring, and terminals. Each operator shall be constructed as a self-contained unit with a ductile iron weatherproof housing and shall be integrally assembled on the applicable valve by the valve manufacturer. Position and limit switches, position transmitters, controls, indicating lights, devices, and selector switches shall be coordinated with the input/output requirements of the control system as indicated on the drawings and specified herein. The motor operators shall have an electrical rating of 480 volt (as indicated on the Contract Drawings), 3 phase, 60 HZ, AC. Overload protection shall be provided for the motor.

3. The reduction gearing shall consist of generated helical or spur gears of heat-treated steel. The worm of the electric operator and the 90-degree operator shall be of carburized and hardened alloy steel with the thread ground and polished. The worm gear shall be one piece and of chilled nickel bronze accurately cut. Reduction gearing shall run in lubricant and shall be designed for 100 percent overload, and effectively sealed against entrance of foreign matter. Gearing shall be designed to be self-locking so that actuation of a torque switch by a torque overload condition will not allow the operator to restart until the torque overload has been eliminated. The gearing mechanism shall be constructed to permit changes in the field of the reduction gear ratio. The use of planetary or cycloidal gearing or aluminum, mild steel, or non-metallic gears will not be acceptable. Permanently lubricated, antifriction ball or roller bearings shall be used throughout.
4. The operators for butterfly and segmented ball valves shall be designed to stroke from full open to full close or from full close to full open in not less than 180 seconds. Operating time for all valves of a given size shall be equal.
5. The Electric Motor Operator shall provide adequate seating, unseating and dynamic torque to properly operate the butterfly and segmented ball valves. The Electric Motor Operator shall be **Limitorque L120 with T Series wormgear actuator** or approved equal. Motorized operators for all valves shall be supplied by the same manufacturer. Actuators shall be as required to open and close with a typical operating pressure of 140 psi and a flow of 1,600 gpm at the 700 East Well site, and 140 psi and 3,000 gpm at the 1000 East Well site.

2.6 SERVICE SADDLES

- A. Shall consist of a 2-piece bronze body and strap, meeting applicable sections of AWWA C800.
- B. Outlet shall be tapped with AWWA I.P. thread (F.I.P.T.). Outlet shall be o ring sealed. Saddles shall be ANSI/NSF 61 certified.
- C. Shall be **Mueller BR2B Series, Ford Style 202B**, or approved equal.

2.7 CORP STOPS

- A. Corp Stops shall be Brass Alloy 85-5-5-5 ASTM B62 and conform to the requirements of AWWA C800.
- B. Corp Stops for 3/4-inch and 1-inch sizes shall be **Mueller B-25028N, Ford FB1100-x-Q-NL**, or approved equal.

2.8 PRESSURE REDUCING VALVES (SMALL)

- A. Pressure reducing valves 1/2-inch to 2-1/2-inch shall have a lead-free cast copper silicon alloy body and yoke with stainless steel trim and integral stainless-steel strainer. Diaphragm shall be reinforced EPDM with EPDM disc. Valves shall be balanced, direct acting type **Model LFU5B-Z3 by Watts.**, or approved equal. Valves shall be installed at the location(s) shown on the drawings. The valve shall be designed for a maximum working pressure of 300 psi and the valve shall be set to operate at the pressure 45 psi.

B.The 1/4-inch pressure reducing valves shall be brass, manufactured by Watts, Series 560G-A, for installation at the location shown on the Contract Drawings. The valve shall be set to operate at 5 psi.

2.9 STRAINERS

A.Metal strainers shall cast bronze wye-pattern with flush valve as manufactured by Zurn, Model SXL or approved equal.

B.Strainers in 1 1/4" or smaller chemical piping or hose shall be CPVC Schedule 80 YS Series True Union Y-Strainers as manufactured by Hayward Industrial Products, Inc. The screens shall be CPVC with 1/16" perforations. All components shall be compatible with sodium hypochlorite chemical.

C.Strainers in 2" Chemical Supply Pipeline shall be one piece molded body, true union type design with removable screen, drain plug, cap, and EPDM or Viton O-ring seal, and CPVC body with solvent welded ends, integral mounting base, rated for the following pressures at 70 degrees F: 1/2- to 2-inches 150 psi, 3- to 4-inches 60 psi. The screens shall be of CPVC, with a free area of 6 times the cross-sectional area of the pipe and 1/16-inch perforations. Strainers shall be Hayward Industries Products Basket Strainer, or

2.10 DRAIN LINE CHECK VALVE

A.Drain line check valves shall be as manufactured by Red Valve and shall be the Tideflex Model TF-1 (no approved equal), low-head check valve for installation at the location shown on the Contract Drawings.

2.11 VALVE BOXES AND LIDS

A.All buried valves shall be installed complete with nominal 6-inch diameter slip type, two-piece cast-iron valve box. The manufacturer shall be Tyler Union 6855 Series or approved equal. The valve box lid shall be designated "WATER" unless noted otherwise on the Contract Drawings.

B.Concrete Collars shall be 10" thick x 2'- 6" in diameter centered on the valve box. They shall have two circumscribing #4 bars, one at three inches from the outside edge and a second bar nine inches from the outside edge each centered in the concrete. Concrete shall be 3,000 psi.

2.12 COMBINATION AIR/VACUUM VALVES

A.Air/Vacuum valves shall be Val-Matic Air/Vacuum Clean Water Valves, or approved equal, with orifice size as designated on the Contract Drawings. Valve interiors and exteriors shall be coated with a fusion bonded epoxy. Valves shall comply with NSF 372 Certified Lead Free, NSF 61 Certified for Drinking Water, and shall meet AWWA C512,

2.13 CHECK VALVES

A.The 14-inch and 12-inch check valves shall be **APCO Globe Style Series 600 Silent Check Valves, Val-Matic Series – 1800 Globe Silent Check Valves**, or approved equal, and shall be rated at 150 psi. Globe Style Silent Check Valve shall be flanged and drilled per ASME B16 with 125/150 Valve interiors and exteriors shall be coated with a fusion

bonded epoxy. Valve plug must be center guided at both ends with a through integral shaft. Valve spring must be a coil spring, Type 316 Stainless Steel with the ends ground flat for true perpendicular closing force. Valve seat and plug shall be replaceable in the field for ease of maintenance. Resilient seated valves shall be drip tight. Flow area through the body shall be equal to or greater than the cross-sectional area of the equivalent pipe size. Two Year Warranty shall be provided for all valves

B. The 1 inch, 1 ¼ inch and 2-inch brass check valves shall be **Watts CVY Series** with rating 125 WSP/200 WOG.

C. The 1 inch and 1 ¼ inch PVC check valves shall be Spears Manufacturing Company, True Union 2000 Industrial Ball Check Valve, or equal.

2.14 SOLENOID VALVE

A. The solenoid valves for chemical sampling shall be 2-way pilot operated general service, 120 VAC, 60 Hz. Valves shall be Brass or Stainless Steel, ASCO Red-Hat series 8210 rated for water to 200 psi - normally closed or approved equal. Valves shall include all couplings or adapters to connect to the piping system.

2.15 HOSE BIBBS and SAMPLING TAPS

A. Hose bibbs shall be as-manufactured by **Watts**, or approved equal, and shall include an integral vacuum breaker or built-in backflow protection devices and cast-iron wheel handle. Sampling Taps shall be smooth nose type. Valves shall be 316 stainless steel or brass as shown on the Contract Drawings.

2.16 STEEL SPOOLS AND STEEL FITTINGS

A. Steel Spools and Steel Fittings shall be sized to match the existing conditions of the piping. They shall meet the requirements of Section 33 92 10 – Steel Pipe, Specials and Fittings.

2.17 GASKETS AND BOLTS

A. Except as otherwise provided, gaskets for flanged joints shall be 1/8-inch-thick rubber fabric. Class 250 or less flange gaskets shall be **Flange-Tyte by U.S. Pipe**, higher pressure joint gaskets shall be **Garlock BLUE-GARD Style 3000**, or approved equal. Wherever blind flanges are shown, the gaskets shall consist of 1/8-inch-thick cloth-inserted rubber sheet which shall cover the entire inside surface of the blind flange and shall be cemented to the surface of the blind flange.

B. All bolts and nuts shall be zinc plated. Bolts shall be rated for the system working pressure with a minimum safety factor of three.

2.18 MECHANICAL-TYPE COUPLINGS (GROOVED)

A. Mechanical-type couplings for steel pipe shall be provided where indicated on the Drawings and shall conform to the requirements of AWWA C606. Mechanical type couplings shall be designed for a water working pressure not less than the design pressure of the pipe on which they are to be installed. Mechanical-type couplings shall be **Victaulic Style W77 AGS**, or approved equal.

B. Gaskets shall be the flush seal type.

C. Mechanical-type couplings for equipment connections shall be provided with rigid grooved couplings or flexible type coupling with harness, unless thrust restraint is provided by other means.

2.19 UNIONS

A. Furnish and install unions for each valve or piece of equipment to permit easy installation and removal of equipment.

2.20 PRESSURE GAUGES

A. Pressure gauges shall be provided where shown on the drawings. Gauges shall meet the requirements of ASME B40.1 Grade 2A and be industrial type with stainless steel movement, liquid filled, and stainless steel, Polypropylene, or Phenolic case. Gauges shall have a rear blowout disc or panel. Unless noted otherwise on the drawings, pressure gauges shall have a 4-1/2-inch dial with white face and black lettering, a 1/2-inch threaded connection, and shut-off valve. The measuring element shall be a stainless-steel Bourdon Tube. Gauges shall be calibrated to read in applicable units, with an accuracy of ± 0.5 percent to 150 percent of the working pressure. Gauges shall be manufactured by **Ashcroft Model 1279 Duragauge, 1900 Series SOLFRUNT by Ametek (U.S. Gauge), Process Gauge by Marsh Bellofram**, or approved equal.

B. Pressure gauges that connect to lines other than potable water shall have gauge guards to prevent corrosion and clogging. Gauge guards shall have a durable flexible diaphragm which serves as a protective barrier between the process fluid and instrument. The diaphragm shall be either elastomer or Teflon and rated for the pressure of the gauge.

C. Pressure gauges for chemical service lines shall be 2-1/2-inch diameter with integral diaphragm seal. These gauges shall be manufactured by **Plast-o-matic**, or approved equal.

2.21 EXPANSION JOINTS

A. Expansion joints shall be **Mercer Flexmore Series 450, Style 451**, with Neoprene, as manufactured by Mercer Rubber Company.

2.22 VACUUM PUMP

A. Vacuum pump shall be Marathon II Air Operated Double Diaphragm Pump Model M07 3/4", 18 gpm, as manufactured by **Warren Rupp**.

PART 3 EXECUTION

3.1 INSTALLATION

A. Valves, valve-operating units, stem extensions and other accessories shall be installed by CONTRACTOR where shown, or where required in the opinion of ENGINEER, to provide for convenience in operation. Where buried valves are indicated, CONTRACTOR shall furnish and install valve boxes at grade with concrete collars. All valves and boxes shall be new and recently manufactured.

B. Install mechanical appurtenances as indicated on the plans and in accordance with the manufacturer's written instructions.

C.Valve boxes in asphalt shall be installed with concrete collars.

- END OF SECTION -

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SECTION 33 13 00
PIPELINE TESTING AND DISINFECTION

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers testing and disinfection in order to remove bacteriological contamination of the pipeline. Disinfection is only required if the pipeline is used for potable water.
- B. CONTRACTOR shall be responsible for obtaining permits for discharging excess testing water and dechlorination of such water, if required.
 - 1. All pressure pipelines shall be tested.
- C. Hydrostatic testing shall meet the requirements of this Section, or the requirements provided in each individual pipeline Section, whichever is more stringent.
- D. If there is a discrepancy between this Section, the individual pipe Sections, or applicable AWWA Standards, the more stringent requirement shall apply.

1.2 RELATED SECTIONS

- A. Related Work specified in other Sections includes, but is not limited to:
 - 1. Section 01 33 00 Submittal procedures
 - 2. Section 33 05 05 Ductile Iron Pipe
 - 3. Section 33 05 07 Polyvinyl Chloride (PVC) Pipe (AWWA C900)
 - 4. Section 33 92 10 Steel Pipe, Specials, and Fittings (AWWA C200)

1.3 REFERENCES

- A. The Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publications are referred to in the text by basic designation only.
 - 1. AWWA C 600 Standard Installation of Ductile-Iron Mains and Their Appurtenances
 - 2. AWWA C 604 Standard Installation of Buried Steel Water Pipe – 4-inch (100mm) and larger
 - 3. AWWA C 605 Standard Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
 - 4. AWWA C 651 Standard for Disinfecting Water Mains
 - 5. Utah Public Drinking Water Regulations

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

- B. Furnish a written testing plan and schedule, including proposed chemicals, water source, methods for conveyance to the project, sequence, control, and disposal. District will take the bacteriological tests.
- C. Disinfection Report:
 - 1. Type and form of disinfectant used.
 - 2. Date and time of disinfectant injection start and time of completion.
 - 3. Test locations.
 - 4. Name of person collecting samples.
 - 5. Initial and 24-hour disinfectant residuals in treated water in parts per million (ppm) for each outlet tested.
 - 6. Date and time of start and completion for flushing.
 - 7. Disinfectant residual after flushing in ppm for each outlet tested.

PART 2 MATERIALS

2.1 DESCRIPTION

- A. All test equipment, temporary valves, bulkheads, and other water control equipment, shall be as determined and provided by CONTRACTOR. No materials shall be used which damage the project pipelines for future conveyance of potable water.
- B. Disinfecting materials shall consist of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets.
- C. Dechlorination agents may be sodium bisulfate, sodium sulfite, or sodium thiosulfate.

PART 3 EXECUTION

3.1 GENERAL

- A. Source of Water
 - 1. CONTRACTOR shall assume all responsibility to obtain the necessary water for testing and disinfection of the water line system. All testing water used in the pipeline shall be potable water from a State approved drinking water system.
 - 2. All pressure pipelines shall be tested.
 - 3. Disposal of flushing water and water containing chlorine shall be by methods acceptable to the State of Utah, Division of Water Quality.

3.2 HYDROSTATIC AND LEAKAGE TESTING OF PIPELINES PROCEDURE

- A. Prior to hydrostatic testing, pipelines 24-inches diameter and larger shall be swept free of debris and visually inspected that all debris has been removed prior to filling.
- B. Prior to hydrostatic testing, pipelines shall be flushed or blown out as appropriate. CONTRACTOR may test pipelines in sections. Sections to be tested shall be defined by isolation valves in the pipeline. Where such valves are not present, CONTRACTOR shall install temporary bulkheads or plugs for the purpose of testing. Sections that do not have isolation valves shall be tested in approximate one-mile segments. Sections that have a zero-leakage allowance may be tested as a unit. No section of the pipeline shall be tested until field-placed concrete or mortar has attained an age of 14 Days. The test shall be

made by closing valves when available or by placing bulkheads and filling the line slowly with water (maximum filling velocity shall not exceed 0.25 foot per second, calculation based on the full area of the pipe). CONTRACTOR shall be responsible for ascertaining that test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to or movement of the adjacent pipe. Unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test to avoid movement and damage to piping and equipment. Remove or protect any pipeline-mounted devices that may be damaged by the test pressure. CONTRACTOR shall provide sufficient temporary tapings in the pipelines to allow for trapped air to exit or for water to be drained. After completion of the tests, such taps shall be permanently plugged. Care shall be taken that air relief valves are open during filling.

- C. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the release valves at a reasonable velocity. The air within the pipeline shall be allowed to escape completely. The differential pressure across the orifices in the air release valves shall not be allowed to exceed 5 psi at any time during filling. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least 24 hours to allow the concrete or mortar lining, as applicable, to absorb water and to allow the escape of air from air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to ENGINEER shall be taken. Additional water shall be added to the pipeline to replace any water absorbed by the cement mortar lining.
- D. The hydrostatic test shall consist of holding 200 psi pressure on the pipeline segment for a period of 2 hours. For projects with long pipeline segments, pipe shall be tested in segments such that the test pressure at the low point of the segment shall not be greater than 210 psi, and the pressure at the high point in the segment shall not be less than 180 psi. The test pressure shall never exceed the pipe or thrust-restraint design pressure or the pressure rating of the pipe unless allowed per the type of pipe specifications.
- E. Visible leaks that appear during testing shall be repaired regardless of the amount of leakage.
- F. Add water to restore the test pressure if the pressure decreases 5 psi below test pressure during the test period. Record the amount of water added.
- G. Pipe with welded joints shall have no leakage. In the case of pipelines that fail to pass the leakage test, CONTRACTOR shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipeline, repeating as necessary until the pipeline passes.
- H. Exposed piping and valves shall show no visible leaks and no pressure loss during the test.
- I. Blowoff isolation gate valves and plug valves (throttling valves) shall be operated and tested during a simulated blow down operation to demonstrate functionality of the valves to the satisfaction of ENGINEER. Isolation valves (gate valves) shall not be used for throttling.
- J. CONTRACTOR shall test all piping either in sections such that dissimilar pipe materials shall not be tested together, or the more stringent leakage allowance shall hold for whole section of tested piping, regardless of pipe material.

K. Steel Pipeline Pressure and Leak Test

1. Hydrostatic testing for Steel pipe shall be in accordance with the requirements of AWWA C 604 and this Section. In case of a conflict between these two references, the more stringent requirement shall be followed.
2. The test shall be made by placing temporary bulkheads as needed in the pipe and filling the line slowly with water. Care shall be taken to see that all air vents are open during the filling. Bulkheads, valves, and connections shall be examined for leaks. If any leaks are found, corrective measures satisfactory to ENGINEER shall be taken. The test shall consist of holding a minimum pressure as shown above or on the Contract Drawings on the section being tested for a minimum period of two hours using either pneumatic or hydraulic means to maintain the pressure. Suitable means shall be provided by CONTRACTOR for determining the quantity of water lost by leakage under the test pressure.
3. Steel pipelines with fully welded joints shall have no leakage. In the case of pipelines that fail to pass the leakage test, CONTRACTOR shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipeline, repeating as necessary until the pipeline passes.
4. Steel pipeline with rubber gasketed joints. The testing allowance is defined as the quantity of water that must be applied to the pipe section being tested to maintain a pressure within 5 psi of the specified hydrostatic test pressure. The maximum allowable makeup water shall not exceed 10 gal per inch diameter per mile per 24 hours. In the case of pipelines that fail to pass the leakage test, CONTRACTOR shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipeline, repeating as necessary until the pipeline passes.

L. Ductile Iron Pipe Gasketed Joints Pipeline Pressure and Leak Test

1. Hydrostatic testing for Ductile Iron pipe shall be in accordance with the requirements of AWWA C 600 and this Section. In case of a conflict between these two references, the more stringent requirement shall be followed.
2. The test shall be made by placing temporary bulkheads as needed in the pipe and filling the line slowly with water. Care shall be taken to see that all air vents are open during the filling. Bulkheads, valves, and connections shall be examined for leaks. If any leaks are found, corrective measures satisfactory to ENGINEER shall be taken. The test shall consist of holding a minimum pressure as shown above or on the Contract Drawings on the section being tested for a minimum period of two hours using either pneumatic or hydraulic means to maintain the pressure. Suitable means shall be provided by CONTRACTOR for determining the quantity of water lost by leakage under the test pressure. The testing allowance is defined as the quantity of water that must be applied to the pipe section being tested to maintain a pressure within 5 psi of the specified hydrostatic test pressure. The maximum allowable leakage shall be defined as follows:

$$L = SD\sqrt{(P)/148,000}$$

L = Testing allowance (makeup water) in gallons per hour of test

S = Length of pipe tested in feet

D = Nominal diameter of pipe in inches

P = Average Test Pressure in pounds per square inch (gauge)

M. PVC C900 Pipe Gasketed Joints Pipeline Pressure and Leak Test

1. Hydrostatic testing for PVC pipe shall be in accordance with the requirements of AWWA C 605 and this Section. In case of a conflict between these two references, the more stringent requirement shall be followed.
2. The test shall be made by placing temporary bulkheads as needed in the pipe and filling the line slowly with water. Care shall be taken to see that all air vents are open during the filling. Bulkheads, valves, and connections shall be examined for leaks. If any leaks are found, corrective measures satisfactory to ENGINEER shall be taken. The test shall consist of holding a minimum pressure as shown above or on the Contract Drawings on the section being tested for a minimum period of two hours using either pneumatic or hydraulic means to maintain the pressure. Suitable means shall be provided by CONTRACTOR for determining the quantity of water lost by leakage under the test pressure. The testing allowance is defined as the quantity of water that must be applied to the pipe section being tested to maintain a pressure within 5 psi of the specified hydrostatic test pressure. The maximum allowable leakage shall be defined as follows:

$$Q = LD\sqrt{(P)/148,000}$$

Q = Testing allowance (makeup water) in gallons per hour of test

L = Length of pipe tested in feet

D = Nominal diameter of pipe in inches

P = Average Test Pressure in pounds per square inch (gauge)

3.3 DISINFECTING OF PIPELINES PROCEDURE

- A. Leakage and pressure testing must be completed prior to disinfection procedures.
- B. All water and solution piping installed under this Contract shall be disinfected using an approved disinfection method in accordance with the AWWA C 651.
- C. CONTRACTOR may use one of the three chlorination methods – tablet, continuous feed, and slug, as outlined in AWWA C 651 that is acceptable to OWNER. Care must be taken to prevent the strong chlorine solution in the pipe being disinfected from flowing back into the line supplying the water.
- D. CONTRACTOR shall provide sampling ports along the pipeline as defined in AWWA C651. Taps may be at manways and air valves to help facilitate the spacing requirement.
- E. Heavily chlorinated water shall not be discharged onto the ground. Upon completion of disinfection, Sodium Bisulfate (NaHSO₄), or other approved dechlorination agent, shall be applied to the heavily chlorinated water to neutralize thoroughly the chlorine residual remaining. Water shall be neutralized to less than 1 ppm total chlorine residual.
- F. After approval of disinfection, CONTRACTOR shall flush the new system until the chlorine residual is a maximum of 0.6 ppm.
- G. After final flushing and before the new water main is connected to the distribution system, two consecutive sets of acceptable samples, taken at least 24 hours apart, shall be collected from the pipeline being tested. Sampling and testing will be completed by CONTRACTOR. CONTRACTOR shall collect at least one set of samples from every

1,200 feet of pipeline, plus one set from the end of the line and at least one set from each branch. All samples shall be tested for bacteriological (chemical and physical) quality in accordance with "Standard Methods for Examination of Water and Wastewater" and shall show the absence of coliform organisms. If the initial disinfection fails to provide satisfactory bacteriological results, or shows the presence of coliform, then the line shall be re-chlorinated, flushed, and retested until satisfactory results are obtained at the expense of CONTRACTOR.

3.4 CONNECTIONS TO EXISTING SYSTEM

- A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before installation. Thorough flushing shall be started as soon as the connection is completed and shall be continued until discolored water is eliminated.
- B. Final Fill: After successful pressure and disinfection tests are completed, the pipeline(s) shall be filled with fresh potable water and shall remain filled.

- END OF SECTION -

SECTION 33 92 10
STEEL PIPE, SPECIALS, AND FITTINGS (AWWA C200, modified)

PART 1 GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall provide fabrication and installation of steel pipe, specials, and fittings, complete and in place, in accordance with AWWA C200 and as modified herein.
- B. A single pipe manufacturer shall be made responsible for furnishing steel pipe, specials, fittings, and appurtenances such as bolts and gaskets.
- C. A special is defined as any piece of pipe other than a normal full length of straight pipe. This includes, but is not limited to, elbows, manhole sections, short pieces of straight pipe, reducers, tees, and bulk heads.

1.2 RELATED WORK

- A. Related Work specified in other Sections includes, but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 09 91 00 Painting and Finishes
 - 3. Section 09 98 00 Pipeline Coatings and Linings
 - 4. Section 31 23 15 Excavation and Backfill for Buried Pipelines
 - 5. Section 33 12 00 Mechanical Appurtenances
 - 6. Section 33 13 00 Pipeline Testing and Disinfection

1.3 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract:
- B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
 - 1. ANSI B16.1 Cast-Iron Pipe Flanges and Flanged Fittings Class 25, 125, and 250
 - 2. ANSI B16.5 Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24
Metric/Inch Standard
 - 3. ANSI/AWS B2.1 Specification for Welding Procedure and Performance Qualification
- C. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
 - 1. ASME B 16.3 Malleable Iron Threaded Fittings
 - 2. ASME B 16.5 Pipe Flanges and Flanged Fittings
- D. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM A 20 Standard Specification for General Requirements for Steel Plates for Pressure Vessels
 - 2. ASTM A 193 Standard Specification for Alloy-Steel and Stainless-Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

3. ASTM A 194 Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
4. ASTM A 234 Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
5. ASTM A 283 Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
6. ASTM A 307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
7. ASTM A 370 Standard Test Methods and Definitions for Mechanical Testing of Steel Products
8. ASTM A 563 Standard Specification for Carbon and Alloy Steel Nuts
9. ASTM A 572 Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
10. ASTM A 578 Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications
11. ASTM A 1011 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
12. ASTM A 1018 Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
13. ASTM E 165 Standard Practice for Liquid Penetrant Examination for General Industry

E. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. AWWA C 200 Steel Water Pipe 6-inch and Larger
2. AWWA C 205 Cement Mortar Protective Lining and Coating for Steel Water Pipe 4-inch and Larger – Shop Applied
3. AWWA C 206 Field Welding of Steel Water Pipe
4. AWWA C 207 Steel Pipe Flanges for Waterworks Service - Sizes 4-inch Through 144-inch
5. AWWA C 208 Dimensions for Fabricated Steel Water Pipe Fittings
6. AWWA C 210 Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
- 7.
8. AWWA C 219 Bolted, Sleeve-Type Couplings for Plain-End Pipe
9. AWWA C 606 Standard for Grooved and Shouldered Joints
10. AWWA C 651 Standard for Disinfecting Water Mains
11. AWWA M 11 Manual of Water Supply Practices – Steel Pipe – A Guide for Design and Installation

1.4 SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Shop Drawings
 1. Prepare and submit certified dimensional drawings consistent with the pipeline alignment and grade on the Contract Drawings, including all fittings and

- appurtenances, and with the size, location, elevation and slope information of existing utilities, pipelines, and encasements obtained by CONTRACTOR in accordance with Section 01 76 30 - Protection of Existing Facilities.
2. Joint and pipe/fitting wall construction details which indicate the type and thickness of cylinder; the position, type, size, and area of reinforcement; coating and lining holdbacks, manufacturing tolerances; and other pertinent information required for the manufacture of the product. Standard joint details shall be submitted where deep bell or butt strap joints are required for control of temperature stresses.
 3. Details for elbows, wyes, tees, outlets, connections, test bulkheads, and nozzles or other specials that indicate amount and position of reinforcement. Fittings and specials shall be properly reinforced to withstand the internal pressure, both circumferential and longitudinal, and the external loading conditions as indicated in the Contract Drawings. Provide design calculations for all fittings and specials, including all reinforcement requirements.
 4. Material lists and steel reinforcement schedules that describe materials to be utilized.
 5. Line layout and marking diagrams which indicate the specific number of each pipe and fitting, the location of each pipe, and the direction of each fitting in the completed line compatible with requirements of AWWA Manual 11 (M-11).
 - a. The pipe station and invert elevation at every change in grade or horizontal alignment.
 - b. The station and invert elevation to which the bell end of each pipe will be laid.
 - c. Elements of curves and bends, both in horizontal and vertical alignment.
 - d. Pipe joint type.
 - e. The limits within each reach of each type of field-welded joint and of concrete encasement.
 - f. Location of mitered pipe sections, beveled ends, butt straps and deep bell lap joints for temperature stress control.
 - g. Location and details for each valve, meter, pump, fitting, and other equipment as shown on the drawings used to determine pipe dimensions. Include location of closures, cut-off sections for length adjustment, temporary access manways, vents, and weld lead outlets for construction convenience.
 - h. Location of bulkheads, including those shown and as required, for hydrostatic testing of pipeline.
 6. Welding Information
 - a. The Shop Drawings shall define the weld type and distinguish between shop and field welds. Shop Drawings shall indicate by welding symbols or sketches the details of the welded joints and the preparation of parent metal required to make them.
 - b. Current (within the last 6 months) Welder Performance Qualifications (WPQ's) shall be submitted for each welder used prior to their performing any Work either in the shop or field. Qualification testing shall be as specified in paragraph 1.3 – Quality Assurance.
 - c. Submit the credentials of CONTRACTOR's Certified Welding Inspectors (CWI's) and quality control specialist for review prior to starting any welding in the shop or field. The credentials shall include, but not be limited to, American Welding Society (AWS), QC-1 Certification. Other nondestructive testing (NDT) quality control personnel shall be certified as required by AWS D1.1.
 - d. Submit NDT data for each shop-welded and field-welded joint. This data shall include all testing on each weld joint, including re-examination of repaired welds, using radiographic testing (RT), magnetic particle testing (MT), dye penetrant testing (PT), ultrasonic testing (UT), or air test examination methods as specified.

Test data shall be reviewed and signed by the CWI.

7. Manufacturer's written Quality Assurance/Control Program.

- C. **Certifications:** CONTRACTOR shall furnish a certified affidavit of compliance for pipe and other products or materials in AWWA C200, AWWA C205, AWWA C206, AWWA C207, AWWA C208, AWWA C210, AWWA C214, AWWA C219, and the following supplemental requirements:
1. Certified copies of mill test reports on each heat from which steel is rolled. Test shall include physical and chemical properties. Submit certified copies of mill test reports for flanges.
 2. Hydrostatic test reports.
 3. Results of production weld tests.
 4. Sand, cement, and mortar tests.
 5. Records of coating application, including technical data sheets, manufacturer name, product name and thickness.
- D. Performing and paying for sampling and testing necessary for certification are CONTRACTOR's responsibility.
- E. **Manufacturer's Qualifications:** Furnish a copy of manufacturer's certification to ISO 9000, SPFA, or LRQA, and documentation of manufacturer's experience in fabricating AWWA C200 pipe. Credentials shall include reference names, telephone numbers, and descriptions of projects for pipe conforming to AWWA C200 that is of similar diameter, length, and wall thickness to the pipe for this project.
- F. **Design Calculations of Fittings and Specials:** Furnish a copy of design calculations for fittings and specials including miters, welds, and reinforcement, prior to manufacture of pipe, fittings, and specials.

1.5 QUALITY ASSURANCE

- A. **Pipe Manufacturer Qualifications:** The pipe manufacturer shall be certified to ISO 9000, the Steel Plate Fabricator's Association (SPFA), or Lloyd's Register Quality Assurance (LRQA) and shall be experienced in fabrication of AWWA C200 pipe of similar diameters, lengths, and wall thickness to this project. The manufacturer shall have the capability of meeting the schedule requirements of this project. Experience shall be in the production facilities and personnel, not the name of the company that owns the production facility or employs the personnel. Verification of experience and production capability will be conducted as part of the initial submittal review process for steel pipe and CONTRACTOR's progress schedule.
- B. **Inspection:** Pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of AWWA C200, C205, C206, C208, C210, and C214 as supplemented by the requirements herein. CONTRACTOR shall notify ENGINEER in writing of the manufacturing start date not less than 14 Days prior to the start of any phase of the pipe manufacture.
- C. **Tests:** Except as modified herein, materials used in the manufacture of the pipe shall be tested in accordance with the requirements of AWWA C200, C205, C206, C208, C210, and C214 as applicable.

1. After the joint configuration is completed and prior to lining with cement mortar, each length of pipe of each diameter and pressure class shall be shop-tested and certified to a pressure of at least 75 percent of the yield strength of the steel. The test pressure shall be held for 2 minutes and the pipe visually inspected to confirm that welds are sound and leak-free.
2. In addition to the tests required in AWWA C200, weld tests shall be conducted on each 5,000-feet of production welds and at any other times there is a change in the grade of steel, welding procedure, or welding equipment. One set of tests per operator per work shift shall be performed.
3. Fittings fabricated from straight pipe previously passing a hydrostatic test need not have an additional hydrostatic test provided welds are tested by nondestructive means and demonstrated to be sound.
4. Material tests shall be performed at no additional cost to OWNER. ENGINEER and OWNER shall have the right to witness testing conducted by CONTRACTOR or pipe manufacturer/fabricator; provided that CONTRACTOR's schedule is not delayed for the convenience of ENGINEER or OWNER.

D. **Welding Procedure Specifications:** Welding procedures used to fabricate and install pipe shall be in accordance with the ASME Boiler and Pressure Vessel Code (BPVC) for shop welds and ANSI/AWS D1.1 for field welds. Written welding procedures shall be required for welds in the shop or the field. Welds qualified per the ASME BPVC shall include supplementary Essential Variables for notch-tough welding. Provisions of ANSI/AWS D1.1 qualified welds pertaining to notch-tough welding shall apply.

E. **Welder Performance Qualifications:** Welding shall be performed by skilled welders, welding operators, and tackers who have had experience in the methods and materials to be used. Welders shall be qualified per the provisions of ASME BPVC for shop welds and ANSI/AWS D1.1 for field welds.

F. Shop Testing of Steel Plate Specials:

1. If any special has been fabricated from straight pipe not previously tested and is of the type listed below, the special shall be hydrostatically tested with a pressure equal to 1-1/2 times the design working pressure: This applies to bends, wyes, crosses, tees with side outlet diameter greater than 30 percent of the main pipe diameter, and manifolds.
2. Specials not required to be hydrostatically tested shall be tested by liquid dye penetrant inspection method in accordance with ASTM E 165, Method A or the magnetic particle method in ASME Section VIII, Division 1, Appendix VI.
3. Reinforcing plates shall be tested by the solution method using approximately 40 psi air pressure introduced between the plates through a threaded test hole. Test hole shall be properly plugged following successful testing.
4. Any weld defects, cracks, leaks, distortion, or signs of distress during testing shall require corrective measures. Weld defects shall be gouged out and re-welded. After corrections, the special shall be retested.
5. Where welded test heads or bulkheads are used, extra length shall be provided to each opening of the special. After removal of each test head, the special shall be trimmed back to the design points with finished plate edges ground smooth, straight, and prepared for the field joint.
6. Testing shall be performed before joints have been coated or lined.
7. Ultrasonic examination shall be performed in accordance with the following:

- a. Steel plate that will be in welded joints or welded stiffener elements shall be examined ultrasonically for laminar discontinuities where both of the following conditions exist:
 - 1) Any plate in the welded joint has a thickness exceeding 1/2-inch.
 - 2) Any plate in the welded joint is subject to transverse tensile stress through its thickness during the welding or service.
 - b. Ultrasonic examination may be waived where joints are designated to minimize potential laminar tearing.
 - c. The ultrasonic examination shall be in accordance with ASTM A578 with a Level I acceptance standard.
8. Plates that are not in conformance with the acceptance criteria in ASTM A578 may be used in the WORK if the areas that contain the discontinuities are a distance at least 4 times the greatest dimension of the discontinuity away from the weld joint.
- G. Shop Nondestructive Testing:** Nondestructive testing shall be performed for various weld categories as indicated below. Testing shall include submitting written documentation of procedures per Section V of the ASME Boiler and Pressure Vessel Code, and acceptance criteria shall be in accordance with Section VIII of the ASME BPVC.
1. Field Butt Joint Welds: Spot radiographically examine pipe in accordance with Paragraph UW-52 of the ASME BPVC Section VIII Division 1. If in the opinion of ENGINEER, the welds cannot readily be radiographed, they shall be 100 percent ultrasonically examined.
 2. Fillet Welds: 100 percent examine every fillet weld using the magnetic particle inspection method.
 3. Groove Welds: 100 percent ultrasonically examine groove welds that cannot be readily radiographically spot examined.
 4. CONTRACTOR's certified welding inspector (CWI) shall 100 percent visually examine every weld as a minimum.
 5. In addition to weld tests indicated, doubler pads shall be air tested as stated in AWWA C206.
 6. CONTRACTOR shall be responsible for performing and paying for said tests and ENGINEER has the right to witness testing conducted by CONTRACTOR.
- H. Onsite Observation:** SUPPLIER shall provide an experienced staff member if requested by CONTRACTOR to be onsite while the pipe and fittings are being installed. The staff member's duties shall include, but not be limited to the following:
1. Observe the installation and welding of the pipe and fittings.
 2. Report any concerns to OWNER'S on-site observer.
 3. Answer questions and provide assistance to OWNER and CONTRACTOR.
- I. Certified Welding Inspector:** Furnish the services of a certified welding inspector(s) (CWI) for the shop and field welding as specified in AWWA C200 and C206. After receiving CWI qualification, the CWI shall have at least 3 years of professional work experience similar to the work being performed for the project. The CWI's shall be directed by a CWI supervisor with at least 5 years of professional work experience similar to the work being performed for the project. The certified welding inspector(s) shall submit written certification that all welds were performed in conformance with these documents. Shop weld tests shall be reviewed and signed by the certified welding inspector(s).

- J. **Field Testing:** Field testing shall conform to the requirements of Section 33 13 00 - Pipeline Testing and Disinfection.
- K. **Welding Requirements:** Welding procedures used to fabricate and install pipe shall be prequalified under the provisions of ANSI/AWS D1.1 - Structural Welding Code-Steel or the ASME Boiler and Pressure Vessel Code, Section 9. Welding procedures shall be required for longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.
- L. **Welder Qualifications:** Welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 or the ASME Boiler and Pressure Vessel Code, Section 9 by an independent local, approved testing agency not more than 6 months prior to commencing work on the pipeline. Machines and electrodes similar to those used in the project shall be used in qualification tests.

1.6 WARRANTY

- A. A one-year warranty for the pipe shall be included from CONTRACTOR, and shall cover the cost of replacement pipe and freight to the project site, should the pipe have any defects in material or workmanship.
- B. In addition to the standard pipe warranty, the welding contractor shall provide in writing a warranty for a period of one year for all welded joints, including formation, installation, and pressure testing.
- C. Unless otherwise noted, the warranty periods shall begin when Substantial Completion is issued for the contract.

PART 2 PRODUCTS

2.1 GENERAL

- A. Manufacturers of steel pipe and steel fittings or specials shall be under the direction and management of one steel pipe manufacturer only. This does not prevent a separate fabricator from fabricating specials or fittings; however, WORK shall be directed by the Main Pipe Manufacturer. The responsibility of the Main Pipe Manufacturer shall include at a minimum:
 - 1. Verify pipe, fittings, and specials are being manufactured in full accordance with the Contract drawings and Specifications and applicable codes and standards.
 - 2. Manage the design, fabrication, testing and delivery of the pipe, fittings, and specials. Provide field support if requested to CONTRACTOR during installation and testing.
 - 3. Prepare and submit submittal information and Shop Drawings.
 - 4. Make any corrections that may be required to the submittal information and Shop Drawings.
 - 5. Certify that the pipe and specials have been manufactured in accordance with the Contract Drawings and Specifications.
- B. Lined and coated buried steel pipe and specials shall conform to AWWA C200 and C205) subject to the following supplemental requirements. Lined and coated exposed steel pipe and specials inside the well houses and inside vaults shall conform to AWWA C200 and

C210 subject to the following supplemental requirements and the requirements of Section 09 91 00 – Painting and Finishes. The pipe, specials, and fittings shall be of the diameter and class indicated and shall be provided complete with welded joints as indicated on the Contract Drawings. For pipe, specials, and fittings 14-inches diameter and larger, the nominal inside diameter after lining shall not be less than the diameter indicated on the Contract Drawings, allowing for tolerances according to AWWA C200 and C205. Pipe, specials, and fittings smaller than 14-inches diameter may be furnished in standard outside diameters. When indicated as a minimum, wall thickness tolerance shall be as allowed by AWWA C200 or the ASTM nominal sheet or plate tolerance, whichever is less.

- C. **Markings:** The manufacturer shall legibly mark pipe, specials, and fittings in accordance with the laying schedule and marking diagram. Each pipe, special, and fitting shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. Each pipe, special, and fitting number shall be located on the inside and outside area of pipe, special, and fitting. Interior marking shall be in full conformance with NSF 61. Each pipe, fitting and special shall be marked at each end with top field centerline. The word “Top” shall be painted or marked on the outside top spigot of each pipe section or fitting. Mark “Top Match Point” for compound bends per AWWA C208.
- D. **Handling and Storage:** The pipe, specials, and fittings shall be handled by use of wide slings, padded cradles, or other devices designed and constructed to prevent damage to the pipe coating/exterior. The use of chains, hooks, or other equipment that might injure the pipe coating/exterior will not be permitted. Stockpiled pipe, specials, and fittings shall be supported on padded skids, sand or earth berms free of rock exceeding 2-inches diameter, sand bags, or suitable means so that the pipe including coating and lining coating will not be damaged. Pipe, specials, and fittings shall not be rolled and shall be secured to prevent accidental rolling. The ends of pipes shall be securely bulkheaded or otherwise sealed during transportation and shall remain sealed until installation.
- E. CONTRACTOR shall replace or repair any pipe, specials, and fittings damaged at no additional cost to OWNER.
- F. **Strutting:** Adequate strutting shall be provided on specials, fittings, and straight pipe so as to avoid damage to the pipe, specials, and fittings during handling, storage, hauling, and installation. For mortar-lined steel pipe, specials, or fittings the following requirements shall apply:
 - 1. The strutting shall be placed as soon as practicable after the mortar lining has been applied and shall remain in place while the pipe, special, or fitting is loaded, transported, unloaded, installed, and backfilled at the Site.
 - 2. The strutting materials, size, and spacing shall be the responsibility of CONTRACTOR and shall be adequate to support the earth backfill plus any greater loads that may be imposed by the backfilling and compaction equipment.
 - 3. Strutting on shop lined pipe shall consist of wood stulls and wedges. Strutting shall be installed in a manner that will not harm the lining.
 - 4. Any pipe, special, or fitting damaged during handling, hauling, storage, or installation due to improper strutting shall be repaired or replaced at no additional cost to OWNER.
- G. **Laying Lengths:** Maximum pipe laying lengths shall be 48-feet with shorter lengths provided as required to accommodate CONTRACTOR’s operation.

- H. Lining: The pipe, specials, and fittings shall have smooth, dense interior surfaces and shall be free from fractures, excessive interior surface crazing, and roughness.
- I. Closures and Correction Pieces: Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing indicated. The locations of the correction pieces and closure assemblies shall be shown on the pipe layout diagrams.
- J. Backfill with CLSM: Where required, backfill with Controlled Low Strength Material (CLSM) shall be the full depth of the pipe zone from 6 inches below to 6 inches above the pipe as a minimum.

2.2 MATERIALS

- A. **Mortar:** Materials for mortar when specified shall conform to the requirements of AWWA C205; provided, that cement for mortar coating shall be Type II modified or Type V and mortar lining shall be Type II modified or Type V. Cement in mortar lining and coating shall not originate from kilns that burn metal-rich hazardous waste fuel, nor shall a fly ash or pozzolan be used as a cement replacement. Admixtures shall contain no calcium chloride.
- B. **Steel for Cylinder and Fittings:** Pipe, specials, and fittings manufactured under AWWA C200 shall satisfy the following requirements:
 1. Minimum yield strength of steel is 42,000 psi.
 2. Be manufactured by a continuous casting process.
 3. Be fully killed.
 4. Be fine grain practice.
 5. Maximum carbon content of 0.25 percent.
 6. Maximum sulfur content of 0.015 percent.
 7. Minimum elongation of 22 percent in a 2-inch gauge length.
 8. Be in accordance with one of the following, ASTM A1011, ASTM A283, ASTM A572, or ASTM A1018.
 9. Maximum carbon equivalent of 0.45, calculated as follows:

$$CE = C + \frac{(Mn+Si)}{6} + \frac{(Cr+Mo+V)}{5} + \frac{(Ni+Cu)}{15}$$

- C. Pipe shall be manufactured as fabricated pipe per AWWA C200 as modified herein. ASTM pipe manufacturing standards referenced in AWWA C200 shall not be used. Pipe sections shall be fabricated by either of the following methods:
 1. Pipe sections may be fabricated by spirally welded short cylindrical coils of steel, joined circumferentially by complete penetration butt joint welds.
 2. Pipe sections may be rolled or pressed from no more than three (3) sheets the full length of the pipe and welded with no more than three (3) longitudinal seams.
- D. Steel equal to or greater than 1/2-inch thick used in fabricating pipe shall be tested for notch toughness using the Charpy V-Notch test in accordance with ASTM A370. Test each heat of steel by taking one specimen from any two coils per heat number. The steel shall withstand a minimum impact of 25 ft-lb at a temperature of 30 deg F.

1. Plate: Charpy tests shall be conducted on each plate as required in ASTM A20.
 2. Coils: Charpy tests shall be conducted on the first 500 tons of steel by testing each coil as follows:
 - a. Tests shall include representative sampling of steel thicknesses required for the Work.
 - b. Each coil shall be tested by taking coupons from the outer, middle, and inner wrap of the coil. Middle coil coupons may be taken from the ends of full-length pipes that are closest to the middle of the coil.
 - c. Coils that do not meet the above Charpy acceptance criteria shall not be used in the production of the pipe.
- E. **External and Internal Pipeline Coating:** In accordance with Section 09 91 00 – Painting and Finishes and Section 09 98 10.

2.3 DESIGN OF PIPE

- A. **General:** The pipe shall be suitable to transmit potable water under the conditions indicated in the Contract Drawings. The steel pipe shall have field welded joints as indicated. The pipe shall be epoxy lined as per Section 09 98 10 as indicated in the Specifications and in the Contract Drawings. Field lining will only be allowed where specifically approved in advance by ENGINEER.
- B. The pipe shall be designed, manufactured, tested, inspected, and marked according to applicable requirements previously stated and, except as hereinafter modified, shall conform to AWWA C200.
- C. **Pipe Dimensions:** Pipe shall be of the diameter and minimum wall thickness indicated on the Contract Drawings.
- D. **Fitting Dimensions:** Fittings shall be of the diameter and class to match the adjacent piping.
- E. **Joint Design:** Joints shall be flanged, lap welded slip joint, or butt strap as indicated on the Contract Drawings.
- F. Lap joints prepared for field welding shall be in accordance with AWWA C 200. The method used to form, shape, and size bell ends shall be such that the physical properties of the steel are not substantially altered. Bell ends shall be formed by an expanding press or by being moved axially over a die in such a manner as to stretch the steel plate beyond its elastic limit to form a truly round bell of suitable diameter and shape. Faying surfaces of the bell and spigot shall be essentially parallel except for mitered bells, but the bell slope shall not vary more than 2 degrees from the longitudinal axis of the pipe.
- G. Spiral weld seams shall be tested by the visible penetrant method of ASTM E 165 or magnetic particle inspection method of ASME Section VIII, Division 1, Appendix VI, for a minimum distance of 12-inches from each end of each joint after the spigot and bell are formed. Defects shall be repaired at no additional cost to OWNER.
- H. Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as indicated. Holdback areas shall be coated as indicated in Section 09 98 10 – Pipeline Coatings and Linings.

- I. Joint Shop Coating: Holdback areas for welded joints and butt straps shall be thoroughly cleaned and given a shop coat of rust-inhibitive primer. The surface preparation and primer shall be compatible with the intended finish coating as specified in Section 09 98 10 - Pipeline Coatings and Linings and Section 09 90 00 Painting and Finishes.
- J. Shop Fit Test: Make certain that joints are correctly field assembled and that excessive annular space between spigots and bells and that the pipe meets the requirements of AWWA C200. The pipe fabricator shall perform dimensional measurements for all pipe joints to verify joints are within manufacturing tolerances prior to shipment. The pipe ends shall be match marked after shop assembly.
 - 1. The shop fit test shall join the pipe ends in the shop with proposed adjacent pipe end.
 - 2. Record the actual annular space with the data to include as a minimum:
 - a. Maximum/minimum space at any point.
 - b. Space at 90-degree intervals top, bottom, and at springline.
- K. Flanges
 - 1. Flanges shall be in accordance with AWWA C 207 Class D for operating pressures up to 175 psi on 4-inch through 12-inch diameter, and operating pressures to 150 psi on diameters over 12-inches.
 - 2. Flanges shall be AWWA C 207 Class E for operating pressures over 150 psi to 275 psi or shall be Class F for pressures to 300 psi (drilling matches ANSI B 16.5 Class 250).
 - 3. Shop lining and coating shall be continuous to the end of the pipe or back of the flange. Flanges shall be shop coated with a soluble rust preventive compound which is NSF 61 certified if used on potable water pipelines.
 - 4. Gaskets shall be full-face, 1/8-inch thick, cloth-inserted rubber, **Garlock 3000, John Crane Co. Style 777**, or approved equal.
- L. Bolts and Nuts for Flanges
 - 1. Bolts for flanges shall be carbon steel, ASTM A 307, Grade B for Class B and D flanges and nuts shall be ASTM A 563, Grade A heavy hex. Bolts for Class E and F flanges shall be ASTM A 193, Grade B7 and nuts shall be ASTM A 194, Grade 2H heavy hex.

2.4 SPECIALS AND FITTINGS

- A. **Design:** Except as otherwise indicated, materials, fabrication and shop testing of specials and fittings shall conform to the requirements stated above for pipe and shall conform to the dimensions of AWWA C208. (Specials consisting of access manways, outlets for air valves, blow-off valves, etc. are excluded from the criteria as follows and collar plates, wrapper plates or crotch plates shall be required for reinforcing the outlet connections in accordance with AWWA M-11 and AWWA C208 requirements.) The minimum thickness of plate for pipe from which specials are to be fabricated shall be the greatest of those determined by the following 3 criteria:
 - 1. Working and Transient Pressure Design

$$T = \frac{PwD/2}{Y/Sw}$$

$$T = \frac{PtD/2}{Y/St}$$

Where:

- T = Steel cylinder thickness in inches
- D = Outside diameter of steel cylinder in inches
- Pw = Design working pressure in psi
- Pt = Design transient pressure in psi
- Y = Specified minimum yield point of steel in psi
- Sw = Safety factor of 2.5 at design working pressure
- St = Safety factor at design transient pressure; for elbows 1.875 and 2.0 for other specials

2. Mainline Pipe Thickness: Plate thickness for specials shall not be less than for the adjacent mainline pipe.
3. Thickness Based on Pipe Diameter unless otherwise specified on the Contract Drawings:

Nominal Pipe Diameter, in	Pipe Manifolds Piping Above Ground Piping Structures
24 and under	3/16-in
25 to 48	1/4-in
over 48	5/16-in

- a. Minimum plate thickness shall be the greater of the adjacent mainline pipe, the thickness on the Contract Drawings, the thickness calculated as indicated herein or as shown on the table above indicating the minimum thickness based on pipe diameter.
 - b. Refer to ASME B36.10M for dimensions of wall thickness for standard weight pipe and nominal pipe size.
- B. Specials installed on saddle supports shall be designed to limit the longitudinal bending stress to a maximum of 10,000 psi. Design shall be in accordance with the provisions of Chapter 7 of AWWA Manual M11.
- C. Reinforcement for wyes, tees, outlets, and nozzles shall be designed in accordance with AWWA Manual M11. Reinforcement shall be designed for the design and test pressures indicated and shall be in accordance with the Contract Drawings. Specials and fittings shall be equal in pressure design strength and shall have the same lining and coating as the adjoining pipe. Unless otherwise indicated, the minimum radius of elbows shall be 2.5 times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11-1/4 degrees.
- D. Moderate deflections and long radius curves may be made by means of beveled joint rings, by pulling standard joints, by using short lengths or pipe, or a combination of these methods; provided that pulled joints shall not be used in combination with bevels. The maximum total allowable angle for beveled joints shall be 5 degrees per pipe joint. Bevels shall be provided on the bell ends. Mitering of the spigot ends will not be permitted. The maximum allowable angle for pulled joints shall be in accordance with the manufacturer's recommendations or the angle which results from a 3/4-inch pull out from normal joint

closure, whichever is less. Horizontal deflections or fabricated angles shall fall on the alignment. In congested city streets or at other locations where underground obstructions may be encountered, the chord produced by deflecting the pipe shall be no further than 6-inches from the alignment indicated.

E. Vertical deflections shall fall on the alignment and be at locations adjacent to underground obstructions, points of minimum earth cover, and pipeline outlets and structures. The pipe angle points shall match the angle points indicated.

F. Outlets, Tees, Wyes, and Crosses

1. Outlets 12-inches and smaller be steel pipe standard thickness in the standard outside diameters and shall include a reinforcing collar. Minimum plate thickness for reinforcements shall be 10-gauge.
2. The design of outlet reinforcement shall be in accordance with the procedures given in Chapter 13 of AWWA Manual M -11 and the design pressures and factors of safety above.
3. In lieu of saddle or wrapper reinforcement as provided by the design procedure in Manual M -11, pipe or specials with outlets may be fabricated entirely of steel plate having a thickness equal to the sum of the pipe wall plus the required reinforcement.
4. Where Manual M-11 requires the design procedure for crotch plate reinforcement, such reinforcement shall be provided.
5. Outlets shall be fabricated so that there is always at least a 12-inch distance between the outer edge of the reinforcing plate and any field welded joints. For outlets without reinforcing plates, outlets shall penetrate the steel cylinders so that there is at least a 12-inch clearance between the outlet and any field-welded joints.
6. Tees, wyes, crosses, elbows, and manifolds shall be fabricated so that the outlet clearances and reinforcing plates from any weld joints are a minimum of 5 times cylinder thickness or 2-inches, whichever is greater. Longitudinal weld joints in adjacent cylinder sections shall be oriented so that there is a minimum offset of 5 times cylinder thickness or 2-inches, whichever is greater.

G. **Steel Welding Fittings:** Steel welding fittings shall conform to ASTM A 234.

2.5 CEMENT-MORTAR LINING

A. Cement-Mortar Lining for Shop Application: Unless indicated otherwise, interior surfaces of buried pipe, specials, and fittings shall be cleaned and lined in the shop with cement mortar lining applied centrifugally in conformity with AWWA C205. Lining for all mitered fittings produced by cutting, rolling and re-welding such as elbows from 5 to 90 degrees up to 72-inches in diameter shall be centrifugally applied in the shop. Fabricated tees, manifolds or elbows greater than 72-inches or tees with crotch plates where heat treating or normalization is required may be lined in accordance with AWWA C205. During the lining operation and thereafter, the pipe, specials, and fittings shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found defective at the Site, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications at no additional cost to OWNER.

B. The minimum lining thickness and tolerance shall be in accordance with Section 09 98 10 – Pipeline Coatings and Linings and AWWA C205.

- C. The pipe shall be left bare as indicated where field joints occur. Ends of the linings shall be left square and uniform. Feathered or uneven edges will not be permitted.
- D. Defective linings shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather edged joints. Temperature and shrinkage cracks in the mortar less than 1/16-inch wide need not be repaired. Pipe specials or fittings with cracks wider than 1/16-inch shall be removed and patched.
- E. The progress of the application of mortar lining shall be regulated in order that handwork, including the repair of defective areas, is cured in accordance with the provisions of AWWA C205. Cement mortar for patching shall be the same materials as the mortar for machine lining, except that a finer grading of sand and mortar richer in cement shall be used when field inspection indicates that such mix will improve the finished lining of the pipe.
- F. Specials and fittings that cannot be mechanically lined and coated shall be lined and coated by hand-application using the same materials as used for the pipe and in accordance with the applicable AWWA or ASTM standards and this Section. Coating and lining applied in this manner shall provide protection equal to that for the pipe. Fittings may be fabricated from pipe that has been mechanically lined and/or coated. Areas of lining and coating that have been damaged by such fabrication shall be repaired by hand-application.
- G. Cement-Mortar Lining for Field Application at joints: Unless otherwise indicated, all steel pipe joints shall be mortar lined. The materials and design of in-place cement mortar lining shall be in accordance with Section 09 98 10 – Pipeline Coatings and Linings and AWWA C205, and the following supplementary requirements:
 - 1. Pozzolanic material shall not be used in the mortar mix.
 - 2. Admixtures shall contain no calcium chloride.
 - 3. The minimum lining thickness shall be as indicated for shop-applied cement mortar lining, and finished inside diameter after lining shall be as indicated.
 - 4. Temperature and shrinkage cracks in the mortar less than 1/16-inch wide need not be repaired. Pipe, specials, or fittings with mortar cracks wider than 1/16-inch shall be removed and repaired.
- H. Protection of Pipe Lining/Interior: All pipe, specials, and fittings with plant-applied cement-mortar linings, shall be supplied with a 12-mil polyethylene sheet or other suitable bulkhead on the ends of the pipe and on each opening to prevent drying out of the lining. Bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

2.6 EXTERIOR COATING OF PIPE

- A. Exterior Coating of Exposed Piping: The exterior surfaces of pipe, specials, and fittings that will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of primer compatible with the finish coating required by Section 09 98 10 - Pipeline Coatings and Linings.
- B. Exterior Coating of Buried Piping: Pipe for buried service, including bumped heads, shall be cement mortar coated per Section 09 98 10 – Pipeline Coatings and Linings.

2.7 INTERIOR COATING OF PIPE – Liquid Applied Epoxy Lining

- A. **Interior Coating of Exposed Piping:** The interior surface of pipe, specials, and fittings that will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of primer compatible with the finish coating required by Section 09 98 01 – Pipeline Coatings and Linings.

2.8 PIPE APPURTENANCES

- A. Pipe appurtenances shall be in accordance with the requirements of the Specifications and Contract Drawings. Access manholes with covers shall be as indicated, installed during fabrication, not in the field. Threaded outlets shall be forged steel suitable for 3000 psi service.

2.9 SAFETY TAPE

- A. Safety tape shall be a minimum of 3-inch wide by 5.0 mil overall thickness, with no less than a 0.35-gauge solid aluminum foil core. It shall be Safety Blue in color per American Public Works Association (APWA) National Color Code and shall be clearly labeled with the words “CAUTION WATER LINE BELOW” or similar wording approved by ENGINEER. Safety tape shall be **MagnaTec by Empire Level Mfg Corp**, or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Excavation and backfill of trenches and for appurtenances shall be in accordance with Section 31 23 15 - Excavation and Backfill for Buried Pipelines.
- B. Safety tape shall be installed above pipe as required by the Contract Drawings.
- C. **Handling and Storage:** Pipe, specials, and fittings shall be carefully handled and protected against damage to lining and coating/interior and exterior surfaces, and impact shocks and free fall. Pipe, specials, and fittings shall not be placed directly on rough ground but shall be supported in a manner that will protect the pipe against injury whenever stored at the Site or elsewhere. Pipe, specials, and fittings shall be handled and stored at the Site in accordance with the requirements stated in Part 2, above. No pipe shall be installed when the lining or coating/interior or exterior surfaces show cracks that may be harmful as determined by ENGINEER. Such damaged lining and coating/interior and exterior surfaces shall be repaired or a new undamaged pipe, special, or fitting shall be provided at no additional cost to OWNER.
- D. Pipe damaged prior to Substantial Completion shall be repaired or replaced at no additional cost to OWNER.
- E. Repair of Defects: Patching inserts, overlays, or pounding out defects shall not be permitted. Repair of notches or laminations on second ends shall not be permitted. Deformation of pipe ends through mechanical means or other methods to achieve pipe fit up of defective pipe shall not be permitted. Damaged ends shall be removed to a point of uniform, non-damaged cylinder end and properly prepared. Distorted or flattened lengths shall be rejected. Buckled sections shall be removed and replaced with a full pipe cylinder.

CONTRACTOR shall submit a written repair plan and receive favorable review from OWNER prior to the start of any repair work.

- F. CONTRACTOR shall inspect each pipe, special, and fitting for damage. CONTRACTOR shall remove or smooth out any burrs, gouges, weld splatter, or other small defects prior to laying the pipe, special, or fitting.
- G. Before placement of pipe, specials, or fittings in the trench, each shall be thoroughly cleaned of any foreign substance that may have collected thereon and shall be kept clean thereafter. For this purpose, the openings of pipes, specials, and fittings in the trench shall be closed during any interruption to the project.
- H. Pipe, specials, and fittings backfilled with CLSM shall be laid directly on moist sandbags or other suitable supports in preparation for the CLSM pipe zone material. Sandbags shall be placed to provide at least 6-inches of CLSM below the bottom of the pipe. Sandbags shall be spaced at a maximum interval of 8-feet and one set shall be placed within 3-feet on both sides of each joint. CONTRACTOR shall provide additional sandbags as needed to support the pipe on line and grade. Excavation outside the normal trench section shall be made at field joints as needed to permit adequate access to the joints for field connection operations and for application of coating on field joints.
- I. Installation Tolerances: Each section of pipe, special, or fitting shall be laid in the order and position on the laying diagram and in accordance with the following:
 - 1. Each section of pipe, special, or fitting having a nominal diameter less than 48-inches shall be laid to line and grade, within plus or minus 2-inches horizontal deviation and plus or minus 1-inch vertical deviation.
 - 2. Each section of pipe, special, or fitting having nominal diameter 48-inches and larger shall be laid to line and grade, within plus or minus 5 percent of diameter horizontal deviation and plus or minus 2.5 percent of diameter vertical deviation.
 - 3. In addition to the horizontal and vertical tolerances above, lay the pipe so that no high or low points other than those on the laying diagram are introduced.
 - 4. After installation, pipe, specials, and fittings shall not show deflection greater than 1.5 percent for mortar-lined and mortar-coated pipe, specials, and fittings; 2.25 percent for mortar-lined and flexible-coated pipe, specials, and fittings; and 3.75 percent for flexible-lined and flexible-coated or bare pipe, specials, and fittings. The allowable deflection shall be based on the design inside diameter.
 - 5. CONTRACTOR shall not permit the pipeline to experience a differential settlement after welding of more than 1.5" over 300 feet.
- J. Where necessary to raise or lower the pipe, specials, or fittings due to unforeseen obstructions or other causes, CONTRACTOR may change the alignment and/or the grades in accordance with the requirements of the Specifications and Contract Drawings. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in a joint exceed 75 percent of the maximum deflection recommended by the pipe manufacturer without prior approval from ENGINEER. No joint shall be misfit any amount that will be detrimental to the strength and water tightness of the finished joint. In all cases the joint opening, before finishing with the protective mortar inside the pipe, shall be the controlling factor.
- K. Except for short runs, pipes shall be laid uphill if on grades exceeding 10 percent. Pipe that is laid on a downhill grade shall be blocked and held in place until sufficient support

is furnished by the following pipe to prevent movement. Bends shall be installed as indicated.

- L. Struts in pipe 42-inches diameter and larger shall be left in place until backfilling operations have been completed. Struts in pipe smaller than 42-inches may be removed immediately after laying. CONTRACTOR shall monitor pipe deflection by measuring pipe inside diameter before struts are removed and 24 hours after struts are removed. Pipe deflection shall not exceed 3 percent 24 hours after the struts are removed. After the backfill has been placed, the struts shall be removed and shall remain the property of CONTRACTOR. For pipe backfilled with CLSM, struts shall be left in place until the CLSM backfill has obtained a minimum 7-day cure.
- M. Cold Weather Protection: No pipe, special, or fitting shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation. No pipe, special, or fitting shall be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.
- N. Pipe, Specials, and Fitting Protection: The openings of pipe, specials, and fittings with shop-applied mortar lining shall be protected with suitable bulkheads to maintain a moist atmosphere and to prevent unauthorized access by persons, animals, water, or any undesirable substance. The bulkheads shall be so designed to prevent drying out of the interior of the pipe, specials, and fittings. CONTRACTOR shall introduce water into the pipe to keep the mortar moist if moisture has been lost due to damaged bulkheads.
- O. Flotation: At all times, means shall be provided to prevent the pipe from floating. Take necessary precautions to prevent the pipe from floating due to water entering the trench or from backfilling with CLSM. CONTRACTOR shall assume full responsibility for any damage due to this cause and shall at its own expense restore and replace the pipe to its specified condition and grade if it is displaced due to floating. Maintain the inside of the pipe free from materials and in a clean and sanitary condition.
- P. **Pipe Cleanup:** As pipe laying progresses, CONTRACTOR shall keep the pipe interior free of debris. CONTRACTOR shall completely clean the interior of the pipe of sand, dirt, mortar splatter, and any other debris following completion of pipe laying, pointing of joints, and any necessary interior repairs prior to testing and disinfecting the completed pipeline. When pipe laying is not in progress and at the end of each day, CONTRACTOR shall cover the exposed ends of all pipes to prevent animals, dust, dirt and other debris from entering the pipe.

3.2 WELDED JOINTS

- A. **General:** Field welded joints shall be in accordance with AWWA C206.
- B. Welding Procedures, Welding Qualifications and Testing:
 - 1. Field welding procedures, welders, welding operators, and tackers shall be qualified in accordance with AWS D1.1 and as defined in Section 3 of ANSI/AWWA C206 or ANSI/AWWA C200, as applicable. Qualifications shall be in accordance with all position pipe tests as defined in Section 5 of AWS D1.1.
 - 2. For field welding, the welder qualification testing shall be performed at the Site. Previous qualifications will not be accepted. CONTRACTOR shall obtain the services

- of an independent testing laboratory to perform the welder qualification on-Site. Copies of test data and certifications shall be provided to ENGINEER. Costs for welder qualification testing shall be paid by CONTRACTOR at no increased cost to OWNER.
3. Upon completion of each field-welded joint CONTRACTOR shall provide a record system that traces a welder's work completion to a specific joint as it relates to the pipeline stationing.
 4. Field lap welds shall be inspected by magnetic particle or dye penetration methods. Field butt welds shall be inspected in accordance with the requirements of API 1104 by the radiographic method and the acceptance criteria of API 1104. Magnetic particle testing is not required for seal welds.
 5. Double welded lap joints and butt strap joints shall be air tested. Repairs and retesting shall be required if any loss of pressure occurs and shall be at no increased cost to OWNER.
 6. Personnel performing the visual inspection of welds shall be qualified and currently certified as Certified Welding Inspector (CWI) in accordance with AWS QC1, Standard for Qualification and Certification of Welding Inspectors. Personnel performing nondestructive tests shall be qualified and certified to meet the requirements of SNT-TC-1A.
- C. Where exterior welds are performed, adequate space shall be provided for welding and inspection of the joints.
 - D. Butt straps shall be as indicated. When fitting up the ends of pipe to be welded or fitting butt-strap pieces, jacking or clamping shall not be allowed. Cold working the metal with sledges or localized application of heat and working the metal with sledges shall not be allowed. If field displacement of joints, where butt strap joints are indicated, does not allow proper fit up with the tolerances indicated, special closure butt straps or mitered pieces shall be shop fabricated and installed.
 - E. A heat resistant shield shall be draped over at least 24-inches of coating beyond the holdback on both sides of the weld during welding to avoid damage to the coating by hot weld splatter. Welding grounds shall not be attached to the coated part of the pipe.
 - F. Care shall be exercised during the initial backfilling to prevent movement of the pipe and to prevent any backfill material from being deposited on the joint.
 - G. To control temperature stresses, the unbackfilled joint areas of the pipe shall be shaded from the direct rays of the sun by the use of properly supported awnings, umbrellas, tarpaulins, or other suitable materials for a minimum period of 2 hours prior to the beginning of the welding operation and until the weld has been completed. Shading materials at the joint area shall not rest directly on the pipe but shall be supported to allow air circulation around the pipe. Shading of the pipe joints need not be performed when the ambient air temperature is below 50 deg F as measured in the trench.
 - H. Temperature Control Joints: At intervals not exceeding 250-feet along welded reaches of the pipeline and at the first regular lap-welded field joints outside concrete encasements and structures, the pipe shall be laid with an initial lap of not less than 1-inch greater than the typical lap dimension. The welding of each such temperature control joint shall be performed when the temperature is approximately the lowest during the 24 hour day, after at least 250-feet of pipe have been laid and the joints have been welded ahead of and in back of the shrinkage control joint, and after backfill has been completed to at least 1-foot

above the top of the pipe ahead of and in back of the shrinkage control joint. Where temperature control joints occur in a traveled roadway or other inconvenient location, the location of the temperature control joint may be adjusted, as necessary.

- I. Prior to the beginning of the welding procedure, any tack welds used to position the pipe during laying shall be removed. Any annular space between the faying surfaces of the bell and spigot shall be equally distributed around the circumference of the joint by shimming, jacking, or other suitable means. The weld shall then be made in accordance with AWWA C206. Where more than one pass is required, each pass except the first and final ones shall be peened to relieve temperature stresses, and dirt, slag, and flux shall be removed before the succeeding bead is applied.
- J. Prior to butt welding, the pipe and joint shall be properly positioned in the trench using line up clamps so that, in the finished joint, the abutting pipe sections shall not be misaligned more than 1/16-inch.
- K. Unless double fillet welds are indicated, field welded lap joints may, at the CONTRACTOR'S option, be made on either the inside or the outside of the pipe.
- L. **Inspection of Field Welded Joints:** An independent testing laboratory shall inspect the joints. Inspection shall be as soon as practicable after the welds are completed.
 - 1. Fillet welds shall be tested by the Magnetic Particle Inspection Method in accordance with ASME Section VIII, Division 1, Appendix VI.
 - 2. In addition, double fillet welds on butt strap joints or double welded lap joints shall be air tested by shop drilling and tapping for 1/4-inch national pipe thread in the lap or bell end of the pipe. Apply 40 psi of air or other satisfactory gas into the connection between the 2 fillet welds. Test pressure shall be measured with a 4-inch diameter, minimum, pressure gauge with a range no greater than 0 to 100 psi. The air test shall consist of holding the test pressure undiminished for 5 minutes. If the air test fails, paint the welds with a soap solution and mark any leaks indicated by the escaping gas bubbles. Leaking portions of the welds or defective welds shall be removed and rewelded. The amount of material removed shall be limited to that required to correct the defect. After the repair is made, the joint shall be checked by repeating the original test procedure to verify that there is no leakage at the inside weld. Close the threaded openings with pipe plugs or by welding them.
 - 3. Butt welds shall be inspected by radiographic methods in accordance with API Standard 1104.
- M. Following tests of the joint, the exterior joint spaces shall be coated in accordance with these specifications after which backfilling may be completed.
- N. **Repair of Welds:** Welds that are defective shall be repaired by CONTRACTOR to meet the requirements of this Specification. Defects in welds or defective welds shall be removed, and that section of the joint shall then be re-welded. Only sufficient removal of defective material that is necessary to correct the defect is required. After the repair is made, the joint shall be checked by repeating the original test procedure. Welds deficient in size shall be repaired by adding weld metal.

3.3 JOINT COATING AND LINING

- A. General: The interior and exterior joint recesses shall be thoroughly wiped clean and water, loose scale, dirt, and other foreign material shall be removed from the inside surface of the pipe.
- B. Joint Coating of Shop-Applied Cement Mortar or Epoxy Pipe: Joints shall be coated in accordance with Section 09 98 10 – Pipeline Coatings and Linings.
- C. Every joint will be tested by CONTRACTOR with an electrical detector capable of at least a 12,000-volt output, furnished by the SUPPLIER. Holiday tests will be conducted in accordance with NACE RP0274. Holidays shall be repaired by CONTRACTOR at no additional cost to OWNER.
- D. Coating Repair: Coating repair shall be in accordance with Section 09 98 10 – Pipeline Coatings and Linings.
- E. Coating of Fittings and Specials: Fittings and specials shall be coated in accordance with Section 09 98 10 – Pipeline Coatings and Linings.
- F. Mortar Joint Lining: After the backfill has been completed to final grade, the interior joint recess shall be filled with grout. The grout shall be tightly packed into the joint recess and troweled flush with the interior surface. Excess shall be removed. At no point shall there be an indentation or projection of the mortar exceeding 1/16-inch. With pipe smaller than 24-inches in diameter, before the spigot is inserted into the bell, the bell shall be daubed with grout. The joint shall be completed and excess mortar on the inside of the joint shall be swabbed out.
- G. Epoxy Joint lining: After the backfill has been completed to final grade, the interior joint recess shall be recoated with the specified epoxy.

3.4 INSTALLATION OF PIPE APPURTENANCES

- A. **Installation of Valves:** Valves shall be handled in a manner to prevent any injury or damage to the valve or any part of it. Joints shall be thoroughly cleaned and prepared prior to installation. CONTRACTOR shall adjust stem packing and operate each valve prior to installation to verify proper operation. Valves shall be installed so that the valve stems are plumb and, in the location, indicated.
- B. **Installation of Flanged Joints:** Before the joint is assembled, the flange faces shall be thoroughly cleaned of foreign material with a power wire brush. The gasket shall be centered and the connecting flanges drawn up watertight without unnecessarily stressing the flanges. Bolts shall be tightened in a progressive diametrically opposite sequence and torqued with a suitable calibrated torque wrench. Clamping torque shall be applied to the nuts only. Full face reinforced rubber gaskets shall be applied to the inside face of blind flanges with adhesive.
- C. **Insulated Joints:** Insulated joints and appurtenant features shall be provided as required. CONTRACTOR shall exercise special care when installing these joints to prevent electrical conductivity across the joint. After the insulated joint is completed, an electrical resistance test shall be performed by CONTRACTOR. If the resistance test indicates a short circuit, CONTRACTOR shall remove the insulating units to inspect for damage,

replace all damaged portions, and reassemble the insulating joint. The insulated joint shall then be retested to assure proper insulation.

- D. **Flexible Coupled Joints:** When installing flexible couplings, care shall be taken that the connecting pipe ends, couplings, and gaskets are clean and free of dirt and foreign matter with special attention given to the contact surfaces of the pipe, gaskets, and couplings. The couplings shall be assembled and installed in conformity with the recommendation and instruction of the coupling manufacturer.
- E. Wrenches used in bolting couplings shall be of a type and size recommended by the coupling manufacturer. Coupling bolts shall be tightened so as to secure a uniform annular space between the follower rings and the body of the pipe. Bolts shall be tightened approximately the same amount. Diametrically opposite bolts shall be tightened progressively and evenly. Final tightening shall be done with a suitable calibrated torque wrench set for the torque recommended by the coupling manufacturer. Clamping torque shall be applied to the nut only.

3.5 PRESSURE TESTING

- A. Pressure testing and disposal of test water shall be in accordance with Section 33 13 00 – Pipeline Testing and Disinfection.

- END OF SECTION -

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SECTION 40 05 13.19
STAINLESS STEEL PROCESS PIPING

PART 1 GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall furnish and install all stainless steel process piping and appurtenances as shown and specified, and as required for a complete and workable piping system.

1.2 RELATED WORK

- A. Related Work specified in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
 2. Section 33 12 00 Mechanical Appurtenances
 3. Section 33 13 00 Pipeline Testing and Disinfection

1.3 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
- B. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
1. ASME B 16.5 Pipe Flanges and Flanged Fittings
 2. ASME B 16.9 Factory-Made Wrought Butt Welded Fittings
 3. ASME B 16.11 Forged Fittings, Socket-Welding and Threaded
 4. ASME B 31.1 Power Piping
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM A 312 Standard Specification for Seamless, Welded, and Heavy Cold Worked Austenitic Stainless Steel Pipes
 2. ASTM A 403 Standard Specification for Wrought Austenitic Stainless Steel Piping and Fittings
 3. ASTM A 409 Standard Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service
 4. ASTM A 778 Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products
- D. AMERICAN WELDING SOCIETY (AWS)
1. AWS D1.1 Structural Welding Code
- E. AMERICAN WATER WORKS ASSOCIATION (AWWA)
1. AWWA C 606 Grooved and Shouldered Joints
 2. AWWA C 651 Standard for Disinfecting Water Mains

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit manufacturer's affidavit certifying product was manufactured, tested and supplied in accordance with applicable references in this section together with a report of the test results and the date each test was completed.
- C. Submit shop drawings of pipe, fittings, supports and appurtenances showing compliance with this Section including necessary dimensions, details, pipe joints and material lists.
- D. Submit gasket material data including manufacturer's catalog indicating that the proposed product is suitable for each fluid of service application.
- E. Submit welders' qualifications in accordance with AWS D1.1.

PART 2 PRODUCTS

2.1 STAINLESS STEEL PIPE

- A. Stainless steel process pipe shall be in accordance with ASTM A 312, Type 316, seamless, Schedule 40S (unless indicated as 80S on the drawings), with screwed fittings for sizes up to and including 3-inches and welded fittings for sizes 3-inches and larger. Flange fittings may be used for pipe diameters 2-inches and larger. Stainless steel process piping 12-inches and larger shall be in accordance with ASTM A 409 or ASTM A 778, Type 316, Schedule 40S with welded or flanged joints.

2.2 PIPE JOINTS

- A. Stainless steel pipe 3-inches and smaller shall have screwed ends with NPT threads. Screwed joints shall be up with Teflon tape. Stainless steel pipe 3-inches and larger shall have welded joints or flanges. Flanges shall have stainless steel nuts and bolts the same material type as the pipe. Where indicated on the Contract Drawings, provide grooved ends for rigid or flexible mechanical couplings. Pipe grooving is only allow for Schedule 40S or 80S pipes. For plain end stainless steel pipe use sleeve-type couplings where noted on the Drawings.
- B. Flanged joints shall be in accordance with ASME B16.5 for the pressure class required for the project conditions or as indicated on the Contract Drawings. CONTRACTOR is responsible for providing the appropriate flanges required to connect stainless steel process pipe to equipment and other appurtenances. CONTRACTOR shall replace flanges that do not match the mating equipment or appurtenance at no additional cost to OWNER. Gaskets shall be ANSI 150 lb. full face, 1/8-inch thick Neoprene for water or wastewater service. Gasket material for chemicals shall be suitable for the chemical service.

2.3 FITTINGS

- A. Threaded fittings shall be forged stainless steel fittings in accordance with ASME B 16.11.
- B. Socket welded fittings shall be forged stainless steel fittings in accordance with ASME B 16.11.

- C. Butt-welded fittings shall be wrought stainless steel fittings in accordance with ASTM A 403 and ASME B 16.9.
- D. Flanged fittings shall be in accordance with ASME B 16.5.
- E. Grooved fittings shall be wrought stainless steel conforming to ASTM A 403 and ASME B 16.9 and to AWWA C 606. Gasket material shall be suitable for the intended service.
- F. Fittings shall be in accordance with the pressure class shown on the Contract Drawings or have the same pressure rating as the pipe.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Stainless steel process piping shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary, piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points.
- B. Piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with Section 05 45 00 - Pipe Supports. Where necessary to avoid stress on equipment or structural members, the pipe shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature changes.
- C. Unless otherwise indicated, connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection. Low points shall be provided with a drain valve.

3.2 PIPE PREPARATION

- A. Prior to installation, each pipe length shall be carefully inspected, flushed clean of any debris or dust, and be straightened, if not true. Ends of threaded pipes shall be reamed and filed smooth. Pipe fittings shall be equally cleaned before assembly.

3.3 PIPE JOINTS

- A. Pipe threads shall be full and cleanly cut with sharp dies or molded. Joints shall be made with Teflon tape.
- B. Grooved couplings shall be installed per the manufacturer's recommendations and shall conform to AWWA C 606.

3.4 INSPECTION AND TESTING OF PIPELINE

- A. Completed stainless steel process piping systems shall be inspected for proper supports, anchorage, and damage to pipe, fittings, and coatings. Any damage shall be repaired by CONTRACTOR at no additional cost to OWNER.

- B. CONTRACTOR shall provide temporary blow-off valves and fittings as required to flush and disinfect new pipelines. Temporary blow-off valves and fittings shall be removed prior to placing pipeline into service.
- C. Source of Water
 - 1. CONTRACTOR shall assume all responsibility to obtain the necessary water supplies for disinfection and/or pressure testing of the pipeline.
- D. Testing Procedure
 - 1. Prior to enclosure or burying, piping systems shall be pressure tested as required on the Contract Drawings, for a period of not less than one hour, without exceeding the tolerances listed on the Contract Drawings. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. CONTRACTOR shall furnish test equipment, labor, materials, and devices.
 - 2. Leakage shall be determined by loss of pressure, soap solution, or other positive and accurate method. Fixtures, devices, or other accessories that would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines shall be plugged or capped as appropriate during the testing procedures.
 - 3. Leaks shall be repaired, and the piping shall be re-tested until no leaks are found.
 - 4. ENGINEER shall be notified at least 48 hours before the pipeline is to be tested so that ENGINEER may be present during the test.

3.5 DISINFECTING

- A. Disinfection shall be in accordance with AWWA C 651 and the requirements of Section 33 13 00 – Pipeline Testing and Disinfection.

- END OF SECTION –

SECTION 40 05 13.33
BRASS PROCESS PIPING

PART 1 GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall furnish and install all brass process piping and appurtenances as shown and specified, and as required for a complete and workable piping system.
- B. This Section includes schedule 40 and 80 brass process pipe in accordance with ASTM B43.

1.2 RELATED WORK

- A. Related Work specified in other Sections includes, but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 05 45 00 Mechanical Metal Supports (Pipe Supports)
 - 3. Section 31 23 15 Excavation and Backfill for Pipelines
 - 4. Section 33 12 00 Mechanical Appurtenances
 - 5. Section 33 13 00 Pipeline Testing and Disinfection

1.3 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
- B. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
 - 1. ASME B1.20.1 Pipe Threads, General Purpose
 - 2. ASME B 16.15 Cast Bronze Threaded Fitting Class 125 & 250
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM B 43 Standard Specification for Seamless Red Brass Pipe, Standard Sizes
- D. AMERICAN WATER WORKS ASSOCIATION (AWWA)
 - 1. AWWA C 651 Standard for Disinfecting Water Mains

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit manufacturer's affidavit certifying product was manufactured, tested, and supplied in accordance with applicable references in this section together with a report of the test results and the date each test was completed.
- C. Submit shop drawings of pipe, fittings, supports, and appurtenances showing compliance with this Section including necessary dimensions, details, pipe joints and material lists.

PART 2 PRODUCTS

2.1 BRASS PIPE

- A. Brass pipe and fittings shall conform to ASTM B 43, regular wall thickness (Schedule 40), except that nipples and pipe of sizes 1-inch and smaller shall be extra strong (Schedule 80).
- B. Brass pipe joints shall be screwed ends with NPT threads. Screwed joints shall be made up with Teflon tape. Threads shall conform to ASME B1.20.1.
- C. All brass pipe and fittings shall be NSF 61 or NSF 372 certified.

2.2 FITTINGS

- A. Threaded fittings shall be in accordance with ASME B 16.15.

PART 3 EXECUTION

3.1 INSTALLATION

- A. For buried pipelines, excavation and backfill of trenches and for appurtenances shall be in accordance with Section 31 23 15 - Excavation and Backfill for Buried Pipelines.
- B. Above ground brass process piping shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary, piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points.
- C. Piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with Section 05 45 00. Where necessary to avoid stress on equipment or structural members, the pipe shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature changes.
- D. Unless otherwise indicated, connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection. Low points shall be provided with a drain valve.

3.2 PIPE PREPARATION

- A. Prior to installation, each pipe length shall be carefully inspected, flushed clean of any debris or dust, and be straightened, if not true. Ends of threaded pipes shall be reamed and filed smooth. Pipe fittings shall be equally cleaned before assembly

3.3 PIPE JOINTS

- A. Pipe threads shall be full and cleanly cut with sharp dies or molded. Joints shall be made with Teflon tape.

3.4 INSPECTION AND TESTING OF PIPELINE

- A. Completed brass process piping systems shall be inspected for proper supports, anchorage, and damage to pipe, fittings, and coatings. Any damage shall be repaired by CONTRACTOR at no additional cost to OWNER.
- B. CONTRACTOR shall provide temporary blow-off valves and fittings as required to flush and disinfect new pipelines. Temporary blow-off valves and fittings shall be removed prior to placing pipeline into service.
- C. Source of Water
 - 1. CONTRACTOR shall assume all responsibility to obtain the necessary water supplies for disinfection and/or pressure testing of the pipeline.
- D. Testing Procedure
 - 1. Prior to enclosure or burying, piping systems shall be pressure tested as required in the Contract Drawings, for a period of not less than one hour, without exceeding the tolerances listed on the Drawings. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. CONTRACTOR shall furnish test equipment, labor, materials, and devices.
 - 2. Leakage shall be determined by loss of pressure, soap solution, or other positive and accurate method. Fixtures, devices, or other accessories that would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines shall be plugged or capped as appropriate during the testing procedures.
 - 3. Leaks shall be repaired, and the piping shall be re-tested until no leaks are found.
 - 4. ENGINEER shall be notified at least 48 hours before the pipeline is to be tested so that ENGINEER may be present during the test.

3.5 DISINFECTING

- A. Disinfection shall be in accordance AWWA C 651 and the requirements of Section 33 13 00 – Pipeline Testing and Disinfection.

- END OF SECTION -

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SECTION 40 91 23
MISCELLANEOUS PROPERTIES MEASUREMENT DEVICES

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers the Work necessary to install a ready to use and tested process and analysis system. CONTRACTOR shall provide all components required for a complete and functional system.

1.2 RELATED WORK

- A. Related Work in other Sections includes, but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures

1.3 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
- B. AMERICAN WATER WORKS ASSOCIATION (AWWA)
 - 1. AWWA C 207 Steel Pipe Flanges for Waterworks Service—Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)
 - 2. AWWA C 751 Magnetic Inductive Flowmeters
- C. NSF INTERNATIONAL (NSF)
 - 1. NSF/ANSI 61 Drinking Water System Components - Health Effects

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit catalog cuts on all process equipment including: switches, meters, sensors, or other items shown on Contract Drawings referencing each item by mark number. Information shall indicate manufacturer specification compliance and dimensional data.
- C. CONTRACTOR shall supply operation and maintenance manuals for all process equipment.

1.5 WARRANTY

- A. Manufacturer shall provide to OWNER written guarantee against defects in material or workmanship for a period of one (1) year.

1.6 DELIVERY AND STORAGE

- A. All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, or other contaminants. Each system shall be factory calibrated and certified prior to delivery.

1.7 QUALITY ASSURANCE

- A. Equipment to be furnished under this section shall be the product of manufacturers regularly engaged in the design and manufacturing of this type of equipment. The manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving CONTRACTOR from responsibility for the proper installation and functionality of the work.

PART 2 PRODUCTS

2.1 GENERAL

- A. Each process measurement system shall typically consist of a sensor and analyzer/transmitter. Where shown on the Contract Drawings, the analyzer/transmitter may be utilized for multiple sensors. When an analyzer/transmitter is used for multiple sensors, it shall be capable of displaying simultaneously each process measurement.
- B. Each analyzer/transmitter shall be equipped with a means to transmit process measurement data to the plant SCADA system.
 - 1. For hardwired signals, unless indicated otherwise on Contract Drawings, provide the following:
 - a. 4-20 mA output signals for each process measurement (for up to 500 Ohm loads).
 - b. Two programmable SPDT relay outputs, rated at 5A up to 230 VAC, for each process measurement.
 - c. Where shown on the Contract Drawings, provide the following digital communications to the plant SCADA system:
 - d. HART Protocol
 - e. PROFIBUS
 - f. MODBUS
- C. Each analyzer/transmitter shall be powered by 115VAC (+/- 10%) at 60 Hz unless shown on Contract Drawings as being powered by 24 VDC (+/- 15%). Each analyzer/transmitter shall retain its programmable settings in non-volatile memory. Battery powered instruments, analyzer, or transmitters will not be accepted.
- D. Each sensor and corresponding analyzer/transmitter shall be supplied as a complete and operable system. This includes all cabling, mounting hardware, and fasteners. When installed outdoors, the analyzer/transmitter shall be protected from the sun such that direct sunlight will not shine on the display.
- E. All analyzers/transmitters shall be waterproof and made from corrosion resistant materials.

- F. All sensors to be immersed in liquids shall be rated for permanent submersion and shall be corrosion resistant.

2.2 MAGNETIC FLOW METERS

- A. Magnetic flow meters shall be the low the low frequency induction type which produces a DC pulsed signal directly proportional to and linear with the flow rate. Liners shall be polyurethane. Flow meters shall be rated at 250 psi. Standard output shall be an analog 4-20 mA signal with a local indication from a liquid crystal display (LCD) reading in gallons per minute flow. The meter shall also have a totalizer (with pulsed output), and non-full pipe detection. Meters shall have a minimum of 2 self-cleaning electrodes. CONTRACTOR shall field verify length of cable for connection.
- B. Flanged connections shall be constructed of Type 304 or Type 316 stainless steel with pressure ratings to match the connecting pipe.
- C. Liner shall be polyurethane or PTFE and electrodes stainless steel suitable for potable water service. Liners and electrodes for service other than potable water shall be constructed of materials conforming to the manufacturer's recommendation for the intended service.
- D. Meter housing shall be rated for NEMA 6 for submersible operation.
- E. Meters shall include grounding rings.
- F. The transmitter shall have six-digit LCD displays for flow rate, percent of span, and totalization; be capable of measuring flow in both directions; automatic range change; capability to convert DC pulse signal from the tube to a standardized 4 to 20 mA DC signal into a minimum of 700 ohms; self-diagnostics and automatic data checking, and a scaleable frequency output, 0 to 100 Hz.
- G. Flow meter shall have an option for process calibration and diagnostics.
- H. The flow measuring system shall conform to the following:
 1. Time constant: 0.5 to 1000 seconds; galvanic or optic isolation
 2. Accuracy: 0.50 percent of flow rate from 10 to 100 percent full scale velocities over 3 feet per second.
 3. Repeatability: 0.25 percent of full scale
 4. Power consumption: 30 watts or less
 5. Power requirements: 120 VAC, plus or minus 10 percent, unless indicated otherwise on the Contract Drawings. Battery powered flow meters will not be accepted.
- I. Provide grounding rings as per the manufacturer's recommendations.
- J. Magnetic flow meters shall be Proline Promag W400 by Endress+Hauser, 8750 Series by Rosemount, or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All equipment shall be mounted and installed as per manufacturer recommendations. Coordinate final location with ENGINEER.

3.2 FLOW METER FIELD QUALITY CONTROL

- A. Each instrument shall be tested before commissioning and ENGINEER shall witness the interface capability in the PLC control system and associated registers.
 - 1. Each instrument shall provide direct programming capability through the PLC
 - 2. Each instrument shall provide direct control of totalizer reset functions through the PLC
 - 3. Each instrument shall be supported with a device profile permitting direct integration in the PLC
- B. ENGINEER shall witness all instrument verifications in the field.
- C. Manufacturers Field Services shall be provided for start-up and commissioning by a Factory field service representative or a manufacturer's authorized service provider (ASP).
 - 1. The manufacturer's representative shall verify installation of all installed flow tubes and transmitters.
 - 2. Manufacturer representative shall notify ENGINEER in writing of any problems or discrepancies and proposed solutions.
 - 3. Manufacturer representative shall perform field verification at the time of installation for long-term analysis of device linearity, repeatability and electronics health. A comparative report shall be generated for each meter tested.
 - 4. The manufacturer's representative shall generate a configuration report for each meter.

3.3 TESTING

- A. After installation of the equipment is complete, operating tests shall be carried out to assure that the equipment operates properly. All piping shall be tested hydrostatically and for leaks. If any deficiencies are revealed during any tests, such deficiencies shall be corrected, and the tests shall be reconducted.

- END OF SECTION -

SECTION 43 32 76
FLUORIDATION / CHLORINATION CHEMICAL PROCESS EQUIPMENT

PART 1 GENERAL

1.1 DESCRIPTION

A. This section covers the work necessary to install a ready to use and tested variable flow rate fluoridation and chlorination chemical process injection systems. CONTRACTOR shall supply and install all equipment defined herein and shall provide all other components required for a complete and functional system.

1. All equipment for the chlorination system shall be Evoqua Wallace and Tiernan, no approved equal.

1.2 RELATED WORK

A. Related Work in other Sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 33 12 00 Mechanical Appurtenances

1.3 REFERENCES AND STANDARDS

A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract:

B. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

1. B16.3 Malleable Iron Threaded Fittings, Classes 150 and 300

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. A 53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
2. B 88 Seamless Copper Water Tube
3. D 1784 Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated PolyvinylChloride (CPVC) Compounds
4. D 1785 Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
5. D 1998 Standard Specifications for Upright Storage Tanks
6. D 2466 Polyvinyl Chloride (PVC) Plastic Pipe and Fittings, Schedule 40
7. D 2564 Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings
8. F 411 Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe, Schedules 40 and 80

D. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. C 800 Standard for Underground Service Line Valves and Fittings
2. C 900 Standard for Polyvinyl Chloride (PVC) pressure Pipe and Fabricated Fittings, 4 In. (100mm) Through 12 In. (300 mm), for Waster Distribution.
3. C 901 Standard for Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm)Through 3 In. (76 mm), for Water Service.

E. CHLORINE INSTITUTE (CI)

1. CI-01 The Chlorine Manual
2. CI Pamphlet 6 - Piping Systems for Dry Chlorine

F. INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

G. INTERNATIONAL MECHANICAL CODE (IMC)

H. INTERNATIONAL PLUMBING CODE (IPC)

1.4 SUBMITTALS

- A. Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit cut sheets for all equipment, piping, fittings, etc.
- C. Shop drawing showing proposed layout with dimensions of the proposed chlorination system piping and equipment.
- D. Submit sizing calculations for ejector and injection quill.
- E. Submit shop drawing for cylinder storage rack construction.
- F. Submit Operation & Maintenance manuals for all chlorination and fluoridation equipment.

1.5 WARRANTY

- A. Manufacturer shall provide to ENGINEER written guarantee against defects in material or workmanship for a period of one (1) year for all equipment utilized.

1.6 DELIVERY AND STORAGE

- A. All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, or other contaminants.

PART 2 PRODUCTS

2.1 FLUORIDATION SYSTEM (1000 EAST)

- A. The fluoride system shall be complete with all piping and fittings as recommended by the manufacturer and as shown on the Contract Drawings. All equipment shall be rated for use with 23% Hydrofluorosilicic Acid.

2.2 CHLORINATION SYSTEM (1000 EAST)

- A. The chlorination at 1000 East shall be in accordance with Section 43 32 76.1 – Calcium Hypochlorite Tablet Chlorination System.

2.3 CHLORINATION SYSTEM (700 EAST)

- A. The chlorination system shall be complete with all piping and fittings as recommended by the manufacturer and as shown on the Contract Drawings. All equipment shall be rated for use with 15% Sodium Hypochlorite.

2.4 STORAGE TANKS - BULK AND DAY

- A. Capacity and containment shall be as noted in the following Table 43 32 79-1.

TABLE 43 32 79-1 - STORAGE TANK CAPACITY/CONTAINMENT

SITE	Bulk Storage (gallons)		Day Tank (gallons)	
	Primary	Secondary	Primary	Secondary
Fluoride (cross-linked polyethylene)				
700 East Well	Existing	-	Existing	-
7750 South Well (10 th East)	-1000	--	30-(2)	--
Chlorination (linear polyethylene)				
700 East Well	600	-	30	-
7750 South Well (10 th East)	-	-	With tablet system	-
			-	-

- B. The storage tank systems shall consist of a primary tank. Manways and covers in the tank tops shall be made of crosslinked or linear polyethylene (see Table 1) and shall be fume tight. Tanks shall meet the requirements of ASTM D 1998, Type I and shall be molded from cross linkable or linear polyethylene as listed in Table 1. Tanks may be either dome or flat top. Tank size shall be such that they fit via the doors.
- C. Resin Type:
 1. Resin used shall be 100% virgin, UV-stabilized, 35 mesh cross linkable or linear high-density polyethylene.
 2. Tanks shall have weatherability equal to that of PAXON grade 7004 natural.
 3. Resins shall meet or exceed the following properties listed in Table 43 32 76-2, below.

TABLE 43 32 79-2 - RESIN PROPERTIES

Classification	ASTM Test	Nominal Value
Density	D1505	0.944 g/cm ³
Tensile strength at yield	D638	3,000 psi
Elongation at Break	D638	400%
Tensile modulus of elasticity	D638	80,000 psi
Flexural modulus	D790	100,000 psi

TABLE 43 32 79-2 - RESIN PROPERTIES		
Classification	ASTM Test	Nominal Value
Heat deflection temperature, 66 psi load	D648	138° F
Vicat softening temperature	D1525	248° F
Impact brittleness temperature	D746	<-180° F
Dart Impact (-40F)	ARM Std.	120 ft. lb
Environmental stress crack Resistance	D1693	>1,000 hrs

- D. Tank design standards shall meet the requirements of ASTM D 1998. Molded part lines shall be located above the lower 1/3 of the straight side wall of the tank. The inner tank wall shall yield gel test results of no less than 65%; entire wall thickness must be more than 80% gelled. Rotationally molded polyethylene tanks shall have an uninterrupted bottom knuckle radius for maximum strength per design requirements in ASTM 1998.
- E. Fittings shall be provided as shown on referenced drawings. All fittings shall be located away from the bottom knuckle radius. Fittings and gaskets must be chemically compatible with the materials to be handled in the tanks. All fittings shall terminate in socket, threaded or flanged connections. Flanges shall match 150 lb ANSI, all threaded plumbing connections shall be standard American Pipe thread cut. Any fittings used on upper tank sidewall or top of tank may be PVC Bulkhead Fittings and they shall be fume-tight.
- F. Seismic restraint shall be supplied and the design for same certified by a licensed Structural Engineer. Design shall conform to the latest edition of the International Building Code. Detailed instructions for installation shall be provided, along with all necessary hardware including anchor bolts. All components of the restraint system shall be protected against the chemical stored in the tank.
- G. Tanks shall have a warranty for five (5) years to be free of defects in material and workmanship. The warranty shall fully cover the tank during the first 3 years of service and be prorated during the remaining two years of warranty period.
- H. A ladder shall be provided to access the top of the tank for all tanks over 3,000 gallon capacity.
- I. Manufactures shall be one who is regularly engaged in the business of designing and fabricating polyethylene storage tanks. Tanks shall be manufactured by **Snyder Industries, LLC., Assmann, Poly Processing**, or approved equal.

2.5 DOSING PUMPS

- A. Chemical dosing pumps shall be Grundfos SMART Digital S dosing pumps designed for hydrofluosilicic acid (23%) or sodium hypochlorite (12%) as specified complete with pump head, tubing and fittings. Pumps shall be rated for a maximum feed rate as noted on the Contract Drawings or specified herein. Pumps shall be capable of manual adjustment and instrument responsive external control for an automatic system. Pumps

shall be capable of injection to the existing system pressure or as noted on the Drawings.

- B. Pumps shall be rated for 120 VAC, with a non-standard plug (twist lock) for fluoridation pump electrical service. Duty cycle shall be continuous. Pumps shall have 4-20ma analog speed input when put in Analog mode.
- C. Pumps shall be warranted for two years and shall be as noted on the Contract Drawings.
- D. Fluoride Pump shall be Grundfos DDA 7.5-16 FCM-PV/V/C-F-31U7U7BG, with backpressure, no equal. Provide multi-function valve.
- E. Chlorine Pump shall be Grundfos DDA 7.5-16 FCM-PV/V/C-F-31U7U7BG, with backpressure, no equal. Provide multi-function valve.

2.6 TRANSFER PUMPS - DRUM TYPE

- A. The fluoridation transfer pump type shall be suitable for hydrofluorosilicic acid (23%). The chlorination transfer pump type shall be suitable for sodium hypochlorite (NaOCl) solution (15%). Pumps shall be capable of lifts up to 20 feet and flows of 20 gpm minimum. Tube set length shall be extended to within 1 inch of the bottom of the Bulk Tank. Pumps shall have a fume-tight mounting seal and connector.
- B. The transfer pump shall be a tube-style vertical centrifugal pump with an axial-flow type polypropylene rotor and mechanical seal.
- C. The pump shall be equipped with a Hastelloy C driveshaft and polypropylene mechanical seal.
- D. The wetted parts of the mechanical seal tube set shall be of polypropylene, Viton, Tefzel, Hastelloy C and PTFE components to operate submerged in hydrofluorosilicic (23%) acid and sodium hypochlorite (NaOCl) solution (15%). The tube set shall be of polypropylene construction with a diameter of 1.875 inches.
- E. The Motor Driver shall be single-phase, 60-Hertz, totally enclosed, fan cooled, (TEFC) induction motor. The motor shall be splash proof and supplied with a corrosion resistant coating suitable for corrosive environments. Motor shall have built -in overload protection switch. The motor rating shall exceed the maximum expected pump horsepower requirements including losses.
- F. Pumps shall be a Lutz B55-T-5 motor and 0110-212 pump tube, or approved equal.
- G. The transfer pump shall have an anti-siphon valve.

2.7 SOLUTION PUMPS

- A. CONTRACTOR shall furnish and install the Solution pumps as shown on the plans. Pumps shall be equipped with a 480 VAC, three phase, 60 hertz motor. Pumps shall be stainless steel Pentair Aurora Model 321, 0.5 HP, or approved equal. The pumps shall be rated for potable water to 150 psi and have a design flow of 24 gallons per minute and head rating as follows:

1. 700 East Chlorination: 20 feet

2. 1000 East Fluoridation 1: 30 feet
3. 1000 East Fluoridation 2: 30 feet
4. Note: the 10th East chlorination system shall have a self-contained circulation pump in the chlorination unit.

2.8 ELECTRONIC DRUM SCALE

- A. CONTRACTOR shall furnish and install electronic drum scales of 0-400 lb or and 0-600 lb capacity as noted. Scale shall be of the digital readout/electronic load cell type. Platform height shall be no more than 2" to permit easy loading and unloading of drums. Platform shall be epoxy powder coated steel. The unit shall be designed and fully warranted for continuous operation, and shall use 115 VAC, 60 hertz.
- B. Scales for fluoridation and chlorination day tanks shall include a single combined wall mounted backlit digital indicator at each site. Indicator shall output net weight via a 4-20 mA signal for remote monitoring. All indicator operations shall be menu prompted for ease of operation. Operator shall be able to monitor chemical by weight, volume, or percent full. An "Auto Load" function shall automatically compensate for tank tare weight during tank change. A data log function shall store the "Daily Usage" for each of the previous 10 days. Full-scale accuracy shall be better than 1/4 of 1% and display to 0.1 lbs. The scales and indicator shall be Models No. 27-DR4DS for 30-gallon day tanks and No. 27-DR6DS for 50-gallon day tanks and Wizard 4000, respectively, as manufactured by Force Flow/Floquip, or approved equal.

2.9 CALIBRATION COLUMN

- A. Calibration columns shall be 100ml capacity, with 1/2-inch NPT(F) threads bottom connection with dust cover top. They shall be made of PVC with Mylar polyester-film shroud. Columns shall be Accudraw PV#3-100, Cole-Parmer P-74600-01 or approved equal.

2.10 RADAR LEVEL SENSOR

- A. Radar level sensors shall be suitable for measurement of fluoridation or chlorination liquids. The gauge shall be operated on the Frequency Modulated Continuous Wave (FMCW) principle with an output signal directly proportional to process level, distance, or volume.
- B. The sensor assembly and signal converter shall be an integral, compact unit. Converter shall be capable of operation with wave stick antenna which shall be supported by a wall-mounting bracket above the tanks.
- C. The unit shall be powered by the A 4-20mA current loop. The maximum loop resistance shall be 750 Ohms. The output shall provide a continuous analog output of signal directly proportional to volume. The gauge shall be capable of local and remote interrogation and/or configuration.
- D. On-site start up assistance and operator training will be required.
- E. The radar level sensor shall be Krohne Model BM702, or approved equal.

2.11 INJECTOR TEE ASSEMBLY

- A. Injector Tees and Injection Check Valves shall be rated for 150 psi working pressure. The Check Valve assembly shall be manufactured from high impact plastic to fit the 1" injection pipeline. The unit shall be manufactured by LMI or approved equal.

2.12 RETRACTABLE INJECTION QUILL ASSEMBLY

- A. The 700 East Chlorine Injector Quill and the 1000 East Chlorine Injector Quill shall have a 1-1/2" main connection with 1-1/2" ball valve, by 1-inch Solution Tube that extends into the pipe by one third the diameter. Injection Quill Assembly shall be a SAF-T-FLO Chemical Injection Assembly, High Corrosion Resistance Retractable Injection Quill, Series HC-150 with check valve or approved equal.
- B. The 1000 East Fluoride Injector Quills have 2" existing main connections. These two connections shall have a 2" x1 1/2" hex reducer with 1-1/2" ball valve, by 1-inch Solution Tube that extends into the pipe by one third the diameter. Injection Quill Assembly shall be a SAF-T-FLO Chemical Injection Assembly, High Corrosion Resistance Retractable Injection Quill, Series HC-150 with check valve or approved equal.
- C. Back pressure valves to prevent siphoning shall be Griffco G-Series Back Pressure Valve, Hayward PBV Series, "Or-equal" with a 0-350 psi rating.

2.13 EMERGENCY EYE WASH AND SHOWER

- A. Emergency eye wash and showers shall meet ANSI Standards. Showers shall be floor mounted combination eye/face wash station. Inlet piping shall be 1 1/4" and have a 150-psi rating. Showers shall have handheld spray units, provisions for a thermal liquid flow switch, and 20 gallon per minute flow control. Showers shall be Speakman Company, SE-697 Emergency Station, with options HS, or approved equal.
- B. Provide a minimum of four wall hooks for installation in the shower room.

2.14 EMERGENCY SHOWER WATER HEATER

- A. CONTRACTOR shall furnish and install the water supply pipelines with the on-demand heaters and tempering valve as shown on the Contract Drawings including all valves, air release valve, couplings, venting system and any other accessories necessary to have a complete and ready-to-use system.
- B. The eye wash and shower shall have a Rinnai TRX02CUIN in-line water heater complete with piping and electrical control cable. The heater shall have a complete gas system including 1-1/4-inch gas piping, 2-inch and 3-inch PVC (sch 40) vent pipe with screen, and 60-gallon propane storage tank,
- C. The thermostatic mixing valve shall be Bradley S-19-2150SR with 3/4-inch inlet to match the heaters, with cold water bypass, emergency shutoff, rated for 150 psi inlet pressure, and be ASSE 1071 Certified, or approved equal.

2.15 10th EAST CHLORINATION SYSTEM (TABLET SYSTEM)

- A. Tablet chlorination system is to be supplied by OWNER and installed by CONTRACTOR. CONTRACTOR is responsible for installation and startup of the

equipment. CONTRACTOR shall coordinate with Waterford Systems (tablet chlorinator supplier – 801-463-9900) for installation and startup of the unit. The unit is a Modified ACCU-Tab Model 3025.

2.16 CHLORINE ANALYZER, pH MONITOR and CONDUCTIVITY TRANSMITTER

- A. See Section 11 54 00 – Process Equipment.

2.17 PIPING AND TUBING AND HIGH-PRESSURE HOSE

- A. Piping and tubing shall be suitable to handle the materials carried as recommended by the manufacturer.
- B. PVC piping and fittings shall be schedule 80 unless otherwise noted. Only Teflon tape shall be used for joint gaskets.
- C. Dosing pump tubing shall be Teflon PFA with a minimum pressure rating of 230 psi. Fittings for tubing shall Kynar.
- D. Sampling line tubing shall be reinforced clear PVC with polyester reinforcement (Ryan Herco 0512-3/8, pressure rating at 225 psi)
- E. High pressure hose shall be PTFE smooth core with FDA 21 CFR 177.1550, with ISO 10993 Certifications and with a temperature range to 100 degrees F. The hose shall be stainless steel reinforced with a silicone jacketing. Hose shall be APFOS-WC-1000 by AdvantaPure or approved equal. Hose shall be NSF 61 certified.
- F. Low pressure hose fittings shall be polyethylene with double hose clamps.
- G. Hose shall be reinforced clear PVC.

2.18 SAFETY EQUIPMENT

- A. CONTRACTOR shall furnish the Safety Equipment listed below in Table 43 32 76-3 - Safety Equipment for each site.

TABLE 4332 76-3 - SAFETY EQUIPMENT (NIOSH approved where applicable)		
Description	Quantity (per site)	Notes
Cartridge Respirator with Full-Face Shield	2 ea	Northern #152-4340
Chemical Cartridges	5 sets (10 total)	Northern #153-7253
Gauntlet neoprene gloves (12" glove minimum length)	6 pair	Northern #121-9934
Full-Face Shield (8" min.)	2 ea	Northern #107-1286 w/shield
Heavy Duty acid type neoprene aprons	2 ea	Northern #136-1372

TABLE 4332 76-3 - SAFETY EQUIPMENT (NIOSH approved where applicable)		
Description	Quantity (per site)	Notes
12" latex Hazmat Boot Covers	4 pair (OWNER to select sizes)	Northern #145-1473
Spill Containment Drum	2 ea	Northern #195-9877
Spill control pillows (foamed-sand type) or Maintenance Sorbents	Capacity: 50 Gal.	Northern #200-17817
Disposable Towels w/ Dispenser	1 dispenser w/ 6 Towels	Northern #109-6628
Hazardous Material Identification Signs w/ Identification Indicators	1 sign per door (10" x 10") and storage tank (4 1/2" x 4 1/2")	Northern #233-5321R Northern #233-5319P and Indicators

2.19 ROTOMETERS

- A. Rotometers for the water flow control shall be as manufactured by Ryan Herco # 7520 5829.253, or approved equal, and shall include an adjusting valve for setting flow. The rotometer shall be capable of measuring water flows of 0-3.5 gpm with a minimum of 5 inches in scale length.

2.20 HAZARDOUS MATERIAL IDENTIFICATION SIGNS

- A. CONTRACTOR shall furnish hazardous material identification signs on the exterior of all doors leading into the Chlorine Room:
1. NFPA 704 Diamond Placard:
 - a. Health Hazard (Blue): 4
 - b. Fire Hazard (Red): 0
 - c. Reactive Hazard (Yellow): 0
 - d. Specific Hazard (White): OX
 2. For outdoor applications, signs shall be:
 - a. Sign Dimension: 10" x 14"
 - b. Manufacturer: Northern Safety and Industrial, or approved equal.
 - c. Material: 0.118" thick outer aluminum with a solid thermoplastic Dura-AlumaLite as manufactured by Northern Safety and Industrial, or approved equal.
 - d. Model:
 - 1) "Danger Chlorine" model #231- 29843
- B. CONTRACTOR shall furnish hazardous material identification signs inside the Chlorine Room:
1. For indoor applications, signs shall be:

- a. Sign Dimension: 10" x 14"
- b. Manufacturer: Northern Safety and Industrial or approved equal.
- c. Material: 0.060" thick polycarbonate material with overlamine Dura-Plastic as manufactured by Northern Safety and Industrial or approved equal.
- d. Model:
 - 1) "Keep All Cylinders Chained" model #231-30333
 - 2) "Notice – Empty Cylinders" model #231-29870
 - 3) "Notice – Full Cylinders" model #231-29871

2.21 VENTS

- A. Tubing vents shall extend to the outside of structures and be turned down and be equipped with a # 14 mesh non-corrodible screen.

2.22 TOXIC FLUORIDE GAS SENSOR/TRANSMITTER

- A. Gas Transmitter for the detection of fluoride shall be provided to monitor the ambient gas concentrations in the chemical building. Gas transmitter shall consist of a NEMA 4X transmitter with a remotely mounted gas sensor. The gas sensor/transmitter shall be ATI series F12 (no equal) with integral power supply and relays). In addition, the transmitter shall be supplied with standard RS-485 MODBUS communication capability or a digital output using HART protocol.
- B. Series F12 transmitter shall utilize plug-in "smart sensor" modules that allow sensors to be swapped quickly without interruption of instrument function. Sensors plugged into the transmitter shall automatically upload zero offset and calibration information so that no transmitter adjustment is needed when sensors are exchanged. Transmitters shall provide a large graphic display indicating both gas concentration and the status of any alarm settings. In addition, the transmitter shall be capable of storing 1 minute average gas concentrations, with stored data displayed in either graphical or tabular format.
- C. Four sealed buttons on the front of the transmitter shall allow the operator to access all program functions. Controls shall allow analog output simulation for convenience in testing remotely connected devices. Switches may also be used for manually resetting alarm relays (if installed) and for activating sensor Auto-Test generator if used.
 - 1. Gas transmitter shall be provided with an integral AC power supply suitable for operation from 85-265 VAC or VDC, 50/60 Hz. The power supply assembly shall also provide three SPST relays for external alarm functions. Each relay shall be assignable as to function using front panel program keys.
 - 2. Gas transmitter shall be supplied with a sensor "Auto-Test" gas generator to provide automatic sensor response verification. The generator shall automatically generate a small amount of gas on command from the transmitter, and a fault alarm shall be generated if the sensor does not respond to the gas test. The system shall provide this automatic response test every 24 hours or as programmed by the user. The results of all sensor tests shall be maintained in on-board memory for review by the user.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All equipment shall be installed as per the manufacturer's directions. Weight of valves, hoses and equipment must not be carried by the fittings themselves. Proper support for all equipment shall be provided.
- B. Chlorination injection points shall have anti-siphon valves and diffuser piping as required mounted horizontally.
- C. Vents shall extend to the outside of the structure and be turned down and be equipped with a non-corrodible screen.
- D. The chlorine equipment appurtenances shall be installed in accordance with CI-01 and CI Pamphlet 6 to provide a complete and integrated system in accordance with the instruction of the manufacturer.
- E. The Chlorine ejector shall be placed on the piping to protect it from damage and installed according to the manufacturer's instruction.
- F. Dosing pumps shall not be mounted higher than 4 feet above the highest liquid level of the day tank. Fluoridation injection points shall have anti-siphon valves and diffuser piping as required mounted on a 45-degree angle from vertical from the floor. Chlorination injection points shall have anti-siphon valves and diffuser piping as required mounted horizontally.
- G. Vents shall extend to the outside of structure roofs and be turned down and be equipped with a non-corrodible screen.

3.2 START-UP AND TESTING

- A. CONTRACTOR and Equipment Supplier (ES) shall verify that structures, equipment, pumps, and motors are compatible for an efficient system.
- B. CONTRACTOR and ES shall make equipment adjustments required to place the system in proper operating condition.
- C. CONTRACTOR and ES shall test the fluoridation and chlorination feed systems for proper operation in the presence of OWNER and ENGINEER. CONTRACTOR shall start up and test the systems with water for a 24-hour period prior to testing with chemicals.
- D. The ES shall furnish all testing equipment and devices required.
- E. If either of the fluoridation or chlorination feed systems fail to meet any of the specified performance requirements, CONTRACTOR and/or ES shall modify and/or replace defective equipment until it meets specified requirements. Re-test system to verify satisfactory operation.
- F. Demonstrate the accuracy of each dosing pump using job supplied calibration column.

- G. CONTRACTOR shall, after installation of storage tanks is complete but before piping connections are made, block all outlets and fill each tank with water to again check for leaks. No leakage will be permitted.
- H. The ES field services:
 - 1. Retain, for a period of not less than one-half (1/2) day per site for installation of fluoridation and chlorination systems, factory-trained representatives. For installation, the representative shall perform the services listed below:
 - a. Inspect the completed installation and prepare an inspection report.
 - b. Test, calibrate and adjust all components for optimum performance.
 - c. Assist in initial start-up and field testing.
 - d. Instruct OWNER's personnel in the operation and user maintenance of all components. Conduct a training seminar at the site.
 - e. Supervise the correction of any defective or faulty work before and after acceptance by OWNER.
- I. CONTRACTOR shall be responsible to supply all chemicals required for testing.
- J. All piping shall be tested hydrostatically for leaks. If any deficiencies are revealed during any tests, such deficiencies shall be corrected, and the tests shall be reconducted.

- END OF SECTION -

SECTION 43 42 21
SURGE TANK

PART 1 GENERAL

1.1 SUMMARY

- A. CONTRACTOR shall furnish and install all materials and work for the surge control system, complete, including but not limited to welded steel tanks, solenoid valves, piping, relief valves, gauges, sight glass and level sensors, air compressors, piping, etc., and placement in operation in accordance with the provisions of the Contract.

1.2 RELATED WORK

- A. Related Work in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
 2. Section 03 31 05 CLSM
 3. Section 09 91 00 Painting and Finishes

1.3 REFERENCES

- A. The latest edition of the following publications form a part of these Specifications to the extent referenced. The publications are referred to in the text to by basic designation only.

B. CODES

1. The building code referenced herein shall be the International Building Code (IBC) as defined in Section 01090 entitled "Reference Standards".
2. ASME Boiler and Pressure Vessel Code.
3. American Welding Society (AWS) Fabrication Code.
4. ASME Fabrication Code

C. COMMERCIAL STANDARDS

1. ANSI B 16.3-85 Malleable iron threaded fittings Class 150 and 300
2. ANSI B 16.9-86 Factory-made wrought steel butt welding fittings
3. ASTM A 53-87 Pipe, steel, black and hot-dipped, zinc-coated welded and seamless
4. ASTM A 47-84 Malleable iron castings
5. ASTM A 197-87 Cupola malleable iron
6. ASTM A 234-87 Pipe fittings of wrought carbon steel and allow steel for moderate and elevated temperatures
7. SSPC-SP5 Shop blast surface preparation - White Metal Blasting Cleaning
8. SSPC-SP6 Shop blast surface preparation - Commercial Blast Cleaning
9. SSPC-SP10 Shop blast surface preparation - Near White Metal Blast Cleaning

1.4 SUBMITTALS

- A. Provide complete dimensional fabrication drawings of the surge tank(s), including shop submittals and catalog cuts for all accessories and piping.

- B. Stamped calculations prepared by a professional engineer (registered in the State of Utah) for approval before tank fabrication.
- C. A complete Piping Schematic showing all air and liquid piping and flows directly associated with the surge tanks.
- D. Immediately following fabrication, and before tank shipment, provide a Certification of ASME Code stamp. This document shall be signed by the fabricator and shall bear a notary stamp for the state in which fabrication takes place, and shall indicate that the code stamp has been obtained for the tank actually to be supplied.

PART 2 PRODUCTS

2.1 SURGE TANK

- A. The surge tank shall have a net available volume of not less than shown in the schedule. Tanks shall be cylindrical with elliptical (or similar) heads.

SURGE TANK SCHEDULE

ITEM	DESCRIPTION	
	7618 South 700 East	7750 South 1000 East
Volume (min)	300 Cubic Feet (2,250 Gallons)	200 Cubic Feet (1,500 Gallons)
Nominal Diameter	7.00 Feet	7.00 Feet
Configuration	Horizontal	Horizontal
Approx. Length	9'-0" Feet	6'-6" Feet
Design Pressure	200 psig	200 psig
Design Test Pressure	300 psig	300 psig
Inlet Diameter	12 inches	12 inches

- B. The design temperature for the tank shall be 70°F.
- C. The tank shall be designed and fabricated in strict accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, latest edition. Tank shall be constructed of carbon steel and fabricated by welding techniques. Plate thicknesses shall be determined in accordance with the allowable stresses listed in the Code for the material, pressure, and temperature specified. Heads for the tank shall be standard elliptical design as specified in the Code, Section VIII, Division 1. Shell and head thicknesses shall include a minimum corrosion allowance of 0.125-inch. The surge tank shall be stamped and certified as required in Section VIII, Division 1, of the ASME Code, and the certification and copy of the required Data Sheet shall be sent to ENGINEER as required under SUBMITTALS.
- D. Surge tanks shall be fabricated by a manufacturer with a minimum of 5 years of experience designing and fabricating pressure vessels.

E. Surge tanks shall be capable of withstanding a full vacuum (-14 PSI) without collapse.

F. Provide the following attachments on the tank:

1. Standard lugs for tank lifting and placement.
2. Access manhole, designed and fabricated in accordance with the ASME Boiler and Pressure Vessel Code. Section VIII, Article D-10, and as shown on the Contract Drawings.
3. Nozzles as shown on the Contract Drawings and in accordance with the Code, Section VIII, Article D-6 Nozzles 2-1/2- inches and larger shall be flanged, ANSI B16.1 Nozzles two inches and smaller shall be screwed. ANSI B16.11. Nozzles shall include the following:
 - a. Water inlet/outlet nozzle
 - b. One 3/4-inch air piping nozzle
 - c. One 3/4-inch pressure relief nozzle
 - d. One 2 inch drain at bottom of tank nozzle
 - e. Two differential pressure sensor nozzles
 - f. Two sight glass nozzles
4. Refer to drawings for nozzle layout information. Approval of submittal materials will not relieve CONTRACTOR of the responsibility to provide a complete and operable system with all of the required connections.
5. Pressure relief (safety) valve in accordance with Boiler and Pressure Vessel Code, Section VIII, GENERAL REQUIREMENTS, UG-125 AND 126. Set at 250 psig. Pressure relief safety valve shall be as provided on the Contract Drawings.
6. Differential pressure transmitter including pipe and isolation valves as required.
7. Sight gage with isolation valves as required.

2.2 TANK ACCESSORIES

A. VALVES

1. Provide all valves as shown on the Contract Drawings and any additional valves needed to make CONTRACTOR'S specific offering operate satisfactorily in accordance with these Specifications.
2. Solenoid Operated Valves (Air Control)
 - a. Valves shall be threaded, bronze body, full line size, two way, normally closed, 120 VAC, 60 HZ, with Nema IV solenoid enclosure. ASCO 8210G3 or equal.
3. Check Valves
 - a. Valves two inches and smaller shall be threaded, 300-pound WOG, swing type, bronze body, Y-pattern, screwed cap, bronze disc. Crane No. 37, Jenkins No. 92-A, or equal.
 - b. Valves 2-1/2 inches and large shall be flanged, 300-pound WOG, iron body, swing type, outside lever and weight, bronze trim, bolted cap. Crane No. 383, or equal.
4. Compressor Check Valves: Valves two inches and smaller shall be 300-pound, cast iron body, threaded end, stainless steel discs and springs, suitable for compressor discharge operation, Pennsylvania Air check, or equal.
5. Pressure Relief Valve: The valve shall have a steel body and bonnet, and shall have stainless steel inner workings. Pressure relief valves shall be certified to ASME Section VIII. Valves shall be **Apollo Servies 530, or** approved equal.

2.3 PIPING

- A. All accessory piping for air service shall be copper pipe, and shall be installed in 6-inch diameter PVC Schedule 40 casing.
- B. All accessory piping for water service (unless noted otherwise on the Contract Drawings) shall be seamless or electric resistance welded black steel conforming to ASTM A 53, Grade B, or ASTM A 106, Grade B.
- C. Piping 2-1/2 inches and larger shall be Schedule 40 and piping two inches and smaller shall be Schedule 80. Piping shall have a working pressure minimum rating of 600 psi.
- D. Fittings two inches and smaller shall be threaded.
- E. Fittings larger than 2 inches shall be flanged (ANSI 300).

2.4 AIR COMPRESSOR

- A. The air compressor and tank shall be Saylor-Beall MFG Co. Model VT-PL-745-120, 7.5 HP motor (208 or 480 Volt 3-Phase, as specified on the Contract Drawings), 26 cfm at 174 PSIG; with 120-gallon ASME receiver, Mag-Starter (motor overload and low voltage protection), pressure lubrication, automatic tank drain, low oil control switch, vibration isolator pads, Y strainer, and spin on oil filter.
- B. The compressor shall be lubricated with food grade oil only and shall be equipped with a filter system required for service with a potable water system. The filter system shall include in-line coalescent, particulate, and adsorbent filters, and a discharge air dryer. The filters shall be Pneumatech model P3C (60-15), P3P (60-15), and P3A (60-15) or equal rated for a working pressure of 250 psi.
- C. An official Service Technician shall be present for equipment start-up and on-site training.

2.5 INSTRUMENTATION AND CONTROL

- A. OPERATIONS: The instrumentation and control systems shall provide the following functions:
 - 1. Level Control
 - a. Surge Tank liquid level shall be controlled to remain in the range shown on the Contract Drawings. Control shall be accomplished by sensing water levels and adding air to, or venting air from, the tank until the midpoint of the range is reached. Low and high level for each operation shall be sensed by the differential pressure transmitter. High-high and low-low levels will also be sensed. Refer to the Contract Drawings
 - 2. Level indication
 - a. Provide liquid level indication locally by means of a full length sight gage.
 - 3. Compressor Control
 - a. Compressor Control: Provide OFF/AUTO (O-A) operation for the compressor. O-A operation shall be such that, when compressor is on AUTO, it will respond to the pressure switches.

4. Vent Air Valve Control
 - a. When in auto mode, the air vent control valve shall open when the water level drops below the low level position. The air vent control valve shall close when the water level reaches the design level.
5. Inlet Air Valve Control
 - a. When in auto mode, the inlet air control valve shall open when the water level rises above the high level position, allowing air to enter the surge tank. The inlet air control valve shall close when the water level reaches the design level. The air compressor shall be activated immediately after the inlet air valve is opened so that air will be pumped into the surge tank.

B. EQUIPMENT

1. Differential Pressure Level Transmitter. Transmitter shall be:
 - a. Alia Model ADP9000 or approved equal
 - b. Certified to NSF 61.
 - c. 0 to 148.5 inH₂O gage measurement range.
 - d. System working pressure is 250 psig.
 - e. Output: 4-20 mA HART.
 - f. Diaphragm Material: Stainless Steel 316L
 - g. Mounting Bracket: Stainless Steel 316.
2. Sight Gage. The site gage shall be an Orion Instruments Vector magnetic site gage or approved equal. The site gage shall 1) be constructed of 316 Stainless Steel, 2) be constructed with a fully enclosed floating magnet system that isolates that measured fluid from the gage, 3) be constructed with level indicators which interact and change based on the level of the magnetic float. The connection shall be 3/4-inch.

2.6 LIFTING LUGS

- A. Equipment weighing over 100 lbs shall be provided with lifting lugs.

2.7 TANK SUPPORT AND ANCHOR SYSTEM

- A. CONTRACTOR shall prepare drawings showing the tank anchoring system. These drawings must be reviewed and stamped by a licensed professional engineer as being in compliance with applicable building and seismic codes.

2.8 SURGE TANK BACKFILL

- A. Backfill for the lower 1/3 of the tank on the portion of the tank outside of the vault shall be CLSM complying with Section 03 31 05 – Controlled Low Strength Material.
- B. Backfill within 2-feet of the surge tank for the remainder of the tank shall consist of clean sand with 100% passing a #3/8 U.S. Sieve and no more than 10% passing the #100 U.S. Sieve.

PART 3 EXECUTION

3.1 GENERAL

- A. The Surge Tank shall be completely shop fabricated; no fabrication will be allowed in the field. Fieldwork shall be limited to assembly of accessories, making process connections, testing, and startup.
- B. All fabrications shall be done in accordance with applicable American Welding Society (AWS) and American Society of Mechanical Engineers' (ASME) Codes. All welders involved in fabrication of the tank shall be ASME certified.

3.2 PAINTING

- A. Painting shall be in accordance with Section 09 91 00 – Painting and Finishes and in accordance with the Contract Drawings.
 - 1. Paint all interior (submerged) surfaces as follows:
 - a. Prepare inside tank surface in accordance with SSPC-SP 5(white metal), or as required by manufacturer, and apply NSF 61 approved epoxy polyamide system, 3 coats for a 24 mil total minimum dry film thickness. Coating shall be in accordance with AWWA C210.
 - 2. Coat all exterior surfaces as follows:
 - a. Shop blast in accordance with SSPC SP-6, or as required by manufacturer, and coat outside of tank with 24 mil minimum thickness Polyurea (Rino Liner), no equal.

3.3 TESTING

A. FABRICATION TEST

- 1. The Surge Tank shall be shop tested hydrostatically to a pressure of 1.5 times the design pressure for a period of not less than 24 hours. All leaks shall be detected and immediately repaired prior to painting.

B. FIELD STATIC TEST

- 1. The Surge Tank and system piping shall be hydrostatically tested to the design pressure immediately following installation and before any dynamic testing. Test period shall be four hours minimum, and all leaks detected shall be immediately repaired. Finish touchup painting shall be provided as necessary.

C. FUNCTIONAL TEST

- 1. Provide a dynamic test of the Surge Control system in response to flow startup and stoppage.
- 2. CONTRACTOR shall provide to the ENGINEER a complete report of each test performed within ten days after test completion. Reports shall include:

- a. Date and time of all testing.
- b. Description of method of testing including pumping combinations, pressure records, etc.
- c. Description of all observed leaks and method and date of repair. Description of any catastrophic failures.
- d. Certification that necessary repairs have been made.
- e. Signature of CONTRACTOR and Manufacturer's representative.

3.4 INSTALLATION

- A. The tank shall be installed as shown by experienced personnel in accordance with the System Manufacturer's written instructions.
- B. All piping connections shall be made true and without misalignment stresses being applied to the tank nozzles. Any modifications to the tank installation or arrangement must be acknowledged by ENGINEER in writing.
- C. Backfill for the surge tank shall be compacted to 95% minimum of maximum dry density.

3.5 SYSTEM OPERATION

- A. CONTRACTOR shall assist OWNER with verification that all equipment supplied and installed by CONTRACTOR is providing the correct signals to OWNER's RTU for proper operation of the surge tank controls.

- END OF SECTION -

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